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FATEC

Mitsubishi Programmable Controllers
Training Manual
Safety Programmable Controller Operating (MELSEC-QS)

● Safety Precautions ●

(Please read the precautions carefully before carrying out practical training.)

Read the relevant manuals and pay careful attention to safety when designing the system.
When carrying out practical work, pay sufficient attention to the following points and handle the device properly.

[Practical training precautions]

⚠ WARNING

- To avoid electric shock, do not touch the terminal while the power is on.
- When opening a safety cover, make sure that the power supply is disconnected or ensure sufficient safety before carrying out the work.

⚠ CAUTION

- Follow the instructor's instructions to carry out practical training.
- Do not remove the training machine module and change the wiring without prior consent.
  Failure to observe this can cause a failure, malfunction, injury, or fire.
- Turn the power supply OFF before removing or installing a module.
  Removing or installing while the power is ON may cause module failure or electric shock.
- If the training machine (X/Y table, etc,) emits an abnormal odor or an abnormal sound, press the "Power switch" or "Emergency switch" to stop the device.
- When an error occurs, contact the instructor immediately.
- A sample program is given in this text, however, the authentication of safety standards has not been acquired.
  Safety standard conformity authentication must be done by the user on the entire safety system.

Revisions

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

Print date	* Text number	Revision
Mar., 2014	SH-081377ENG-A	First edition

Table of Contents

This text is for understanding basic methods of use and programming of the Safety Programmable Controller (MELSEC-QS).

Related Manuals

Manual name	Manual number (Model code)
Safety Application Guide This explains an overview of the safety system, how to build a safety system, examples of routing and laying wiring, and an application program. (sold separately)	SH-080613ENG 13JR90
QSCPU User's Manual (Function Explanation, Program Fundamentals) This explains the functions required for creating a program using QSCPU, programming method and devices, etc. (sold separately)	SH-080627ENG 13JR93
QSCPU User's Manual (Hardware Design, Maintenance and Inspection) This explains the specifications of the QSCPU, safety power supply module and safety base unit. (sold separately)	SH-080626ENG 13JR92
QSCPU Programming Manual (Common Instructions) This explains how to use sequence instructions, basic instructions, application instructions, and QSCPU dedicated instructions. (sold separately)	SH-080628ENG 13JW01
GX Developer Version 8 Operating Manual (Safety Programmable Controller) This manual explains GX Developer functions that have been added/changed for support of the safety programmable controller. (sold separately)	SH-080576ENG 13JU53
CC-Link Safety System Master Module User's Manual (Details) This manual explains the specifications, settings and procedure up to operation, parameter settings, and troubleshooting of the QS0J61BT12 model CC-Link Safety system master module. (sold separately)	SH-080600ENG 13JR88
CC-Link Safety System Remote I/O Module User's Manual (Details) This manual explains the specifications, settings and procedure up to operation, parameter settings, and troubleshooting of the CC-Link Safety system remote I/O module. (sold separately)	SH-080612ENG 13JR89

* When performing procedures described in this text, use GX Developer version 8.65T or later.

Generic term and abbreviation

Generic term/abbreviation	Description
Safety CPU module	Abbreviation for QS001CPU module
Safety power supply module	Generic term for QS061P-A1, QSP061P-A2 model power supply module
Safety main base unit	Abbreviation for QS034B main base unit
CC-Link Safety master module	Abbreviation for QS0J61BT12
CC-Link Safety system remote I/O module	Generic term for QS0J65BTS2-8D, QS0J65BTS2-4T, QS0J65BTB2-12DT
GX Developer	Abbreviation for GX Developer software package

Memo

Chapter 1 Overview

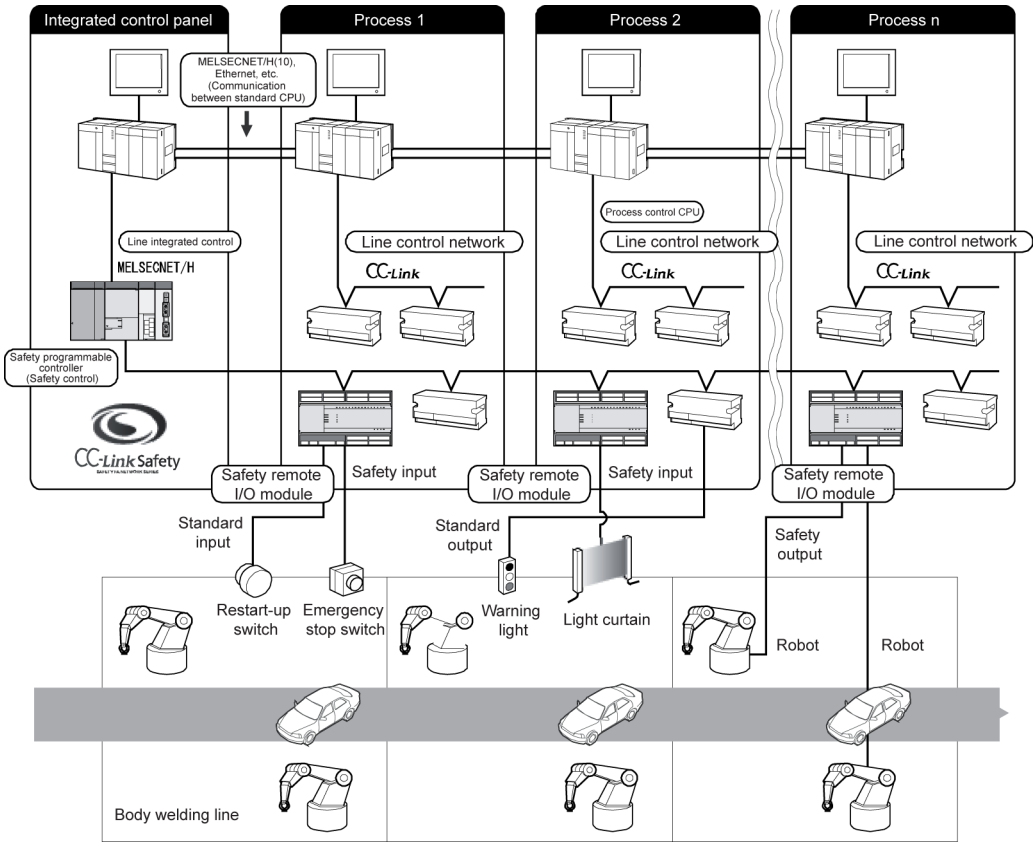
1.1 Safety Programmable Controller

The safety programmable controller has acquired the safety approval of EN954-1 Category 4, ISO13849-1 PL e, and IEC61508 SIL3.
The user can use the safety programmable controller to configure a safety system up to EN954-1 Category 4, ISO13849-1 PL e, and IEC61508 SIL3.

The figure below shows the controller applied to a motor car welding line as an application example of the safety programmable controller.

Safety system was implemented to provide following functionalities:
- to supply power to the robot if the safety conditions can be verified
- to shut off the power if the safety conditions cannot be verified
- to verify the safety conditions using emergency stop switches or light curtains

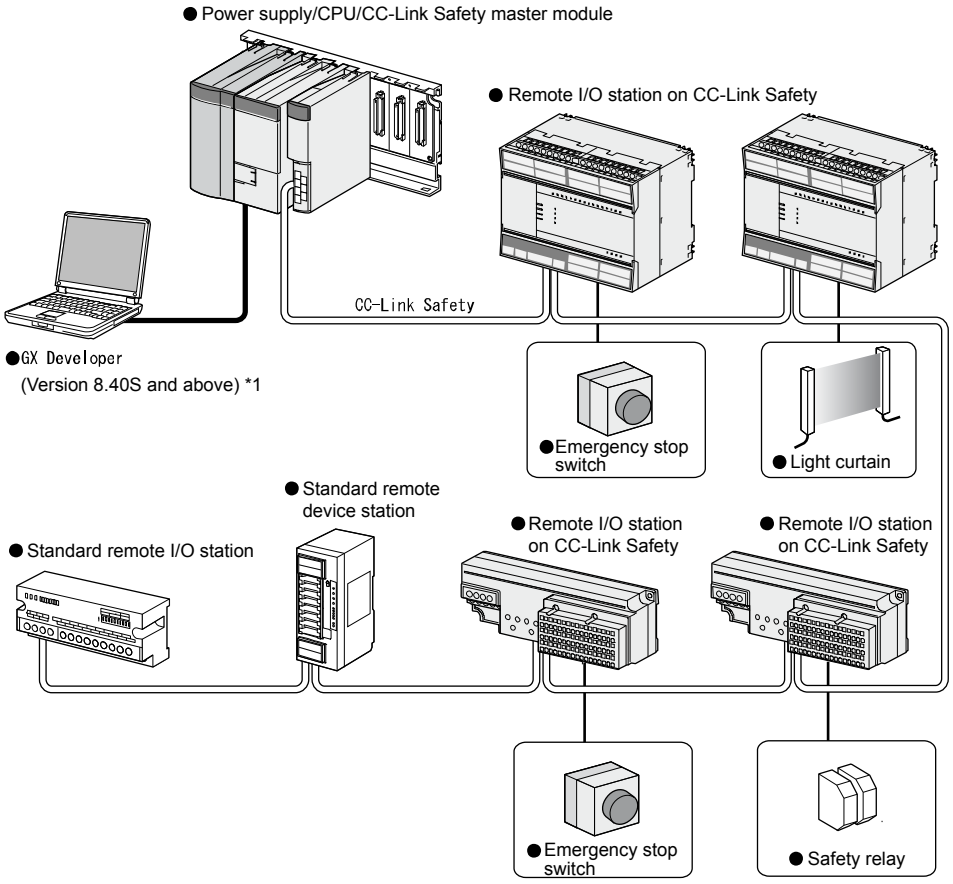
The safety programmable controller operates in a following way.
The safety condition signal is connected to the safety remote I/O module.
The safety condition signal is sent to the safety CPU module from the safety remote I/O module. The safety CPU module processes the received safety condition signal using the sequence program, and sends the safety output to the safety remote I/O module.
The safety output stops the robot power.



1.2 Features of the Safety Programmable Controller

The features of the QS series CPU module are given below.

(1) Configuration of safety programmable controller system possible



*1: Available functions vary according to the version.

For details on modules that can be mounted on the safety main base unit (QS034B), refer to Appendix 7.5.

(2) The safety CPU operation mode is equipped for safe system operation
The CPU module is equipped with two safety CPU operating modes, "SAFETY MODE" for safe operation of the system and "TEST MODE" for configuration and maintenance of the system.
Provision of these two modes ensures that user mistakes can be prevented and the system can be operated safely.

(a) SAFETY MODE
SAFETY MODE is a mode for safe system operation. This mode prohibits the write operation from a programming tool and the device test operation during the system operation.

(b) TEST MODE
TEST MODE is a mode for maintenance. This mode enables the write operation from a programming tool and the device test operation to debug or maintain the sequence program.

(3) Enhanced operation history and error history

The CPU module records up to a total of 3,000 operations performed by the user on the CPU module or failures that occur on the CPU module and CC-Link Safety as the operation and error histories.

As a result of recording the content of operations performed by the user on the CPU module to the operation and error histories, the order in which operations and failures occurred can be clarified. Troubleshooting can be easily performed by checking the operation and error histories.

Content recorded in the operation and error histories is shown in the below table:

Information	Description	History information per one entry
Operation history information	Operations performed by the user on the CPU module are saved as a history. (Operations of changing the action of the CPU module are recorded.)	• Operation codes • Operation messages • Operation execution date and time • Result codes • Operation attached information
Failure history information	The following failures are saved as a history: • Failures, faults detected by self diagnostics • Hardware failures • Faults detected by CC-Link Safety	• Error codes • Error messages • Occurrence date and time • Error information category (common information/individual information) • Error information (common information/individual information)

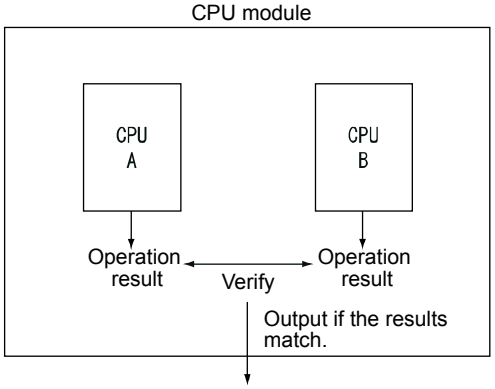
(4) Improved RAS

(a) Improved memory diagnostics

Diagnostics of memory mounted on the CPU module has been improved.

(b) CPU redundancy

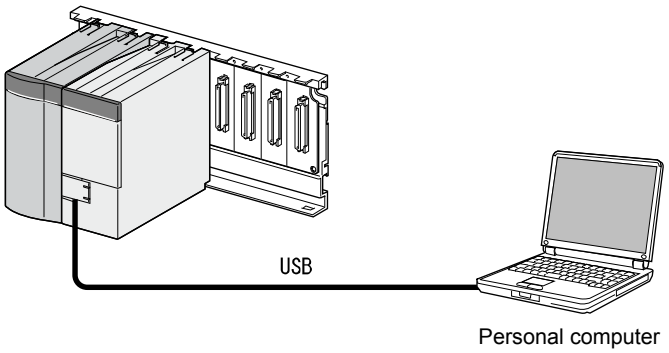
Two CPUs (CPU A and CPU B) are mounted in the CPU module. The operation results of CPU A/CPU B are verified and output only if they match, hence preventing incorrect output. (If the verification results do not match, then the system stops.)



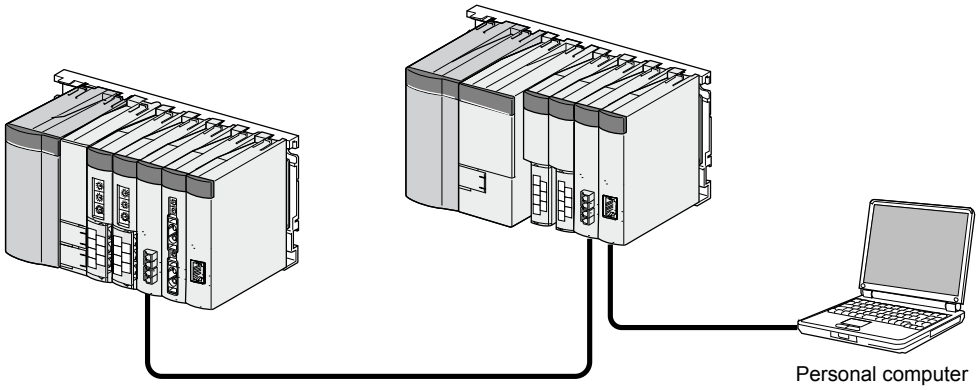
(c) Improved hardware diagnostics using hardware circuits
When a hardware failure that cannot be detected by the OS occurs, incorrect output can be prevented using the diagnostic functions given in the following table.

Name of diagnostic function	Description
Overvoltage, undervoltage detection	Detects overvoltage and undervoltage of the power supply voltage supplied to the CPU module from the power supply module.
Clock stop detection	Detects stoppage of the input clock to the CPU module internal circuit.

(5) USB interface mounted
The CPU module is equipped with the USB interface to communicate with a programming tool.



(6) Connection to personal computer and standard programmable controller possible*1
Data can be read from MELSOFT products on a personal computer connected to the CC-Link IE Controller Network, MELSECNET/H and Ethernet*2, and data communication between the safety programmable controller and a standard programmable controller is possible using dedicated instructions.
Also, the data of the ladder monitor, device monitor, and operation and error histories of the safety programmable controller can be read from GOT.



*1: For details on the access range to safety CPU module from GX Developer and GOT, refer to the QSCPU User's Manual (Function Explanation, Program Fundamentals).
*2: Access to the CPU module can be restricted by using remote passwords.

(7) Connection with GOT possible*
Connection with the GT15, GT SoftGOT1000 series is now possible. (as of May 2008)
*: Only read operation enabled. Write operation cannot be performed.

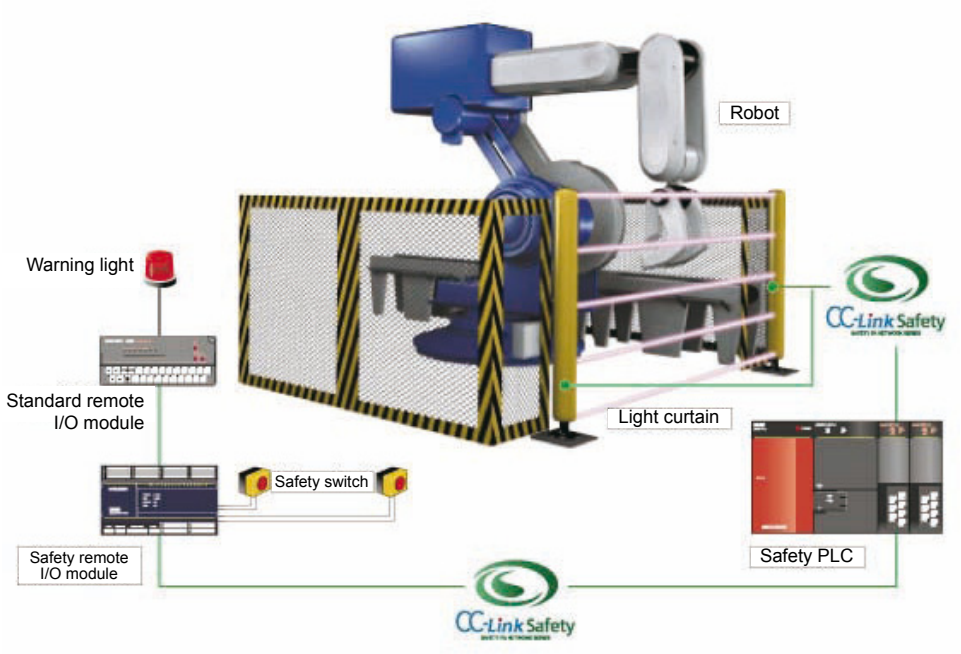
1.3 Training Machine Used in This Text

In the actual workplace, isolate the surroundings of the robot using a safety fence as shown in the figure below.
Other measures are not required once the robot is completely isolated to prevent people from approaching hazard sources.
However, it is assumed that people will go near the robot for maintenance, etc. or people will enter via the fence opening.

Here, the safety system is configured to stop the power in case a person goes near the robot by entering via a door or the opening. The entry of a person or an emergency stop in the event of a hazardous situation is handed over as safety information to the safety system using safety components (emergency stop switch, light curtain, door switch). The power is shut off when entry of a person or pressing of an emergency stop switch is detected.

This training machine can be used for practical training in basic safety functions.

Illustration of safety system

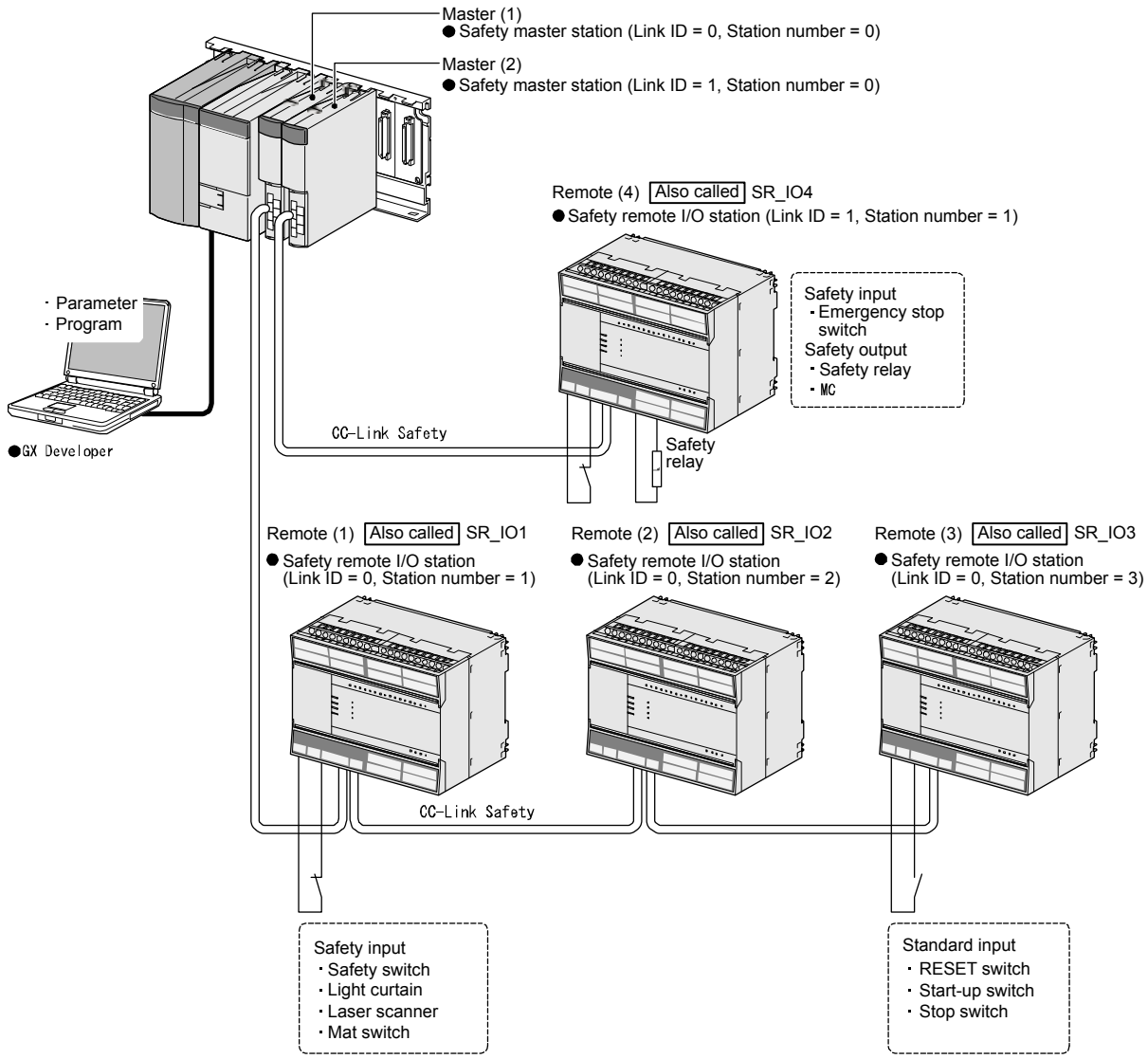


Memo

Chapter 2 System Configuration

2.1 Safety Application System Configuration Example

This chapter explains an example of designing a safety application using a safety programmable controller, based on the system configuration shown in the figure below.



2.2 Network Related Switch Settings of Module

2.2.1 Switch Settings for Each Module

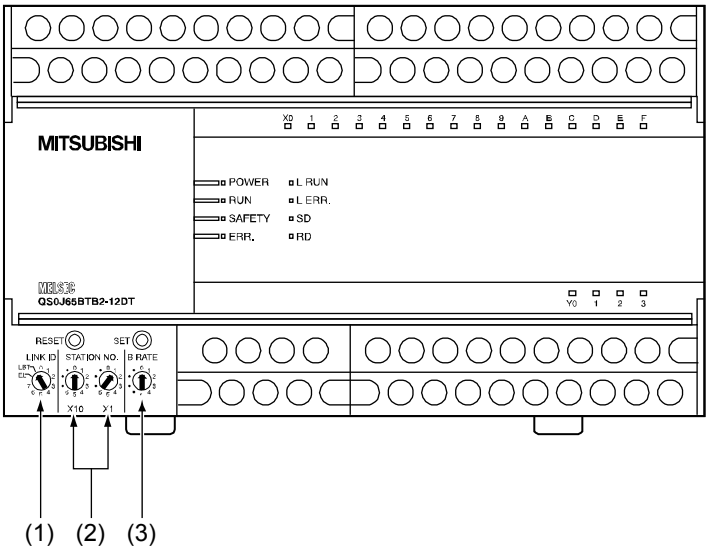
Set the switch settings of each module as follows.

(1) Safety power supply module
The safety power supply module does not have switches.

(2) Safety CPU module
The safety CPU module does not have network related switches.

(3) Safety master module
The safety master module does not have switches.

(4) Safety remote I/O module
Set the link ID, station number and transmission speed.



No	Remote I/O Module No.	Remote (1) SR_IO1	Remote (2) SR_IO2	Remote (3) SR_IO3	Remote (4) SR_IO4
(1)	Link ID	0	0	0	1
(2)	Station number setting switch	1	2	3	1
(3)	Transmission speed setting switch	2 (2.5 Mbps)	2 (2.5 Mbps)	2 (2.5 Mbps)	2 (2.5 Mbps)

POINT

For the procedure for activating safety remote I/O module switch settings, refer to the QS0J65BTB2-12DT Type CC-Link Safety Remote I/O Module User's Manual (Detailed).

2.2.2 Switch Setting Procedure (After Change)

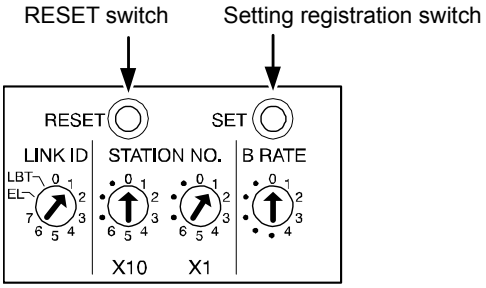
Follow the procedure below to return to the CC-Link Safety System using the newly changed switch settings.

(1) Turn the power supply of the safety remote I/O module OFF then back ON again, or press the Reset switch.

(2) Press the setting registration switch once.
The "RUN" LED flashes.

(3) After one second, press the setting registration switch once.
The "RUN" LED flashing interval changes.

(4) Turn the power supply of the safety remote I/O module OFF then back ON again, or press the Reset switch.



2.3 Setting CC-Link Parameters

Set the CC-Link parameters as follows.
Check the meaning of each parameter and setting ranges by referring to the QS0J65BTB2-12DT Type CC-Link Safety System Master Module User's Manual (Detailed).

Module		Master (1)	Master (2)
Start I/O No.		00H	20H
Operation setting	CPU STOP setting*1	Perform forced clear	Perform forced clear
Mode setting		Safety remote net mode - Ver.1	Safety remote net mode - Ver.1
Transmission speed		2.5 Mbps	2.5 Mbps
Safety refresh monitoring time		300 ms	300 ms
Link ID		0	1
Total number of connected modules/stations		3	1
Remote input (RX) refresh device		X100	X200
Remote input (RY) refresh device		Y100	Y200
Remote register (RWr) refresh device		-	-
Remote register (RWw) refresh device		-	-
Special relay (SB) refresh device		SB0	SB200
Special register (SW) refresh device		SW0	SW200
Number of retries		3	3
Number of automatic return modules		1	1
Station information setting	Station information setting	Refer to Section 2.3.1	
	Safety remote station setting	Refer to Section 2.3.2	
Remote device station initial setting		None	None

*1: When the safety CPU operating mode is SAFETY MODE, "Forced clear" is locked.

POINT

The link ID and transmission speed of CC-Link parameters set in GX Developer and the link ID and transmission speed of the connected remote I/O main switch should be set the same.

2.3.1 CC-Link Station Information Settings

Set the CC-Link station information settings as follows.

Module	Quantity/number of stations	Station type	Number of occupied stations	Reserved/invalid station
Master (1)	1/1	Safety remote I/O station	One station occupied	No setting
	2/2	Safety remote I/O station	ONe station occupied	No setting
	3/3	Safety remote I/O station	One station occupied	No setting

Module	Quantity/number of stations	Station type	Number of occupied stations	Reserved/invalid station
Master (2)	1/1	Safety remote I/O station	One station occupied	No setting

2.3.2 Setting Safety Remote Station Parameters

Set the safety remote station parameters as follows.

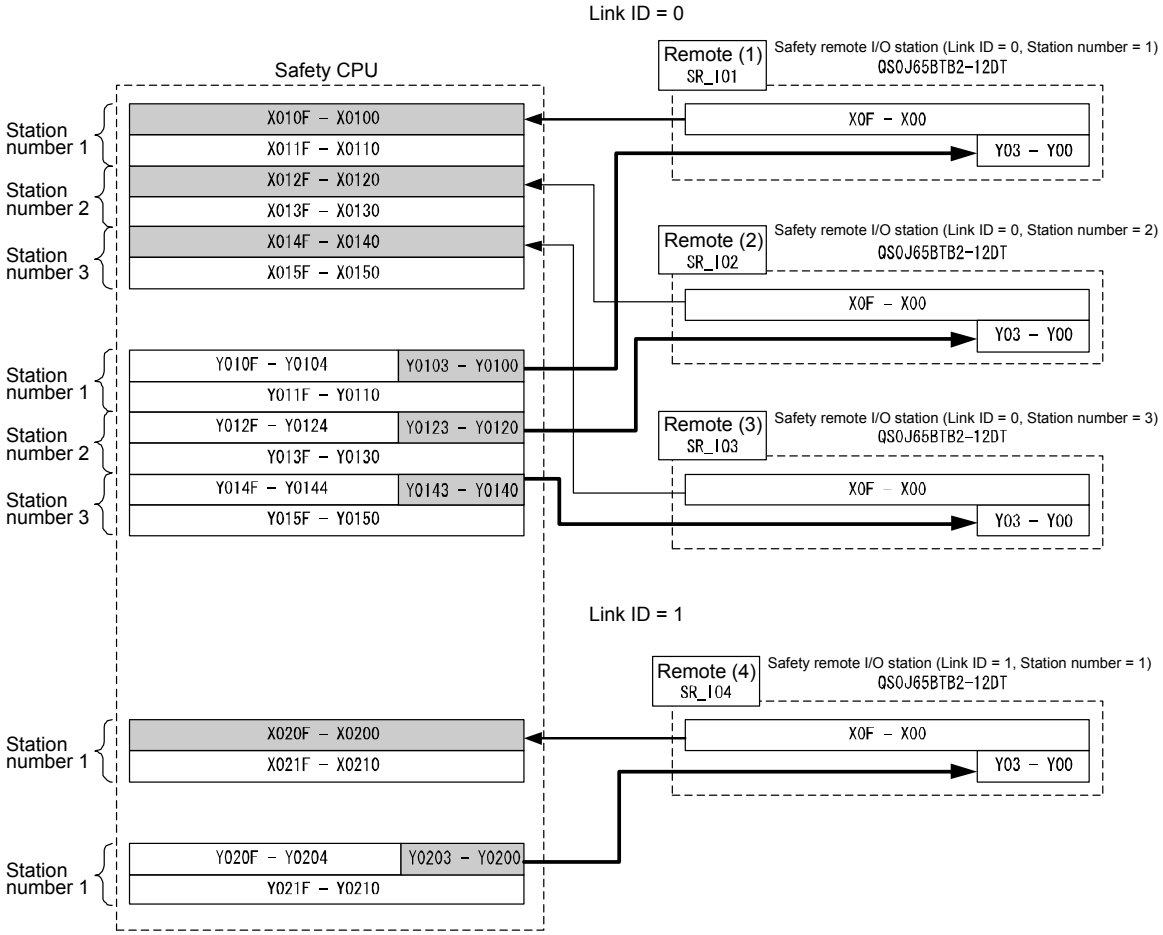
Module	(1)	(2)	(3)	(4)
	SR_IO1	SR_IO2	SR_IO3	SR_IO4
Model	QS0J65BTB2-12DT	QS0J65BTB2-12DT	QS0J65BTB2-12DT	QS0J65BTB2-12DT
Module technical version*1	A	A	A	A
Specify production information to find module	Yes (check)	No (No check)	No (No check)	Yes (check)
Production information*2	1100000000000010	-	-	1100000000000020
Parameter	The parameters are described for individual examples in Section 2.6.			

*1: For the module technical version, check the rating plate on the side of the corresponding safety remote station.

*2: Check the rating plate on the side of the module of the corresponding safety remote station, and input the production information.
Production information is necessary for the maintenance of correct functions after module replacement and for the detection of errors, for example, in the setting of the same station number to multiple safety remote stations.
Use the production information for appropriate and safe usage of safety programmable controllers.

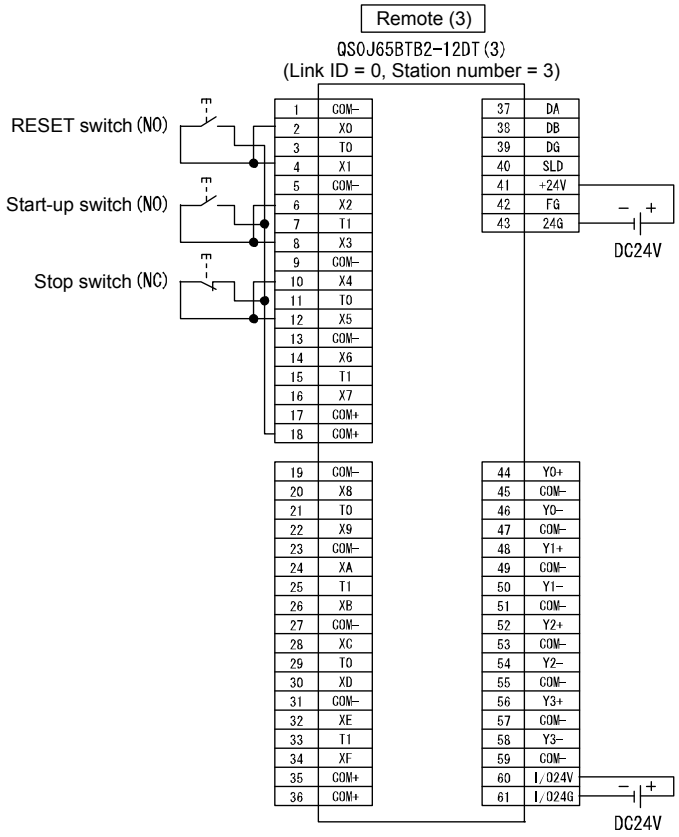
2.4 Relation Between Safety CPU Module Device and Remote I/O

According to the settings in section 2.3, the relation between the safety CPU module device and input/output of the remote I/O station is as follows.
Create the sequence program by using the device numbers in the shaded areas.



2.5 Wiring Diagram and Parameter Setting of Standard Inputs

The RESET switch, start-up switch and stop switch are wired as follows.



Wiring of remote (3) SR_IO3

Set the parameters of the RESET switch, start-up switch and stop switch as follows.
(* For the list of parameters, refer to Appendix 9.)

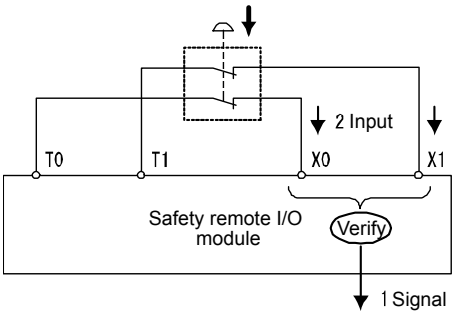
Item	Setting range
Time of noise removal filter X0, 1 *1	[0: 1 ms], 1: 5 ms, 2: 10 ms, 3: 20 ms, 4: 50 ms
Time of noise removal filter X2, 3 *1	[0: 1 ms], 1: 5 ms, 2: 10 ms, 3: 20 ms, 4: 50 ms
Time of noise removal filter X4, 5 *1	[0: 1 ms], 1: 5 ms, 2: 10 ms, 3: 20 ms, 4: 50 ms
Dual input mismatch detection time X0, 1 *1	100 ms (Setting range: 20 to 500 ms)
Dual input mismatch detection time X2, 3 *1	100 ms (Setting range: 20 to 500 ms)
Dual input mismatch detection time X4, 5 *1	100 ms (Setting range: 20 to 500 ms)
Input dark test execution selection X0, 1	0: Execute, [1: Do not execute]
Input dark test execution selection X2, 3	0: Execute, [1: Do not execute]
Input dark test execution selection X4, 5	0: Execute, [1: Do not execute]
Input dark test pulse OFF time	[0: 400 μs], 1: 1 ms, 2: 2 ms

*1: Adjust the time of noise removal filter, input dark test pulse OFF time, and output dark test pulse OFF time by adjusting the installation environment and wiring length.
Set the dual input mismatch detection time to roughly 100 ms in the case of a mechanical switch and to 20 ms for sensor input.

(1) Dark test
Output the OFF pulse when input/output is ON, and perform failure diagnosis of contacts, including external devices.

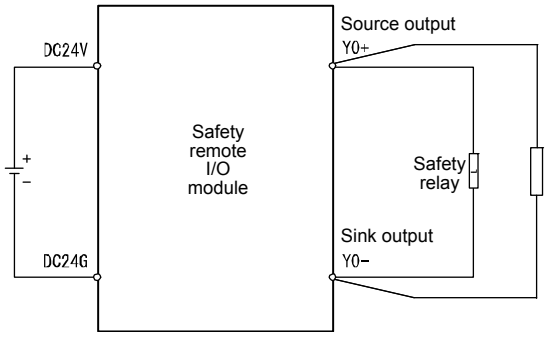
(2) Dual wiring

(a) Input dual wiring function
The input dual wiring function is used for duplicating the input wiring.
By comparing the input signal in dual wiring, it is possible to immediately detect input errors.

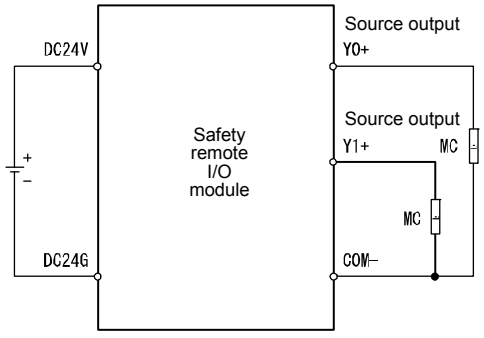


(b) Output dual wiring function
The output dual wiring function is used for duplicating the output wiring.
By comparing the output signal in dual wiring, it is possible to immediately detect output errors.
There are two dual wiring methods for the safety remote I/O module output.
Select the method depending on the wiring with external safety devices.

- Dual wiring method that combines source output and sink output

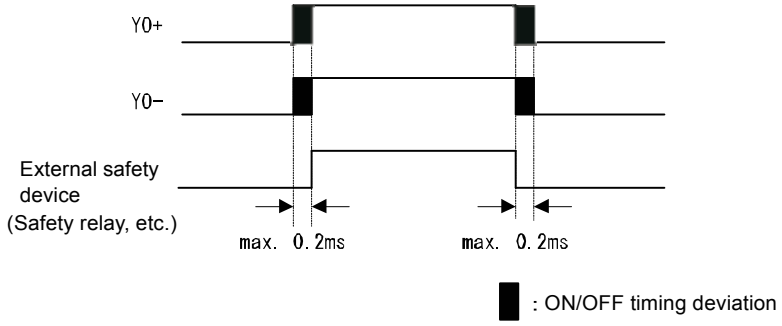


- Dual wiring method that combines two source outputs



POINT

- On the safety remote I/O module, the dual wiring method by combining sink outputs is not available.
- In case of dual wiring by combining source output and sink output, due to the relationship with internal processing on the safety remote I/O module, the Y0+ ON/OFF timing and Y0- ON/OFF timing may deviate by up to 0.2 ms as shown in the following figure.
  The waveform as shown in the following figure may be measured at the output terminal, but there is no effect on operation of external safety devices.



2.6 Case Studies

2.6.1 Emergency Stop Circuit

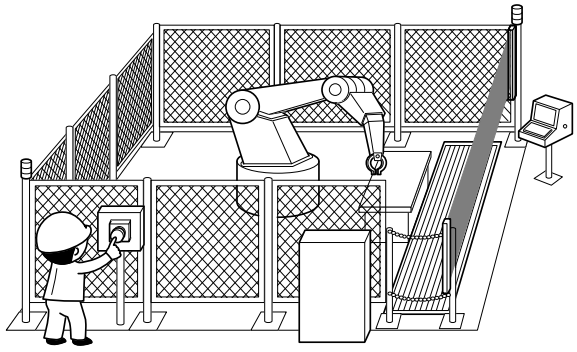
(1) Application overview

This safety application turns OFF the power source of the robot by an emergency stop switch.
Robot start and stop are controlled by turning ON/OFF the main contact of the contactor for opening/closing the power source of the robot by the contact of a safety relay.

The emergency stop switch and safety relay are connected to the safety programmable controller.
The safety programmable controller controls ON/OFF status of the safety relay by a sequence program.
When the safety programmable controller detects an error by self diagnostics, output to the safety relay is turned OFF regardless of the sequence program.
When output is turned OFF by self diagnostics, output remains OFF till the safety CPU module or safety remote I/O module is reset regardless of the sequence program.

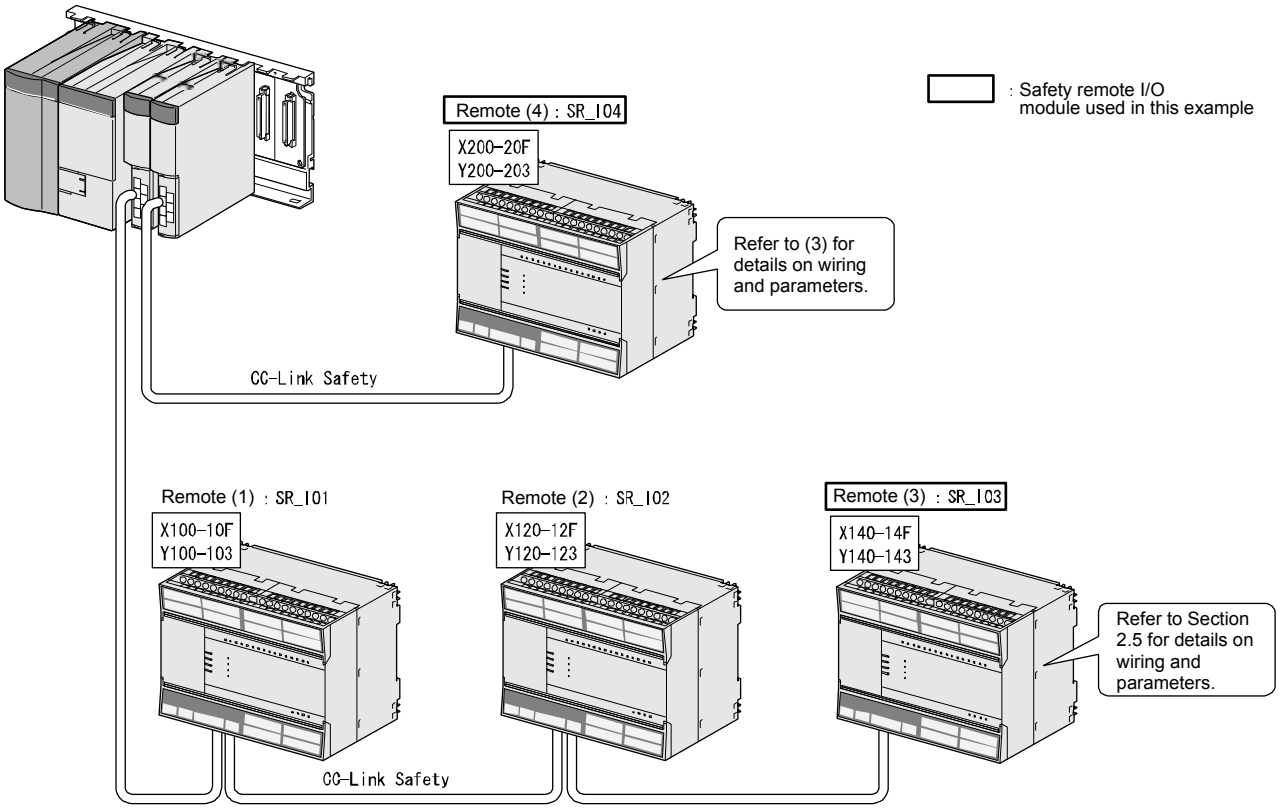
The following functions are achieved by the sequence program.

1) After confirming safety (emergency stop signal ON state), the operator first presses the RESET switch. Then, the safety relay is turned ON by pressing the start-up switch.
2) When the safety relay is welded, the normally closed contact of the safety relay is input to the safety programmable controller so that it cannot be started up. The operator checks for welding.
3) The safety programmable controller is started up only when the RESET switch and start-up switch are turned ON and OFF to prevent the controller from being started by mistake when the RESET switch and start-up switch are welded or short-circuited.
4) Either turn OFF emergency stop switch input after operation, or turn OFF safety relay output when a safety remote I/O station error is detected.



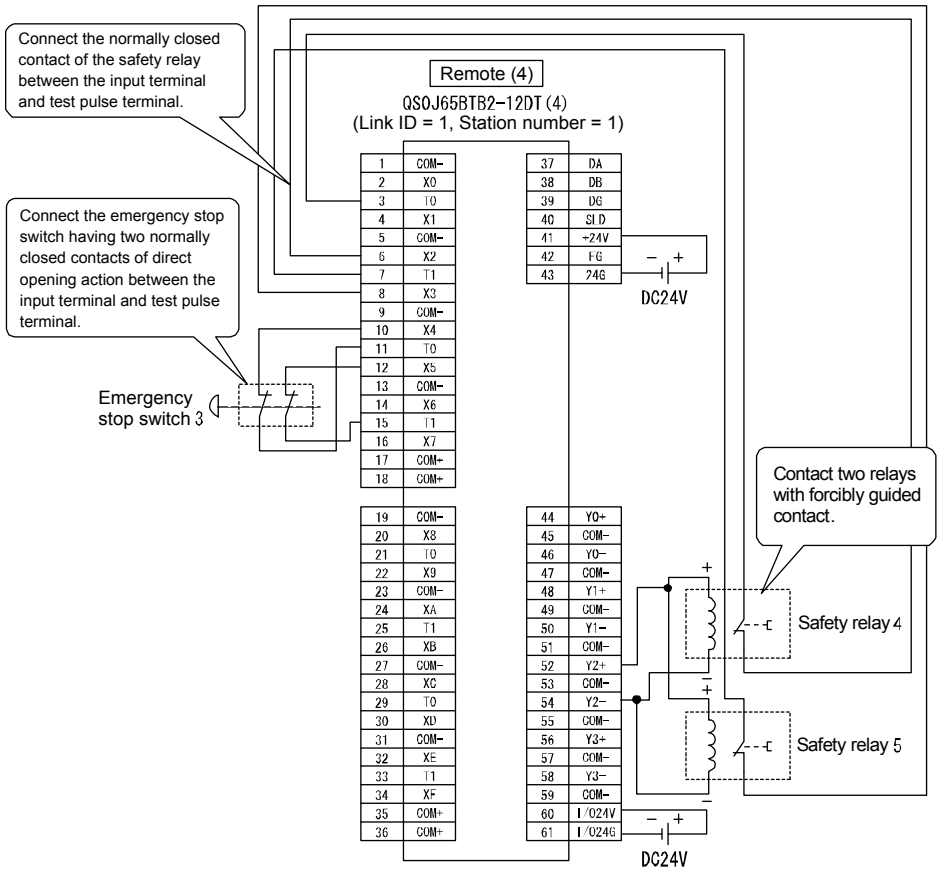
("Safety Guidebook - Safety Measures at Manufacturing Sites":
Excerpt from Nippon Electric Control Equipment Industries Association)

(2) Connection of safety devices



2 - 11

(3) Wiring and parameter settings
Wire the emergency stop switch and safety relay to the safety remote I/O module as follows.



Wiring of remote (4) SR_IO4

Set the parameters for the emergency stop switch and safety relay as follows.
(* For the list of parameters, refer to Appendix 10.)

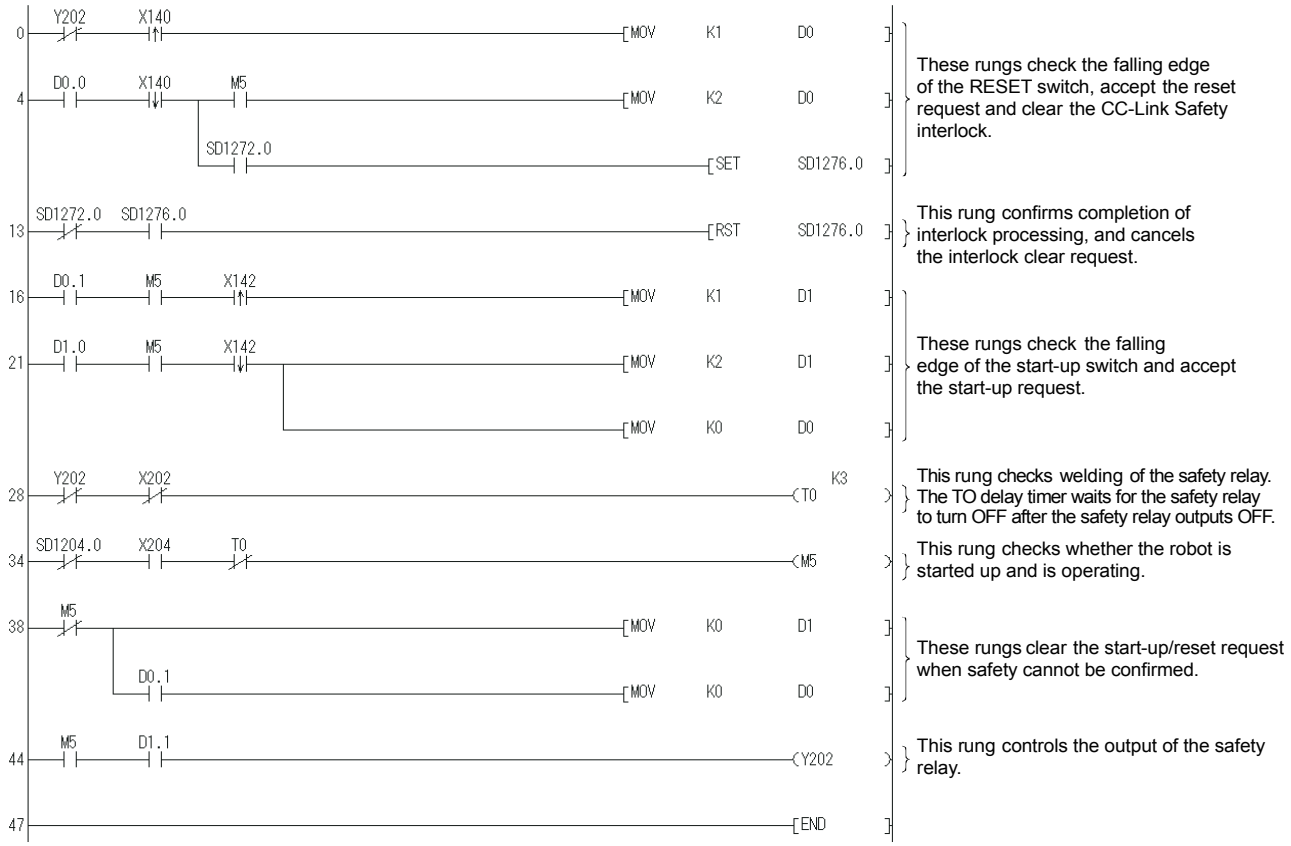
Item	Setting range
Time of noise removal filter X2, 3 *1	[0: 1 ms], 1: 5 ms, 2: 10 ms, 3: 20 ms, 4: 50 ms
Time of noise removal filter X4, 5 *1	[0: 1 ms], 1: 5 ms, 2: 10 ms, 3: 20 ms, 4: 50 ms
Dual input mismatch detection time X2, 3 *1	100 ms (Setting range: 20 to 500 ms)
Dual input mismatch detection time X4, 5 *1	100 ms (Setting range: 20 to 500 ms)
Input dark test execution selection X2, 3	[0: Execute], 1: Do not execute
Input dark test execution selection X4, 5	[0: Execute], 1: Do not execute
Input dark test pulse OFF time	[0: 400 µs], 1: 1 ms, 2: 2 ms
Output wiring method Y2	0: Not used, [1: Dual wiring (source + sink)], 2: Dual wiring (source + source)
Output dark test execution selection Y2	[0: Execute], 1: Do not execute
Output dark test pulse OFF time Y2 *1	0: 400 µs, [1: 1 ms], 2: 2 ms

*1: Adjust the time of noise removal filter, input dark test pulse OFF time, and output dark test pulse OFF time by adjusting the installation environment and wiring length.
Set the dual input mismatch detection time to roughly 100 ms in the case of a mechanical switch and to 20 ms for sensor input.

(4) Device numbers used
Create the sequence program by using the following device numbers.

Safety/general	External device	Device No.
Safety	Emergency stop switch	X204 or X205
Safety	Safety relay	Y202
Safety	Safety relay (welding check)	X202 or X203
General	Start-up switch	X142
General	RESET switch	X140

(5) Sequence program
The sequence program performs the following processing.



The constants and internal devices used in the program are as follows.

(a) How to use constants
K□: Indicates a decimal number.

Ex) K1 → Indicates the decimal number 1.

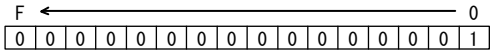
(b) How to use internal devices

Internal device	Description
T0	Indicates a timer device. The device turns ON after the time specified in K□ has elapsed.
D0	Indicates a word device. Here, it is used as restart status. (1) D0 = 0 indicates initial status or that start-up processing is completed. (2) D0 = 1 (D0.0: ON) indicates that the RESET switch has been pressed. (3) D0 = 2 (D0.1: ON) indicates that the RESET switch has been released from the (2) state and restart processing is completed.
D1	Indicates a word device. Here, it is used as start-up status. (1) D1 = 0 indicates initial status or that safety cannot be confirmed. (2) D1 = 1 (D1.0: ON) indicates that the start-up switch has been pressed. (3) D1 = 2 (D1.1: ON) indicates that the start-up switch has been released from the (2) state and start-up processing is completed.

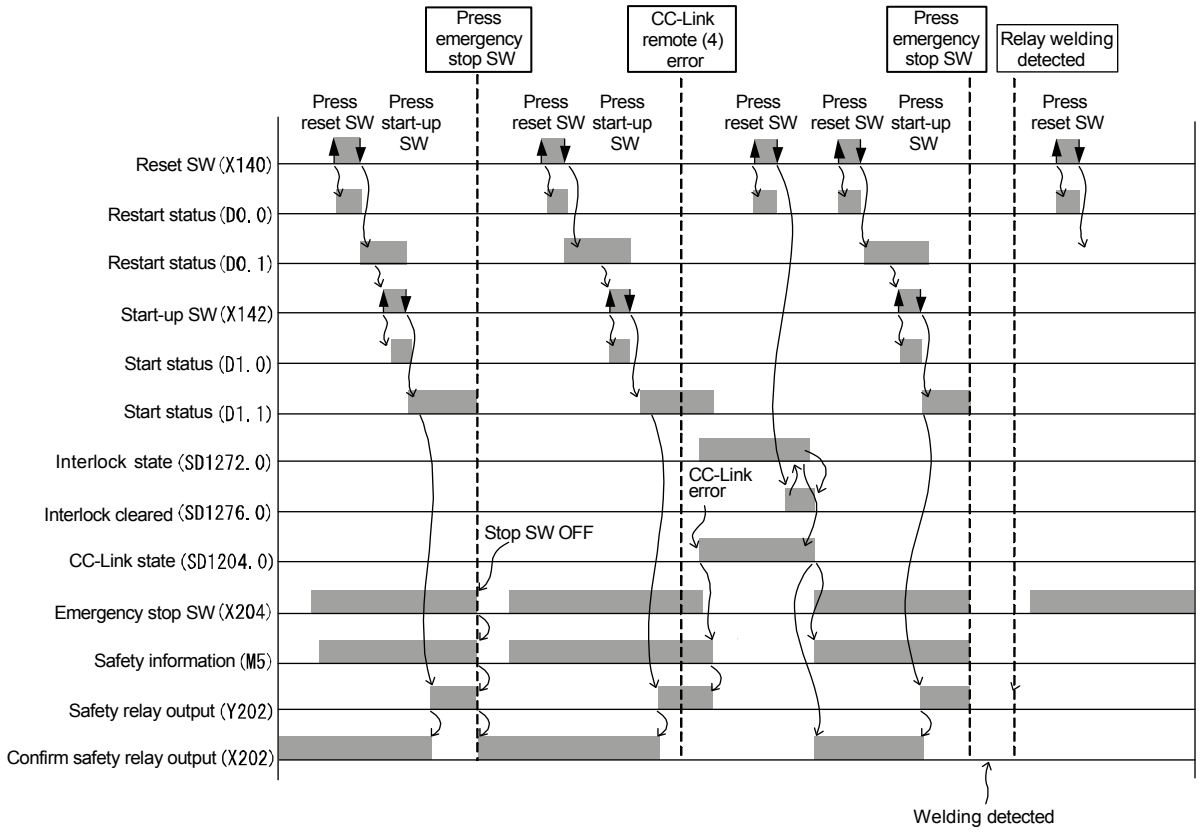
(c) How to use bit specification of words

D□□.□: Indicates the data of □th bit of word device D□□.

Ex) D0.0 → Indicates the 0th bit of D0.



(6) Timing chart



2.6.2 Door Lock Circuit

(1) Application overview

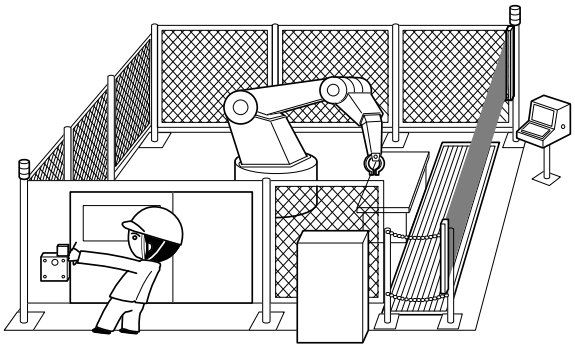
This application is for preventing the door from opening before the power source of the robot is stopped by the spring-locking safety switch installed on the door of the safety fence.
This safety switch is normally locked by the force of the spring. When voltage is applied to the solenoid, the lock is switched OFF and the door can be opened. Specifically, the lock is switched OFF by the status signal indicating a robot stop. The robot cannot be started when the lock is switched OFF and door is open.

Robot start and stop are controlled by turning ON/OFF the main contact of the contactor for opening/closing the power source of the robot by the contact of a safety relay.

The safety switch and safety relay are connected to the safety programmable controller.
The safety programmable controller controls ON/OFF status of the safety relay by a sequence program.
When the safety programmable controller detects an error by self diagnostics, output to the safety relay is turned OFF regardless of the sequence program.
When output is turned OFF by self diagnostics, output remains OFF till the safety CPU module or safety remote I/O module is reset regardless of the sequence program.

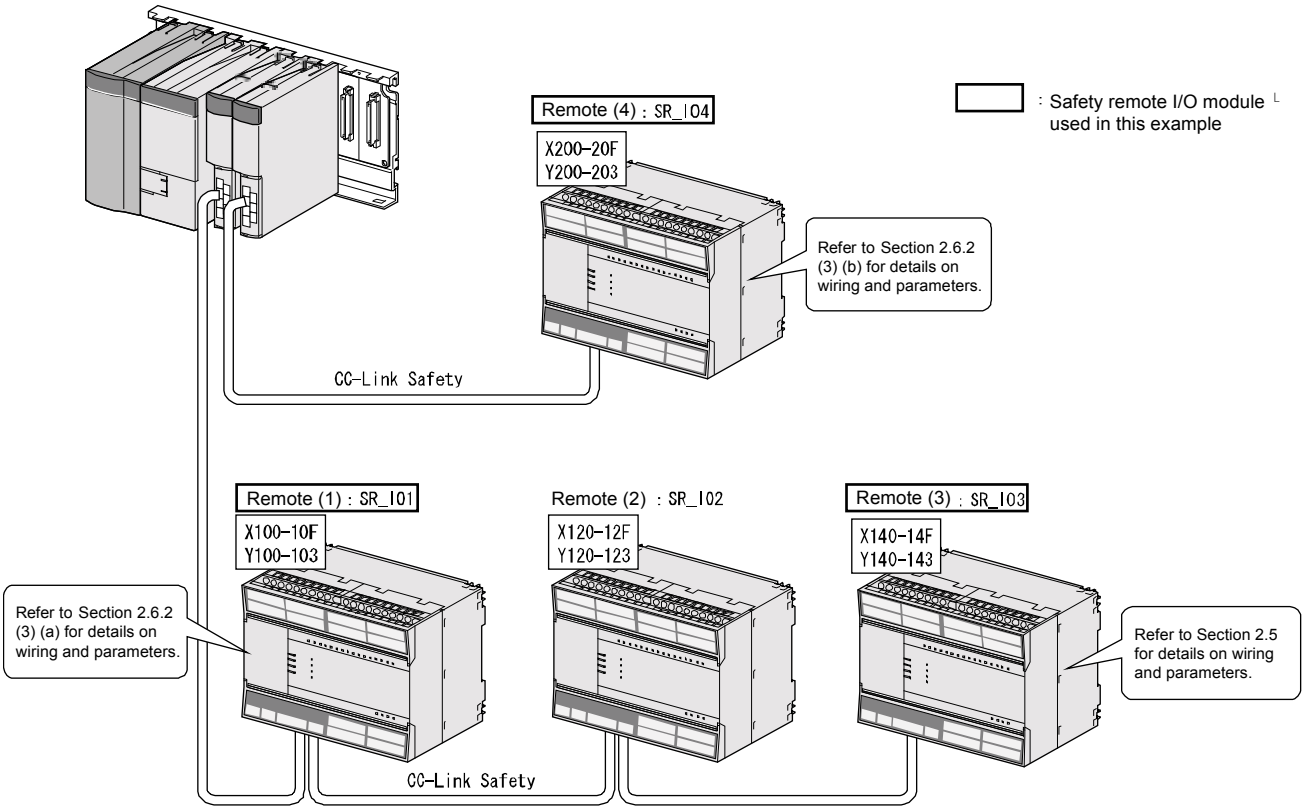
The following functions are achieved by the sequence program.

1) When the safety switch is ON, the operator first presses the RESET switch. Then, the safety relay is turned ON by pressing the start-up switch.
2) When the safety relay is welded, the normally closed contact of the safety relay is input to the safety programmable controller so that it cannot be started up. The operator checks for welding.
3) The safety programmable controller is started up only when the RESET switch and start-up switch are turned ON and OFF to prevent the controller from being started by mistake when the RESET switch and start-up switch are welded or short-circuited.
4) The safety relay output turns OFF by pressing the stop switch.
5) Turn OFF safety relay output when a safety remote I/O station error is detected after operation.



("Safety Guidebook - Safety Measures at Manufacturing Sites":
Excerpt from Nippon Electric Control Equipment Industries Association)

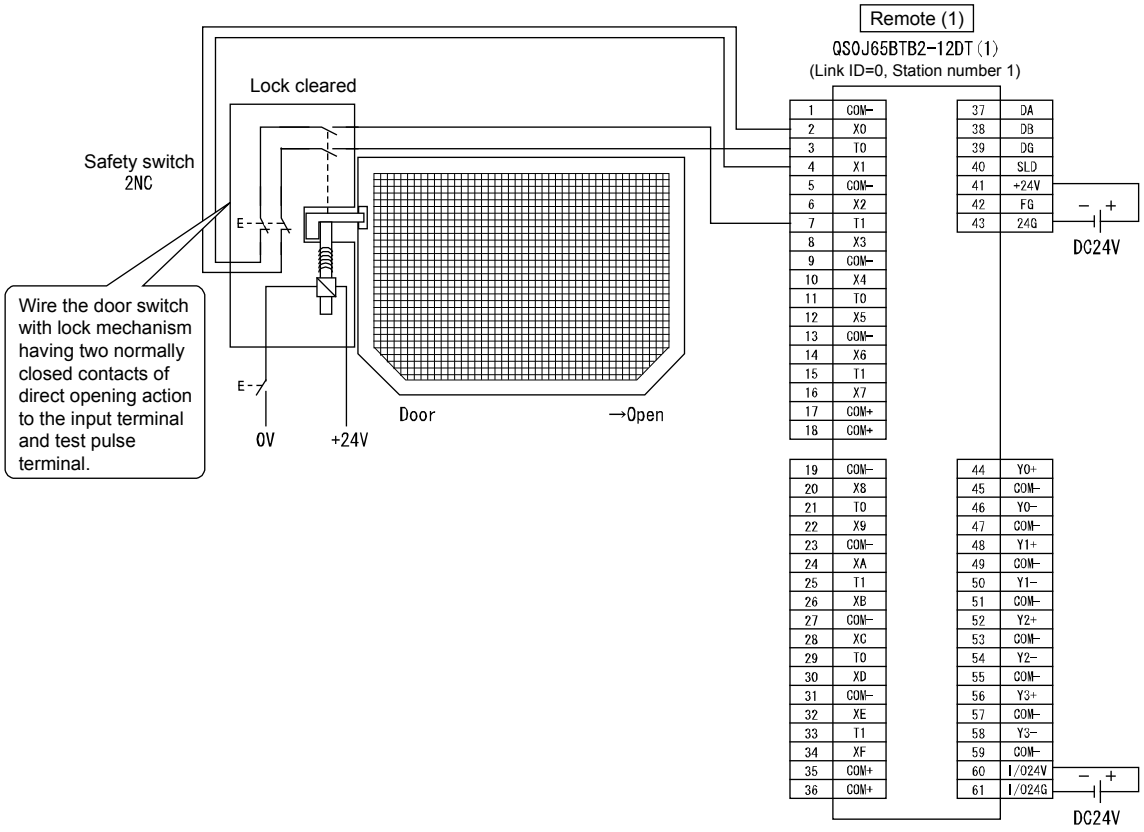
(2) Connection of safety devices



(3) Wiring and parameter settings

(a) Remote (1): SR_IO1

Wire the spring-locking safety switch to the safety remote I/O module as follows.



Wiring of remote (1) SR_IO1

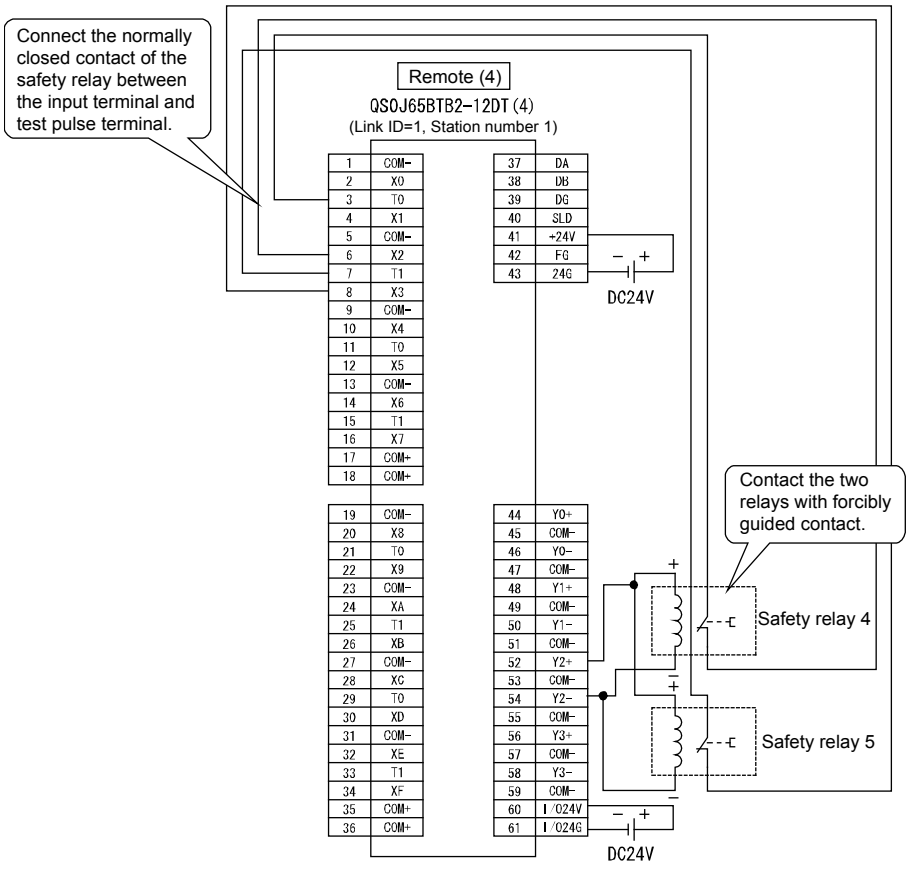
Set the parameters for the spring-locking safety switch as follows.
(* For the list of parameters, refer to Appendix 10.)

Item	Setting range
Time of noise removal filter X0, 1 *1	[0: 1 ms], 1: 5 ms, 2: 10 ms, 3: 20 ms, 4: 50 ms
Dual input mismatch detection time X0, 1 *1	100 ms (Setting range: 20 to 500 ms)
Input dark test execution selection X0, 1	[0: Execute], 1: Do not execute
Input dark test pulse OFF time *1	[0: 400 µs], 1: 1 ms, 2: 2 ms

*1: Adjust the time of noise removal filter and input dark test pulse OFF time by adjusting the installation environment and wiring length.
Set the dual input mismatch detection time to roughly 100 ms in the case of a mechanical switch and to 20 ms for sensor input.

(b) Remote (4): SR_IO4

Wire the relay with forcibly guided contact to the safety remote I/O module as follows.



Wiring of remote (4) SR_IO4

Set the parameters for the relay with forcibly guided contact as follows.

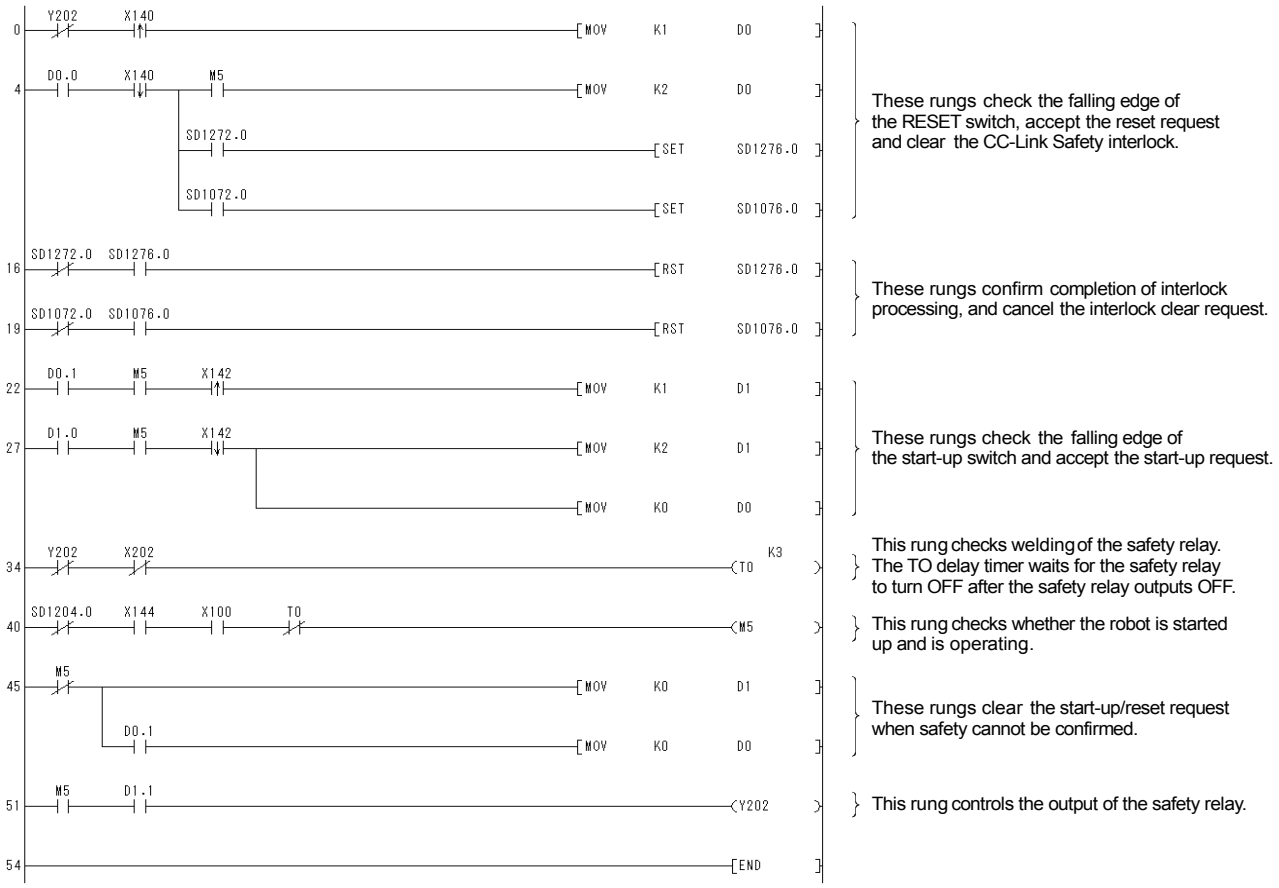
Item	Setting range
Time of noise removal filter X2, 3 *1	[0: 1 ms], 1: 5 ms, 2: 10 ms, 3: 20 ms, 4: 50 ms
Dual input mismatch detection time X2, 3 *1	100 ms (Setting range: 20 to 500 ms)
Input dark test execution selection X2, 3	[0: Execute], 1: Do not execute
Input dark test pulse OFF time *1	[0: 400 µs], 1: 1 ms, 2: 2 ms
Output wiring method Y2	0: Not used, [1: Dual wiring (source + sink)], 2: Dual wiring (source + source)
Output dark test execution selection Y2	[0: Execute], 1: Do not execute
Output dark test pulse OFF time Y2 *1	0: 400 µs, [1: 1 ms], 2: 2 ms

*1: Adjust the time of noise removal filter, input dark test pulse OFF time, and output dark test pulse OFF time by adjusting the installation environment and wiring length.
Set the dual input mismatch detection time to roughly 100 ms in the case of a mechanical switch and to 20 ms for sensor input.

(4) Device numbers used
Create the sequence program by using the following device numbers.

Safety/general	External device	Device No.
Safety	Safety switch	X100 or X101
Safety	Safety relay	Y202
Safety	Safety relay (welding check)	X202 or X203
General	RESET switch	X140
General	Start-up switch	X142
General	Stop switch	X144

(5) Sequence program
The sequence program performs the following processing.



The constants and internal devices used in the program are as follows.

(a) How to use constants
K□: Indicates a decimal number.

Ex) K1 → Indicates the decimal number 1.

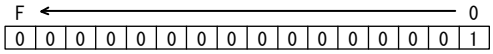
(b) How to use internal devices

Internal device	Description
T0	Indicates a timer device. The device turns ON after the time specified in K□ has elapsed.
D0	Indicates a word device. Here, it is used as restart status. (1) D0 = 0 indicates initial status or that start-up processing is completed. (2) D0 = 1 (D0.0: ON) indicates that the RESET switch has been pressed. (3) D0 = 2 (D0.1: ON) indicates that the RESET switch has been released from the (2) state and restart processing is completed.
D1	Indicates a word device. Here, it is used as start-up status. (1) D1 = 0 indicates initial status or that safety cannot be confirmed. (2) D1 = 1 (D1.0: ON) indicates that the start-up switch has been pressed. (3) D1 = 2 (D1.1: ON) indicates that the start-up switch has been released from the (2) state and start-up processing is completed.

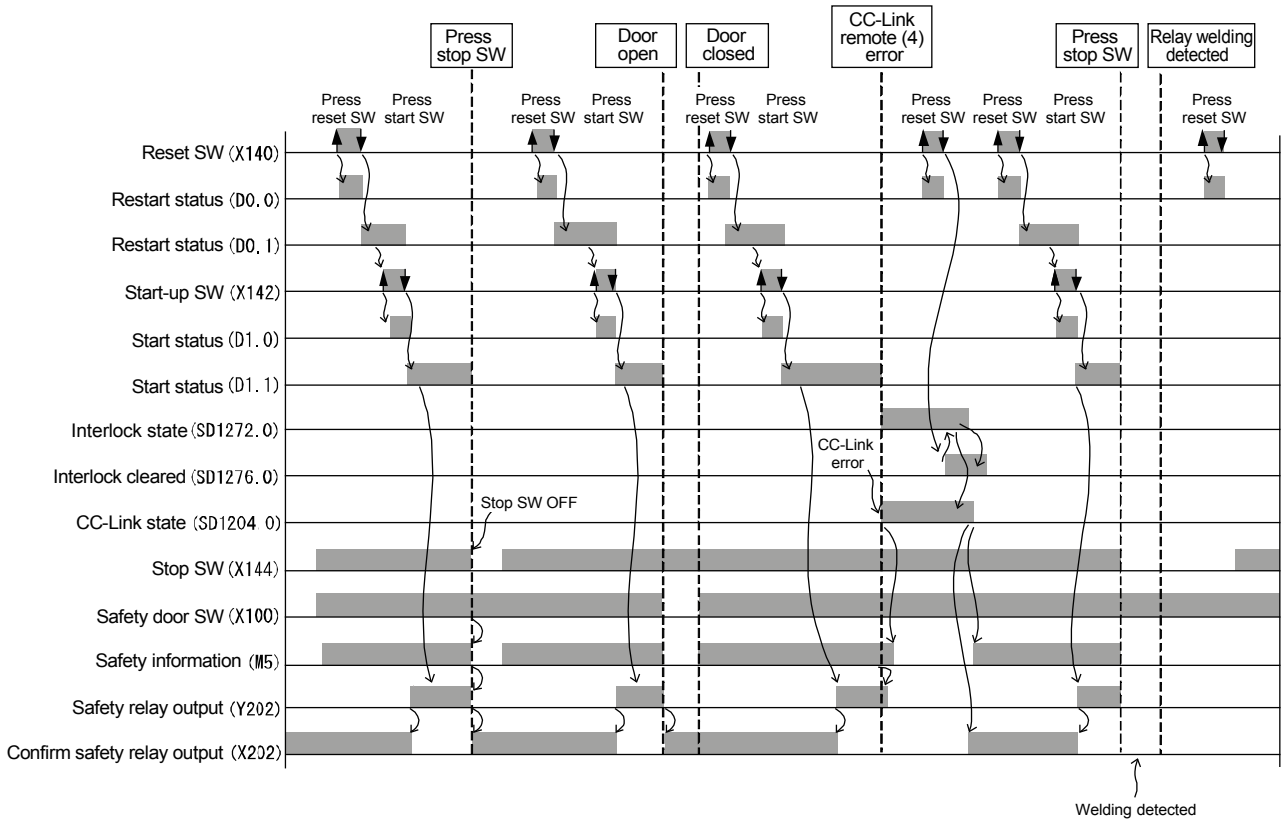
(c) How to use bit specification of words

D□□.□: Indicates the data of □th bit of word device D□□.

Ex) D0.0 → Indicates the 0th bit of D0.



(6) Timing chart



2.6.3 Entry Detection and Presence Detection Circuit

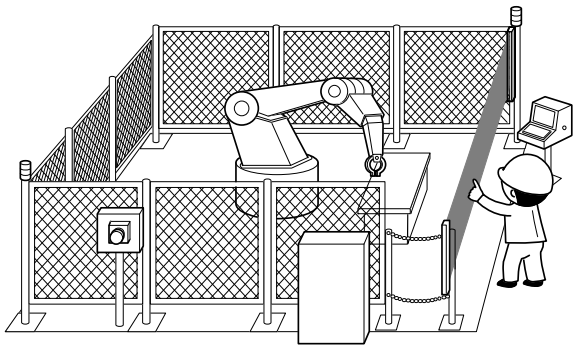
(1) Application overview

This is a safety application for detecting entry and presence of people in a hazardous area and for turning OFF the power source of robot.
The entry of a person in a hazardous area is detected by blocking the light of the light curtain. The presence of a person in a hazardous area is detected by a laser scanner. The robot is stopped if entry/presence of person is detected.
The robot cannot be operated until the person leaves the hazardous area.

The light curtain, laser scanner and contactor are connected to the safety programmable controller.
The safety programmable controller controls ON/OFF status of contactor by the sequence program.
When the safety programmable controller detects an error by self diagnostics, output to the contactor is turned OFF regardless of the sequence program.
When output is turned OFF by self diagnostics, output remains OFF till the safety CPU module or safety remote I/O module is reset regardless of the sequence program.

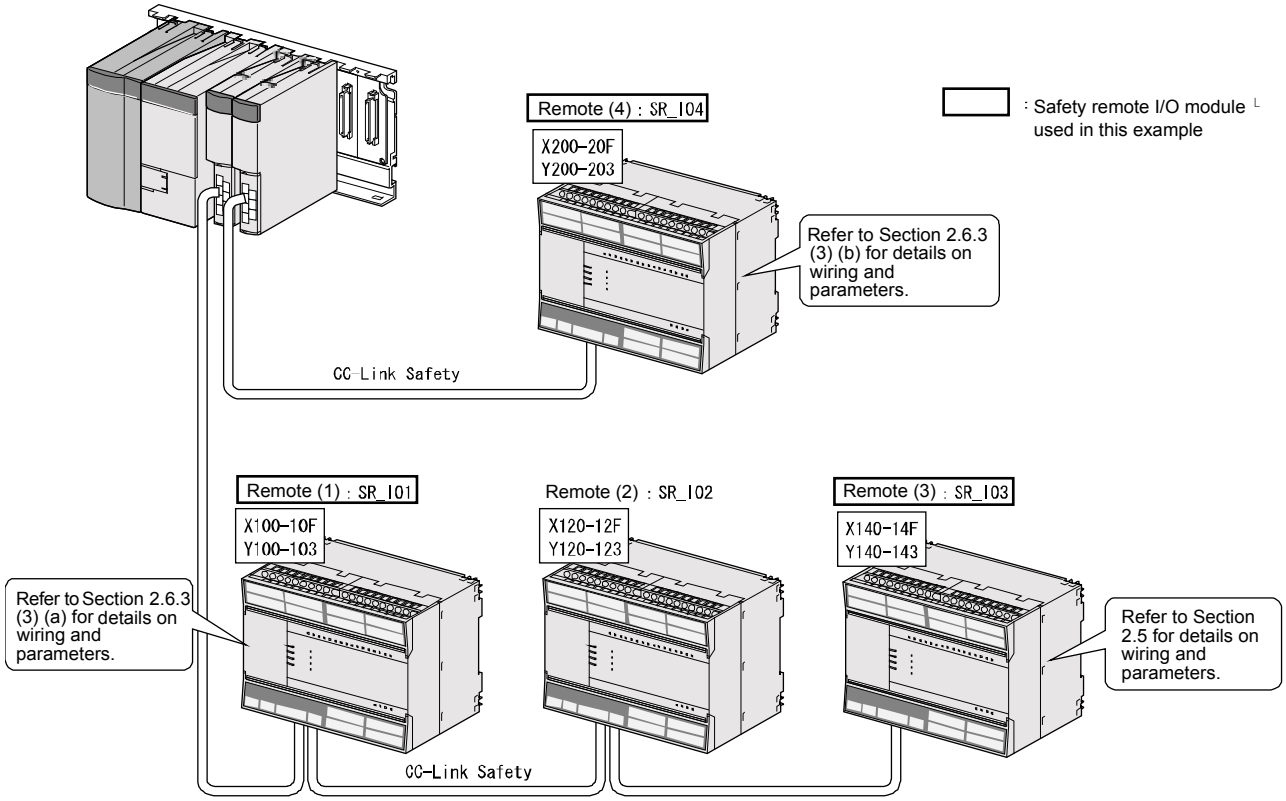
The following functions are achieved by the sequence program.

1) After safety confirmation (light curtain and laser scanner signals are both ON), the operator first presses the RESET switch. Then, the contact turns ON by pressing the start-up switch.
2) When the contactor is welded, the normally closed contact of the contactor is input to the safety programmable controller so that it cannot be started up. The operator checks for welding.
3) The safety programmable controller is started up only when the RESET switch and start-up switch are turned ON and OFF to prevent the controller from being started by mistake when the RESET switch and start-up switch are welded or short-circuited.
4) Either turn OFF the light curtain signal or laser scanner signal after operation, or turn OFF contactor output when a safety remote I/O station error is detected.



("Safety Guidebook - Safety Measures at Manufacturing Sites":
Excerpt from Nippon Electric Control Equipment Industries Association)

(2) Connection of safety devices



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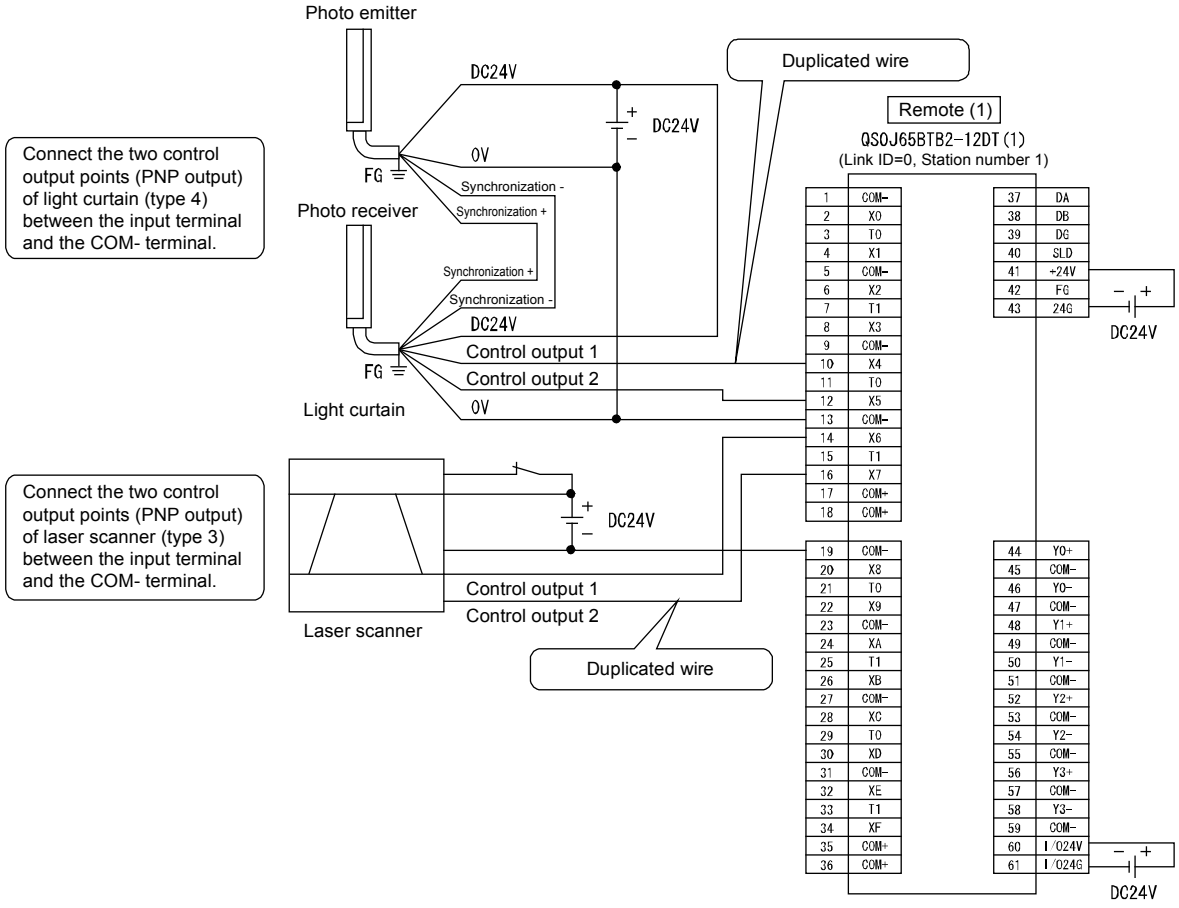
(3) Wiring and parameter settings
Wire the light curtain and laser scanner to the safety remote I/O module as follows.

(a) Remote (1): SR_IO1



Wiring of remote (1) SR_IO1

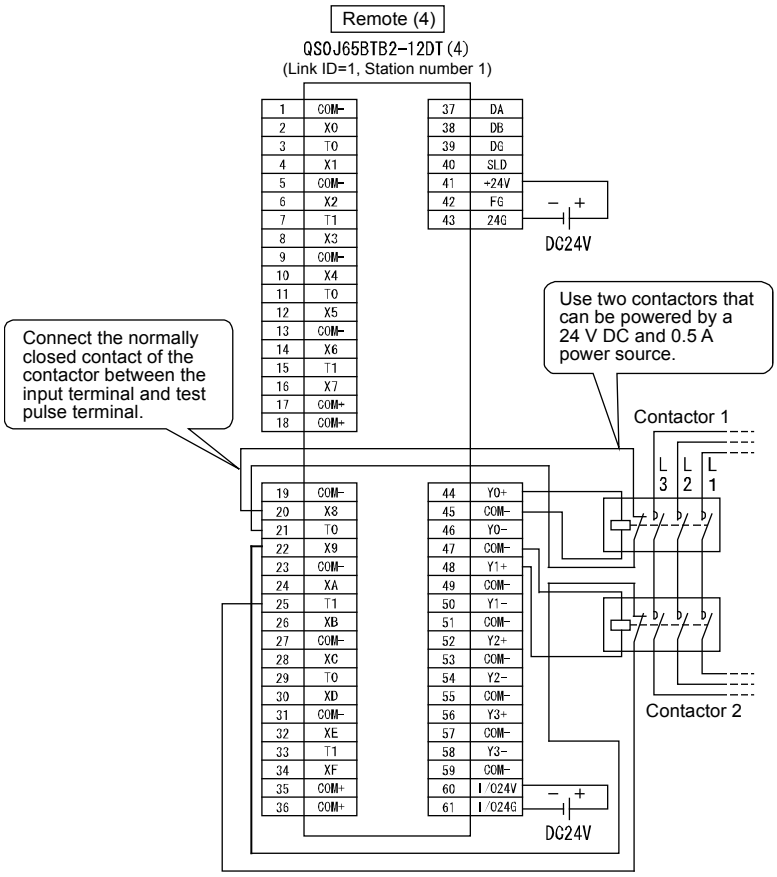
Set the parameters of the light curtain and laser scanner as follows.
(* For the list of parameters, refer to Appendix 10.)

Item	Setting range
Time of noise removal filter X4, 5 *1	[0: 1 ms], 1: 5 ms, 2: 10 ms, 3: 20 ms, 4: 50 ms
Time of noise removal filter X6, 7 *1	[0: 1 ms], 1: 5 ms, 2: 10 ms, 3: 20 ms, 4: 50 ms
Dual input mismatch detection time X4, 5 *1	20 ms (Setting range: 20 to 500 ms)
Dual input mismatch detection time X6, 7 *1	20 ms (Setting range: 20 to 500 ms)
Input dark test execution selection X4, 5	0: Execute, [1: Do not execute]
Input dark test execution selection X6, 7	0: Execute, [1: Do not execute]
Input dark test pulse OFF time *1	[0: 400 μs], 1: 1 ms, 2: 2 ms

*1: Adjust the time of noise removal filter by adjusting the installation environment and wiring length.
Set the dual input mismatch detection time to roughly 100 ms in the case of a mechanical switch and to 20 ms for sensor input.

(b) Remote (4): SR_IO4

Wire the contactor to the safety remote I/O module as follows.



Wiring of remote (4) SR_IO4

Set the parameters of the contactor as follows.

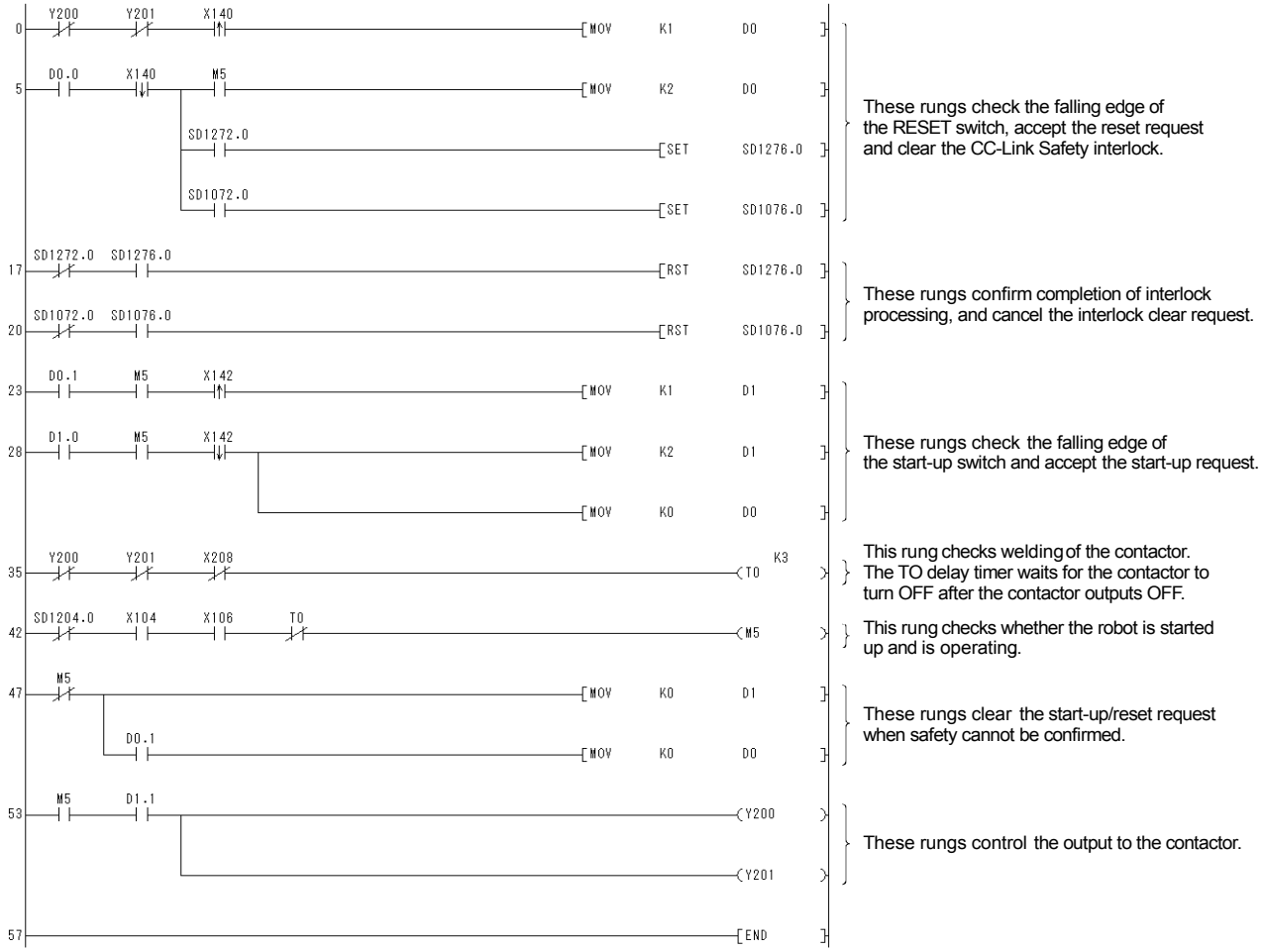
Item	Setting range
Time of noise removal filter X8, 9 *1	[0: 1 ms], 1: 5 ms, 2: 10 ms, 3: 20 ms, 4: 50 ms
Dual input mismatch detection time X8, 9 *1	100 ms (Setting range: 20 to 500 ms)
Input dark test execution selection X8, 9	[0: Execute], 1: Do not execute
Input dark test pulse OFF time *1	[0: 400 µs], 1: 1 ms, 2: 2 ms
Output wiring method Y0	0: Not used, [1: Dual wiring (source + sink)], 2: Dual wiring (source + source)
Output wiring method Y1	0: Not used, [1: Dual wiring (source + sink)], 2: Dual wiring (source + source)
Output dark test execution selection Y0	[0: Execute], 1: Do not execute
Output dark test execution selection Y1	[0: Execute], 1: Do not execute
Output dark test pulse OFF time Y0 *1	0: 400 µs, [1: 1 ms], 2: 2 ms
Output dark test pulse OFF time Y0 *1	0: 400 µs, [1: 1 ms], 2: 2 ms

*1: Adjust the time of noise removal filter, input dark test pulse OFF time, and output dark test pulse OFF time by adjusting the installation environment and wiring length.
Set the dual input mismatch detection time to roughly 100 ms in the case of a mechanical switch and to 20 ms for sensor input.

(4) Device numbers used
Create the sequence program by using the following device numbers.

Safety/general	External device	Device No.
Safety	Light curtain	X104 or X105
Safety	Laser scanner	X106 or X107
Safety	Contactor	Y200, Y201
Safety	Contactor (welding check)	X208 or X209
General	RESET switch	X140
General	Start-up switch	X142

(5) Sequence program
The sequence program performs the following processing.



The constants and internal devices used in the program are as follows.

(a) How to use constants
K□: Indicates a decimal number.

Ex) K1 → Indicates the decimal number 1.

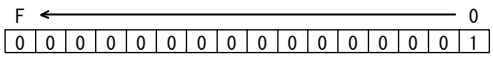
(b) How to use internal devices

Internal device	Description
T0	Indicates a timer device. The device turns ON after the time specified in K□ has elapsed.
D0	Indicates a word device. Here, it is used as restart status. (1) D0 = 0 indicates initial status or that start-up processing is completed. (2) D0 = 1 (D0.0: ON) indicates that the RESET switch has been pressed. (3) D0 = 2 (D0.1: ON) indicates that the RESET switch has been released from the (2) state and restart processing is completed.
D1	Indicates a word device. Here, it is used as start-up status. (1) D1 = 0 indicates initial status or that safety cannot be confirmed. (2) D1 = 1 (D1.0: ON) indicates that the start-up switch has been pressed. (3) D1 = 2 (D1.1: ON) indicates that the start-up switch has been released from the (2) state and start-up processing is completed.

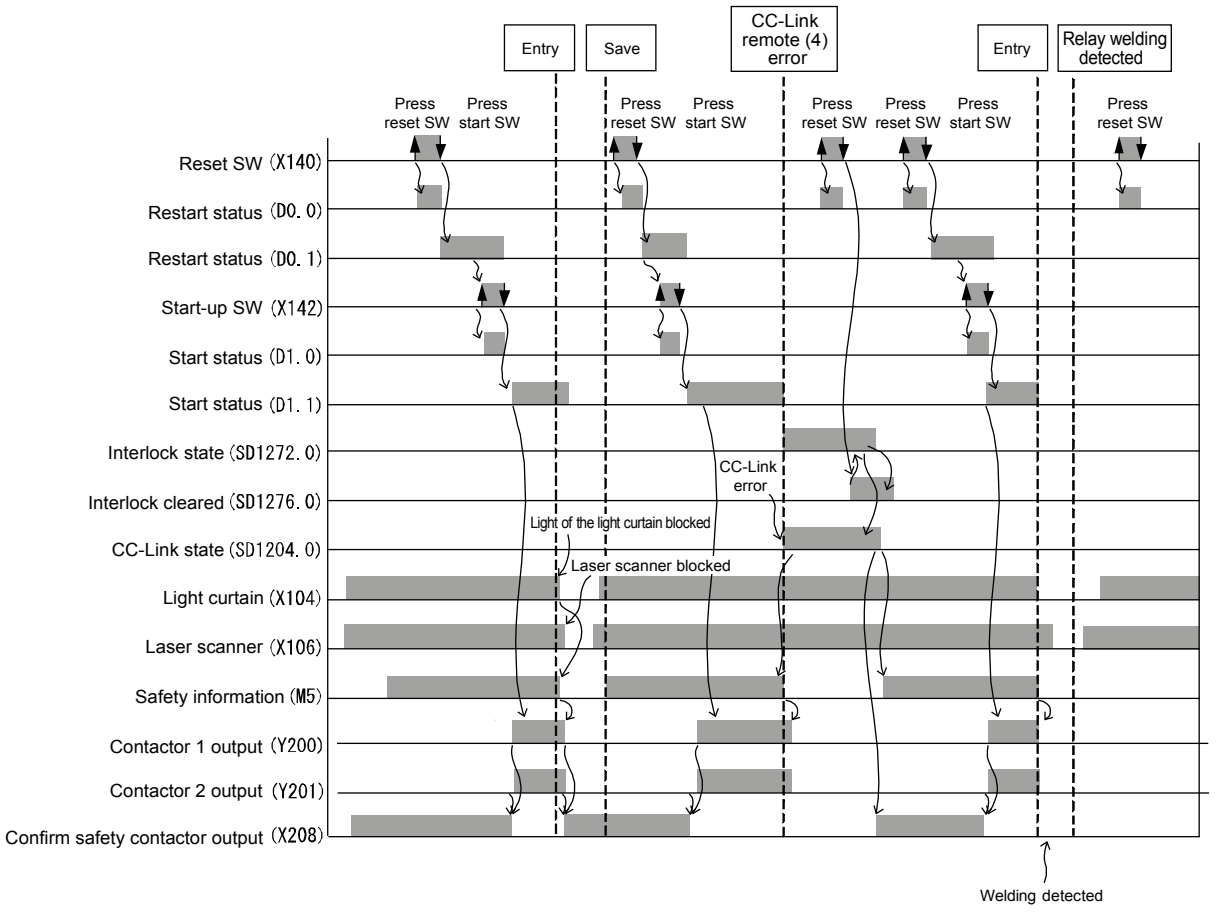
(c) How to use bit specification of words

D□□.□: Indicates the data of □th bit of word device D□□.

Ex) D0.0 → Indicates the 0th bit of D0.



(6) Timing chart



2.7 Precautions When Using the Safety Programmable Controller

Authenticate conformance with safety standards for all users of the entire safety system.
Examination of safety system is performed for the entire safety system including safety components and sequence programs.
Also, all tasks related to configuration of the safety system (design, installation, operation, maintenance, etc.) should be carried out by a person who is trained in safety standards, safety devices, safety programmable controllers, etc.

2.7.1 Precautions When Designing Safety Applications

(1) Response time
Response time is the time required by the safety programmable controller to turn the safety output OFF after safety input turned OFF.
Response time is required for determining the safety distance of the safety system.

POINT
The response time of the safety programmable controller becomes longer if GX Developer is connected. Do not keep GX Developer connected during actual operation of the safety system.

(2) Calculation of target failure measures (PFD/PFH)
Target failure measures (PFD/PFH) is a target value of reliability for each SIL level given in IEC61508.
Calculate the target failure measures (PFD/PFH) for each safety functions by the following formula:

PFD/PFH = A + B + C + D ····· PFD/PFH calculation formula

Variable	Meaning
A	PFD/PFH combined for safety CPU module, safety power supply module, safety main base unit, and CC-Link Safety master module
B	PFD/PFH of safety remote I/O module (1) When safety input device and safety output device are connected to the same safety remote I/O module B = B1 (2) When safety input device and safety output device are connected to a different safety remote I/O module B = B1 + B2
B1	PFD/PFH of safety remote I/O module to which safety input device is connected
B2	PFD/PFH of safety remote I/O module to which safety output device is connected
C*1	PFD/PFH of safety input device
D*1	PFD/PFH of safety output device

*1: For details on the PFD/PFH of C, D, refer to the manual, etc. of the safety component used.

PFD/PFH related to the safety programmable controller are shown below.

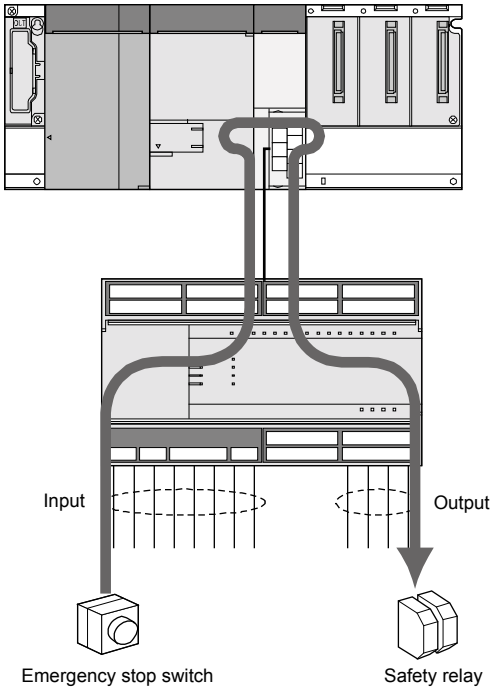
Module		PFD	PFH(/h)
PFD/PFH*2 combined for safety CPU module, safety power supply module,safety main base unit, and CC-Link Safety master module		1.39×10^{-4}	4.95×10^{-9}
PFD/PFH of safety remote I/O module	QS0J65BTB2-12DT (DC input/transistor output combined module)	2.57×10^{-5}	1.15×10^{-9}
	QS0J65BTS2-8D (DC input module)	1.68×10^{-5}	7.46×10^{-10}
	QS0J65BTS2-4T (transistor output module)	1.68×10^{-5}	7.46×10^{-10}

*2: The number of safety master modules is not related to the value of PFD and PFH.

(a) In case of one QS0J65BTB2-12DT

PFD = (PFD of A) + (PFD of B) + (PFD of C) + (PFD of D)
= $(1.39 \times 10^{-4}) + (2.57 \times 10^{-5})$ + (PFD of C) + (PFD of D)
= 1.65×10^{-4} + (PFD of C) + (PFD of D)

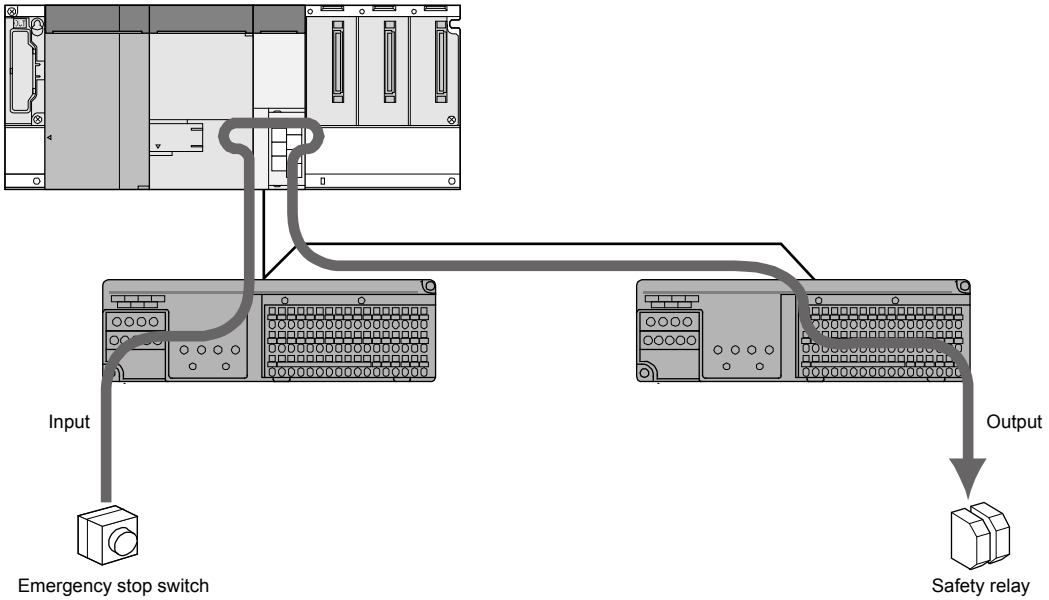
PFH = (PFH of A) + (PFH of B) + (PFH of C) + (PFH of D)
= $(4.95 \times 10^{-9}) + (1.15 \times 10^{-9})$ + (PFH of C) + (PFH of D)
= 6.10×10^{-9} + (PFH of C) + (PFH of D)



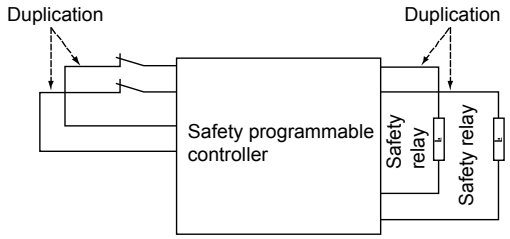
(b) In case of one QS0J65BTS2-8D and QS0J65BTS2-4T

PFD = (PFD of A) + (PFD of B) × n + (PFD of C) + (PFD of D)
= (1.39×10^{-4}) + $((1.68 \times 10^{-5}) + (1.68 \times 10^{-5}))$ + (PFD of C) + (PFD of D)
= 1.73×10^{-4} + (PFD of C) + (PFD of D)

PFH = (PFH of A) + (PFH of B) × n + (PFH of C) + (PFH of D)
= (4.95×10^{-9}) + $((7.46 \times 10^{-10}))$ + (7.46×10^{-10}) + (PFH of C) + (PFH of D)
= 6.44×10^{-9} + (PFH of C) + (PFH of D)



(3) Safety component connection method
Wire the safety components as shown in the figure below in duplicate.



POINT

Use a combination of the following input terminals for the dual input signal to the safety remote I/O module.
Use of combinations other than the following results in error due to dual input mismatch detection.
{X00, X01}, {X02, X03}, {X04, X05}, {X06, X07}
{X08, X09}, {X0A, X0B}, {X0C, X0D}, {X0E, X0F}

When executing the input dark test function, use the test pulse terminal to connect the safety components.

POINT

When executing the input dark test function, use the following combinations of input terminals and test pulse terminals of the safety remote I/O module.
Connection to a wrong test pulse terminal is judged to be a disconnection and results in a fault.
Correct combinations
{X00, X02, X04, X06, X08, X0A, X0C, X0E} and T0
{X01, X03, X05, X07, X09, X0B, X0D, X0F} and T1

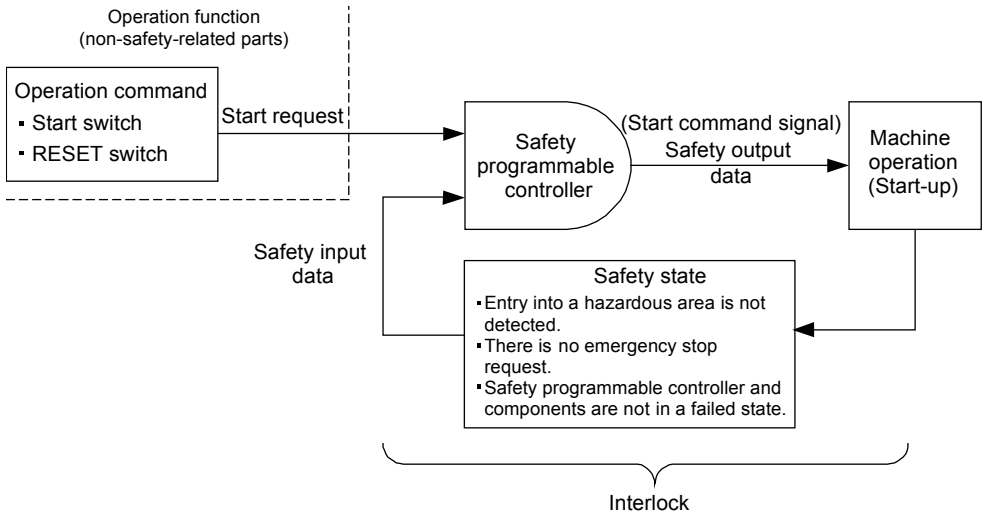
For details of dual wiring and the input dark test function, refer to the CC-Link Safety System Remote I/O Module User's Manual (Detailed).

(4) Using GX Developer monitor data
Do not use the monitor data displayed on GX Developer for safety-related operations.
(For example, do not perform safety operations such as starting the machine, resetting of stop status etc., based on the monitor data displayed on GX Developer.)

2.7.2 Programming Precautions

(1) How to make a basic program
Pay attention to the following points when creating a program for implementing safety functions.

- Program so that the machine is started up only if the safety status can be confirmed when the start switch is pressed.
- Program so that the machine is stopped if safety status cannot be confirmed.
- Program so that the machine is started up at falling edge of the start switch signal changing to OFF from an ON state.
  It is possible to avert the risk of improper start-up of machine at the time of switch failure (contact welding, spring damage etc.).
- Create an interlock program that uses the RESET button, etc. for restart (so that there is no restart without manual operation) after safety functions operate and output is turned OFF.



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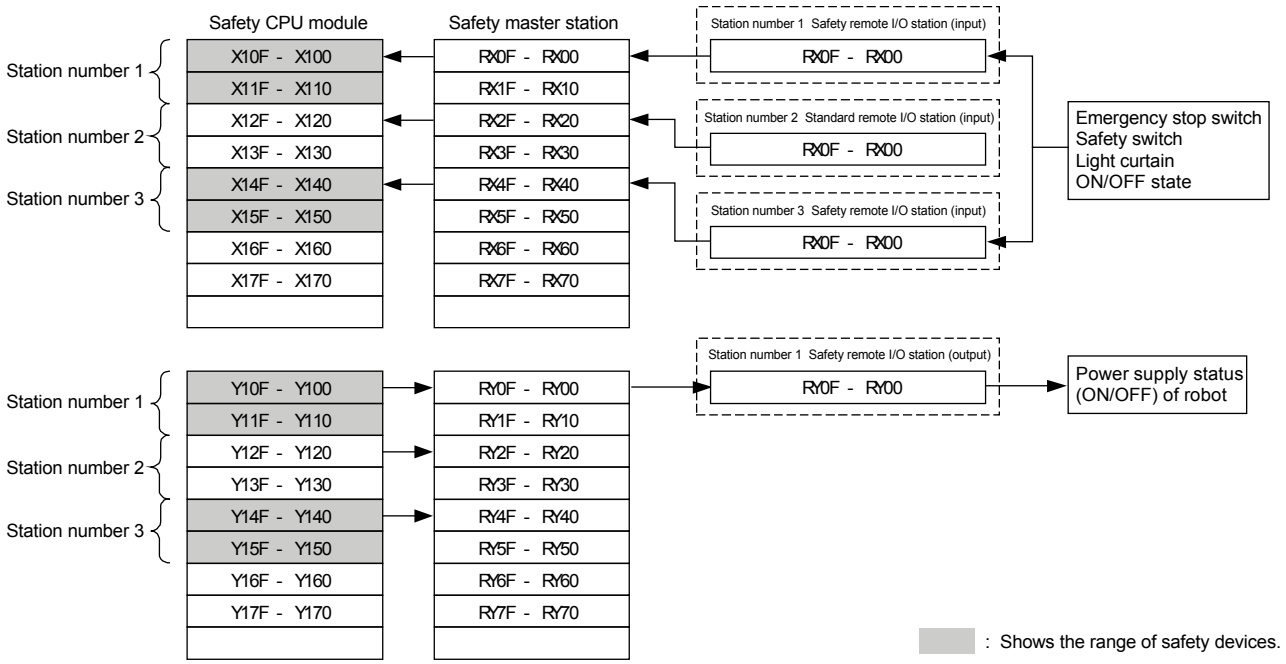
(2) Devices used by program for implementing safety functions
The data of the following safety refresh devices can be used as safety input/output data. Write the program for implementing the safety functions by using the safety refresh devices.

(a) Safety refresh devices
Internal device data refreshed by communication with the safety remote I/O station is the safety input/output data.



*1: The above figure shows an instance where X100 and Y100 are set in the auto refresh parameters.
The following device ranges that are not actually input/output to the safety remote I/O station also are included.
Station number 1: X110 to X11F, Y110 to Y11F, Station number 3: X150 to X15F, Y150 to Y15F

(b) Special relays (SM), special registers (SD)
Only CC-Link Safety related devices SM1000 to SM1299 and SD1000 to SD1299 can be used in the program for implementing safety functions.

(3) Detection of CC-Link Safety errors

Errors related to CC-Link Safety can be detected by the safety station refresh communication status shown in the following table.
Create an appropriate program for turning OFF the safety output by using the safety station refresh communication status when an error is detected.

(a) Safety station refresh communication status

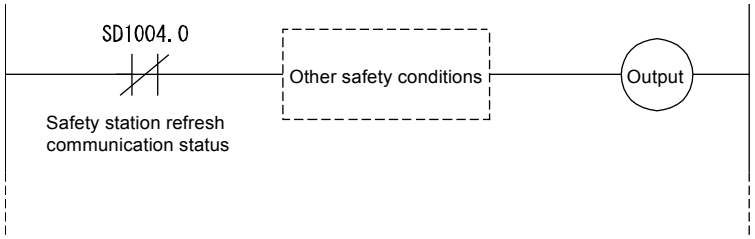
The names and numbers of the special registers for confirming the safety station refresh communication status are shown in the table below.

<table>
<tr><th rowspan="2">Name</th><th rowspan="2">Number</th><th>Explanation of special register
(safety station refresh communication status) bits</th></tr>
<tr><th>Meaning of each bit indicated by the station number in the table
0: Normal or reserved station specification,
not connected, standard remote station
1: Safety station communication error</th></tr>
<tr><td>Safety station refresh communication status (First safety master module)</td><td>SD1004
to
SD1007</td><td>
<table>
<tr><th></th><th>b15</th><th>b14</th><th>～</th><th>b1</th><th>b0</th></tr>
<tr><td>SD1004</td><td>16</td><td>15</td><td>～</td><td>2</td><td>1</td></tr>
<tr><td>SD1005</td><td>32</td><td>31</td><td>～</td><td>18</td><td>17</td></tr>
<tr><td>SD1006</td><td>48</td><td>47</td><td>～</td><td>34</td><td>33</td></tr>
<tr><td>SD1007</td><td>64</td><td>63</td><td>～</td><td>50</td><td>49</td></tr>
</table>
In the table, 1 to 64 indicate station numbers.
</td></tr>
<tr><td>Safety station refresh communication status (Second safety master module)</td><td>SD1204
to
SD1207</td><td>
<table>
<tr><th></th><th>b15</th><th>b14</th><th>～</th><th>b1</th><th>b0</th></tr>
<tr><td>SD1204</td><td>16</td><td>15</td><td>～</td><td>2</td><td>1</td></tr>
<tr><td>SD1205</td><td>32</td><td>31</td><td>～</td><td>18</td><td>17</td></tr>
<tr><td>SD1206</td><td>48</td><td>47</td><td>～</td><td>34</td><td>33</td></tr>
<tr><td>SD1207</td><td>64</td><td>63</td><td>～</td><td>50</td><td>49</td></tr>
</table>
In the table, 1 to 64 indicate station numbers.
</td></tr>
</table>

For details, refer to the QSCPU User's Manual (Function Explanation, Program Fundamentals).

(b) Program example

The program for detecting CC-Link Safety errors is shown in the figure below.
This example shows use of SD1004.0 to output from station number 1 safety remote I/O station connected to the first safety master module.



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(4) Clearing CC-Link safety errors

When a CC-Link safety error is detected, the safety station interlock status shown in the following table, turns ON.

To resume CC-Link Safety communication, the safety station interlock clear request shown in the table below must be turned ON.

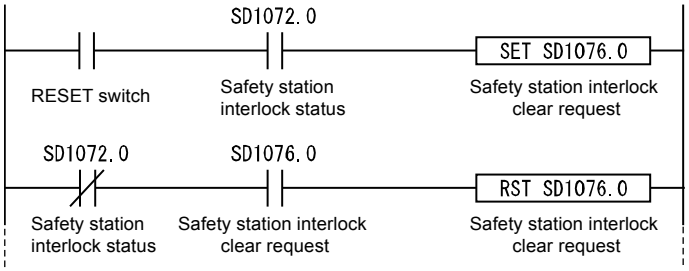
Create a program that turns the safety station interlock clear request ON by manual operation of the RESET button, for example.

<table>
<tr><th>Name</th><th>Number</th><th>Explanation of special register (safety station interlock status) bits</th></tr>
<tr><td>Safety station interlock status
(First safety master module)</td><td>SD1072
to
SD1075</td><td>0: Interlock OFF
1: Interlock ON (first station number only)
<table><tr><td></td><td>b15</td><td>b14</td><td>~</td><td>b1</td><td>b0</td></tr><tr><td>SD1072</td><td>16</td><td>15</td><td>~</td><td>2</td><td>1</td></tr><tr><td>SD1073</td><td>32</td><td>31</td><td>~</td><td>18</td><td>17</td></tr><tr><td>SD1074</td><td>48</td><td>47</td><td>~</td><td>34</td><td>33</td></tr><tr><td>SD1075</td><td>64</td><td>63</td><td>~</td><td>50</td><td>49</td></tr></table>In the table, 1 to 64 indicate station numbers.</td></tr>
<tr><td>Safety station interlock clear request
(First safety master module)</td><td>SD1076
to
SD1079</td><td>0: Safety station input/output interlock not cleared
1: Safety station input/output interlock cleared
(first station number only)
<table><tr><td></td><td>b15</td><td>b14</td><td>~</td><td>b1</td><td>b0</td></tr><tr><td>SD1076</td><td>16</td><td>15</td><td>~</td><td>2</td><td>1</td></tr><tr><td>SD1077</td><td>32</td><td>31</td><td>~</td><td>18</td><td>17</td></tr><tr><td>SD1078</td><td>48</td><td>47</td><td>~</td><td>34</td><td>33</td></tr><tr><td>SD1079</td><td>64</td><td>63</td><td>~</td><td>50</td><td>49</td></tr></table>In the table, 1 to 64 indicate station numbers.</td></tr>
<tr><td>Safety station interlock status
(Second safety master module)</td><td>SD1272
to
SD1275</td><td>0: Interlock OFF
1: Interlock ON (first station number only)
<table><tr><td></td><td>b15</td><td>b14</td><td>~</td><td>b1</td><td>b0</td></tr><tr><td>SD1272</td><td>16</td><td>15</td><td>~</td><td>2</td><td>1</td></tr><tr><td>SD1273</td><td>32</td><td>31</td><td>~</td><td>18</td><td>17</td></tr><tr><td>SD1274</td><td>48</td><td>47</td><td>~</td><td>34</td><td>33</td></tr><tr><td>SD1275</td><td>64</td><td>63</td><td>~</td><td>50</td><td>49</td></tr></table>In the table, 1 to 64 indicate station numbers.</td></tr>
<tr><td>Safety station interlock clear request
(Second safety master module)</td><td>SD1276
to
SD1279</td><td>0: Safety station input/output interlock not cleared
1: Safety station input/output interlock cleared
(first station number only)
<table><tr><td></td><td>b15</td><td>b14</td><td>~</td><td>b1</td><td>b0</td></tr><tr><td>SD1276</td><td>16</td><td>15</td><td>~</td><td>2</td><td>1</td></tr><tr><td>SD1277</td><td>32</td><td>31</td><td>~</td><td>18</td><td>17</td></tr><tr><td>SD1278</td><td>48</td><td>47</td><td>~</td><td>34</td><td>33</td></tr><tr><td>SD1279</td><td>64</td><td>63</td><td>~</td><td>50</td><td>49</td></tr></table>In the table, 1 to 64 indicate station numbers.</td></tr>
</table>

For details, refer to the QSCPU User's Manual (Function Explanation, Program Fundamentals).

(a) Program example

The figure below shows an example of clearing the interlock of station number 1 safety remote I/O station connected to the first safety master module.

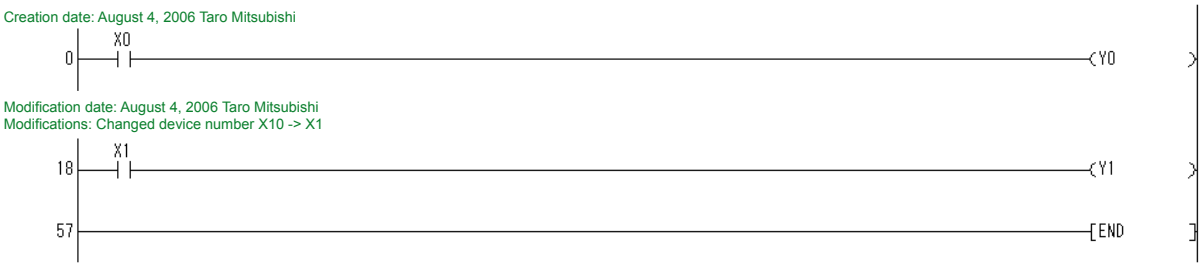


(5) Management of GX Developer project file versions

Using the statement function of GX Developer, input the creation date and name of the programmer at the start of the program.

When a program is modified, input the modification date, modified by and modifications at the modified location by using the statement function for management of the modification history.

Also, manage data written to the programmable controller by storing it on a personal computer's hard disk or a CD.



(6) User registration

Determine the users allowed to handle the project in question, and register the user information and privileges necessary for login authentication to the project.

For details regarding user registration, refer to the GX Developer Version 8 Operating Manual (Safety Programmable Controller).

2.7.3 Start-up Precautions

Confirm following points when the safety system is started up for the first time or when changes were made to the safety system.

(1) Check network connection configuration settings
Check that the main unit settings of the on-site safety remote I/O module are as specified in the design.
The verification items are as follows:

(a) Link ID
(b) Station number
(c) Transmission speed

For details on the main unit switch settings of the safety remote station, refer to section 2.2.1.

(2) Confirm before writing parameters and program
Before writing to a PLC, check that the parameters and program are as instructed in the design on the GX Developer screen, etc.
For the parameter setting method by GX Developer, refer to Section 3.2.4.

For the explanation and setting ranges of parameters in the parameter settings by GX Developer, refer to Appendix 10.

(3) Using the checklist
Before starting operation, use the checklist described in the safety application guide to check that the safety system has been configured correctly.

2.7.4 Precautions for Maintenance of Safety Functions

(1) Periodic inspection
To check that the emergency stop switch and safety sensors, etc. are not malfunctioning, carry out periodic inspection at least every one year to satisfy Category 3 and at least every six months minimum to satisfy Category 4.
Test not only the diagnostics of the safety programmable controller, but also the safety functions from emergency stop request through to stopping of the machine.

(2) Module replacement
In case of equipment related to the safety programmable controller, replace the modules according to the module replacement cycle in the table below.

Module	Module replacement cycle
Safety power supply module	5 years
Safety CPU module	10 years
Safety master module	10 years
Safety remote I/O module	5 years
Safety main base unit	10 years

(3) Operating mode during actual operation
Set the operating mode of the safety programmable controller during actual operation to SAFETY MODE.

(4) Management of information copied to ROM on the CPU
Periodically check the information in ROM to confirm that the program and parameters on the safety CPU module have not been rewritten illegally.

(a) When a project file is saved to ROM, check the information copied to CPU using GX Developer and note down that information separately.
(b) Periodically check the information copied to ROM using GX Developer to check for illegal rewriting of information.
(c) If an illegal rewrite is found, stop operation.
Use the backup project file to restore to the normal project settings.

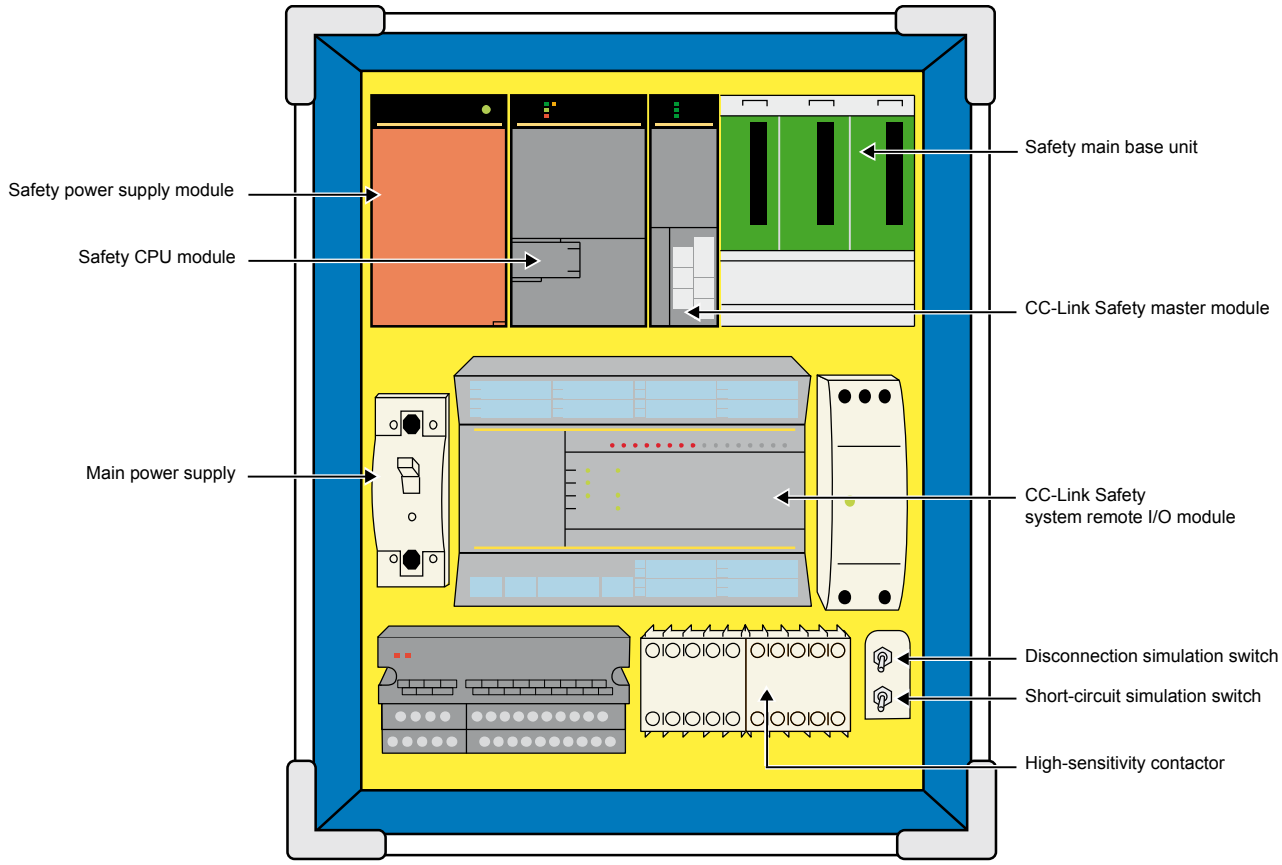
For details on how to check information in ROM, refer to Section 6.6.

(5) Password management
GX Developer project files and the safety CPU module are password-protected. To prevent access by unauthorized users, properly manage the registered passwords, and take precautions to prevent the leaking of passwords to unauthorized users.

2.8 Hardware Configuration of Training Machine

2.8.1 Hardware Configuration of Training Machine (Safety Programmable Controller Side)

The following shows the training machine (safety programmable controller side) equipped with safety programmable controller.



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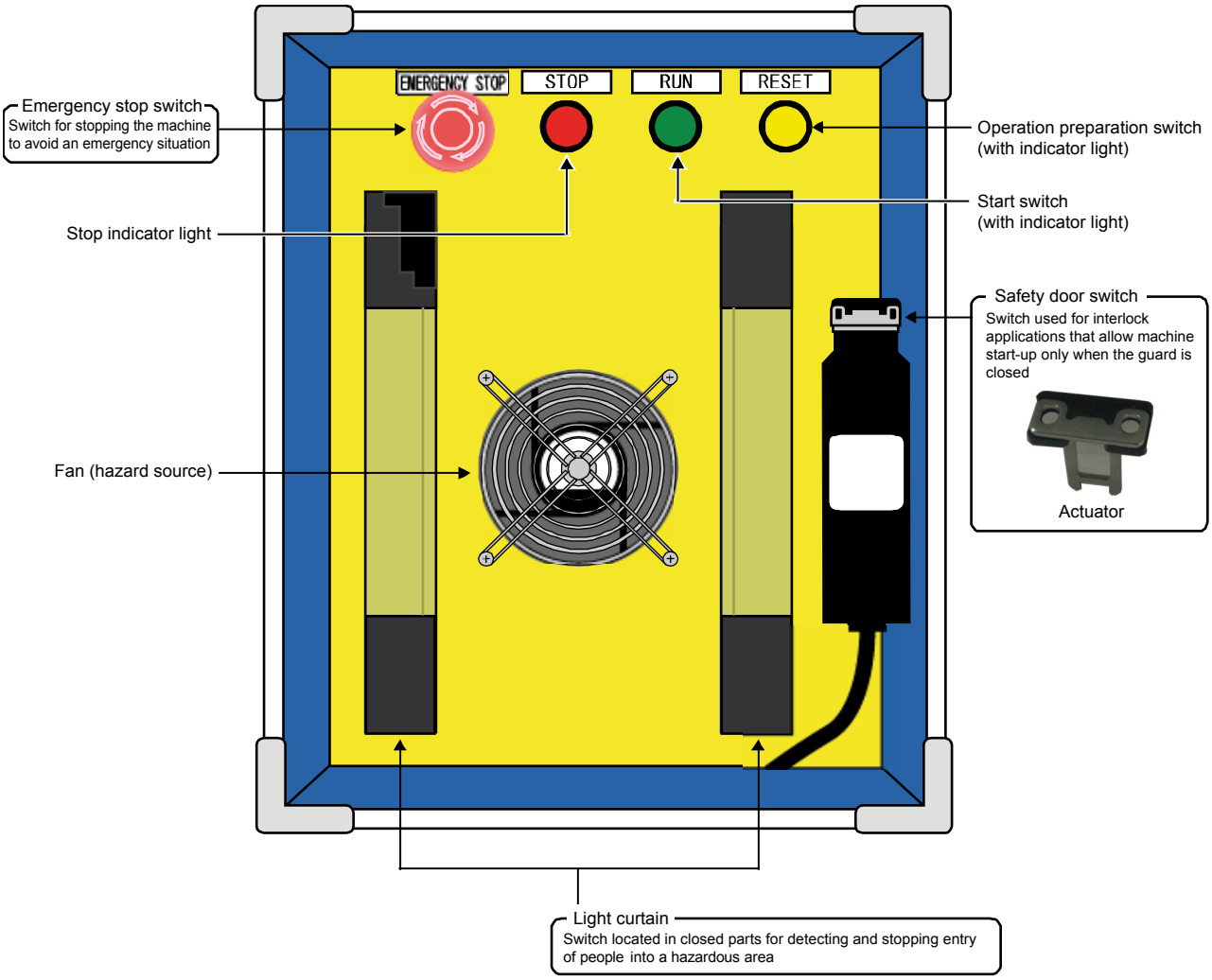
2.8.2 Hardware Configuration of Training Machine (Equipment Side)

The following shows the training machine (equipment side) equipped with safety components.



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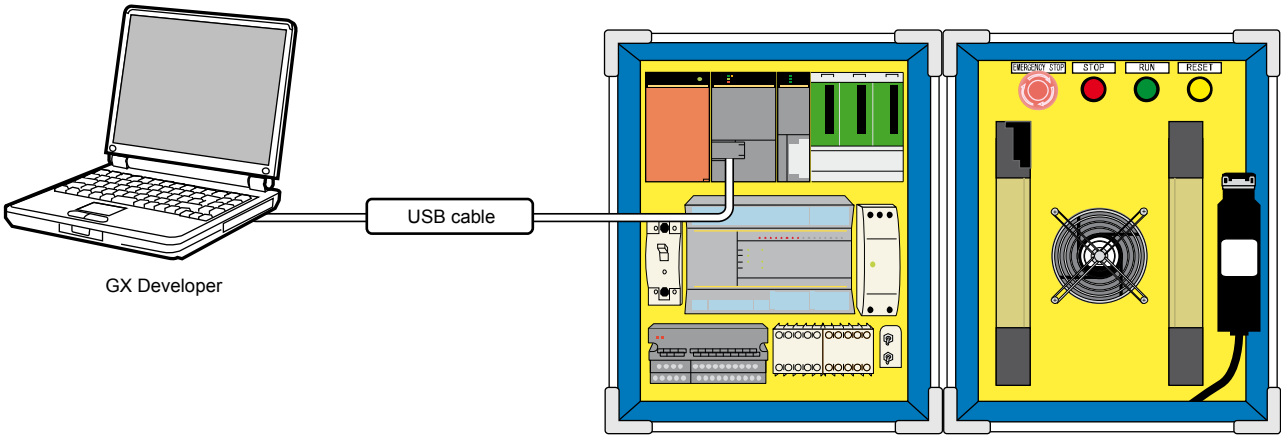
2.8.3 System Configuration of Training Machine



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2.8.4 Wiring Specification

The wiring of each remote I/O module of the training machine used in this school text is as follows.

Safety remote I/O module

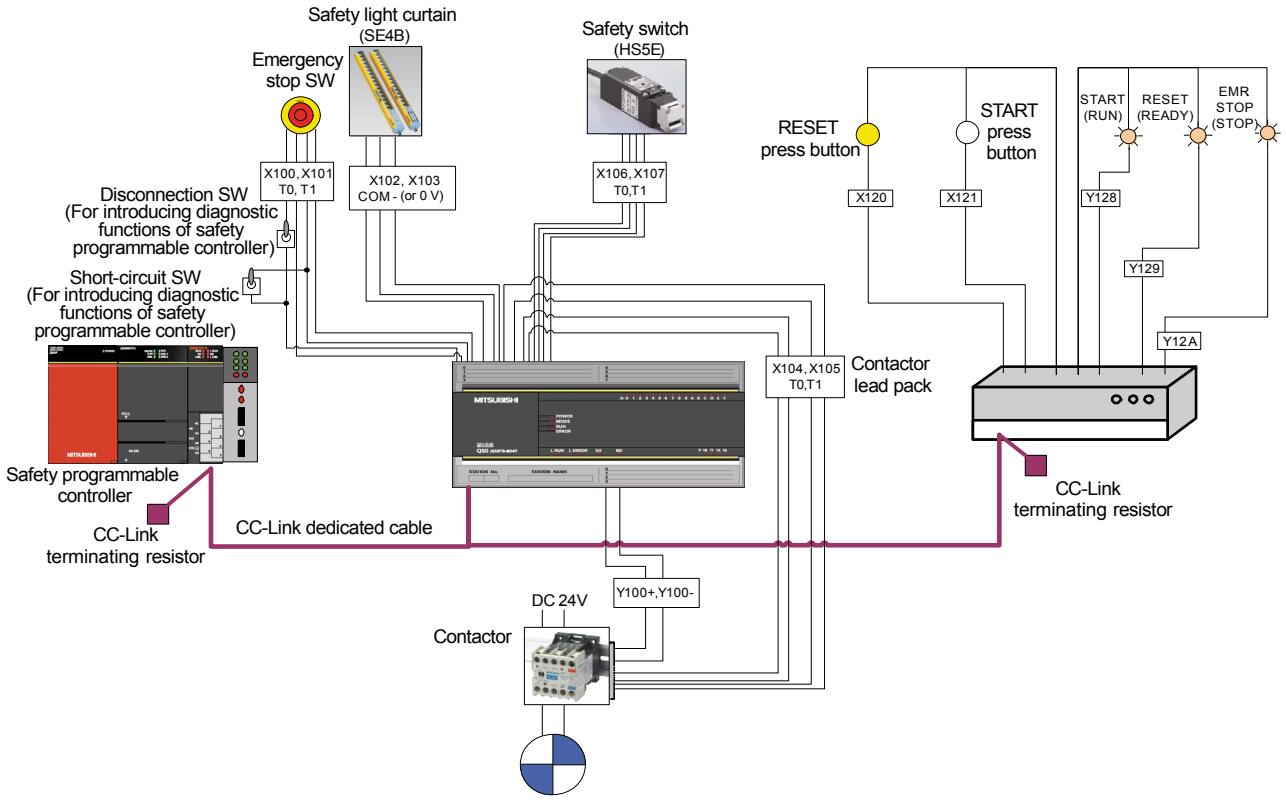
No.	Component	Input	Dark test	Output	Output dark test
1	Emergency stop switch	X0–T0, X1–T1	○ Execute	-	-
2	Light curtain	X2, X3, COM-	× Not required	-	-
3	Door switch	X6-T0, X7-T1	○ Execute	-	-
4	Contactor	X4-T0, X5-T1	○ Execute	Y0+, Y0-	○ Execute

Standard remote I/O module

No	Component	Input	Dark test	Output	Output dark test
1	General switch	X10-COM, X11-COM	Not possible (*1)	-	-

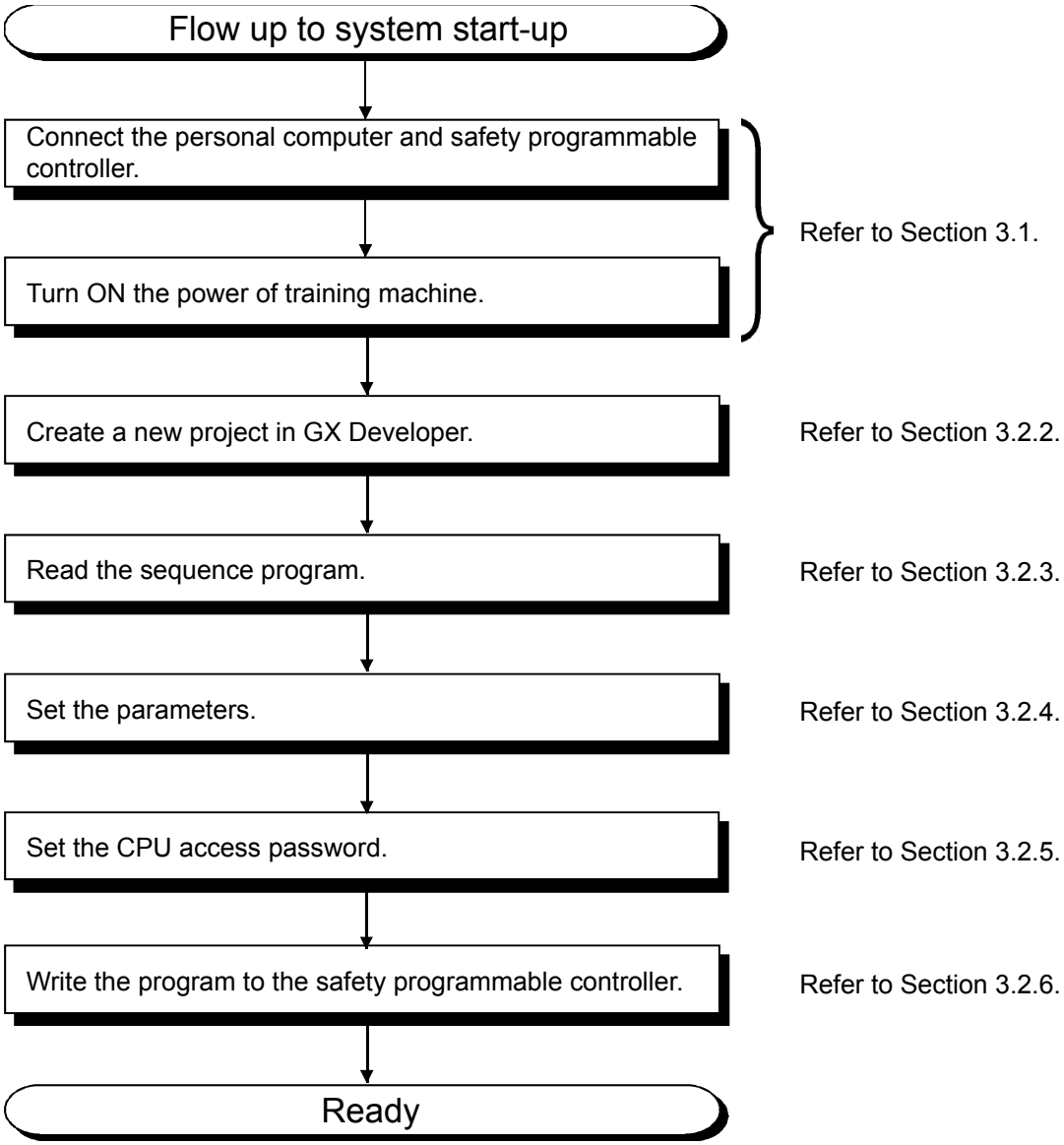
*1: The input dark test cannot be executed since wiring is general CC-Link remote I/O wiring and dual input is not supported.
It is necessary to create a ladder program that can detect welding of switches.
(Check by OFF → ON → OFF)

2.8.5 Wiring



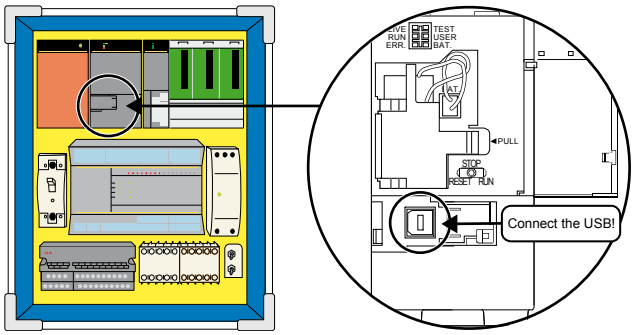
2.9 Overall Flow of Training (System Start-up)

The following shows the overall flow of training carried out in Chapter 3.



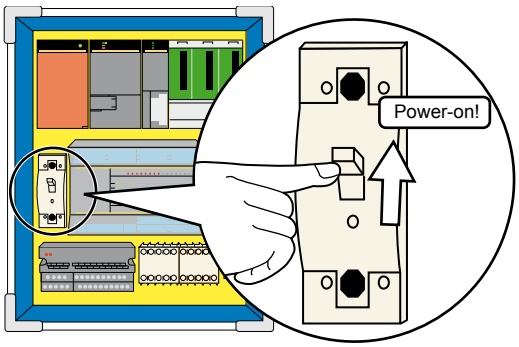
Chapter 3 Preparation

3.1 Connecting/Powering ON the Personal Computer and Safety Programmable Controller

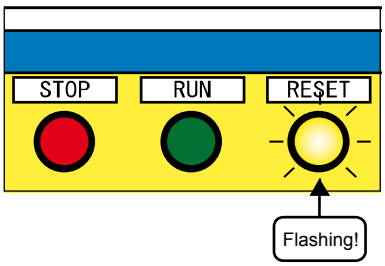


(1) Connect the personal computer and safety programmable controller by the USB interface.

The USB connector of the safety programmable controller is as shown on the left.



(2) Turn the power on after confirming that the socket of the training machine is plugged in.



(3) After power-on, confirm that the operation preparation switch (RESET) of the training machine (equipment side) is flashing.

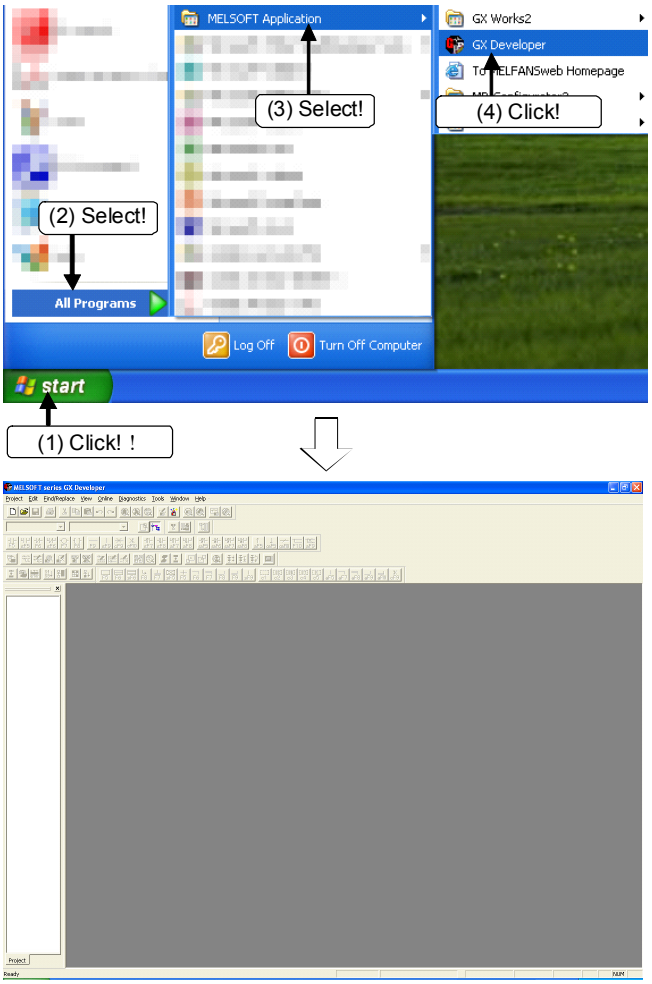
If the operation preparation switch (RESET) is flashing, there are no problems on the training machine.

CAUTION

After power-on, if the operation preparation switch (RESET) is not flashing (OFF), immediately stop using the training machine and report to the instructor as a failure may have occurred on the training machine.

3.2 Starting Up GX Developer

3.2.1 Starting GX Developer



(1) Click the Start button.

(2) Select the [All Programs] menu.

(3) Select the [MELSOFT Application] menu.

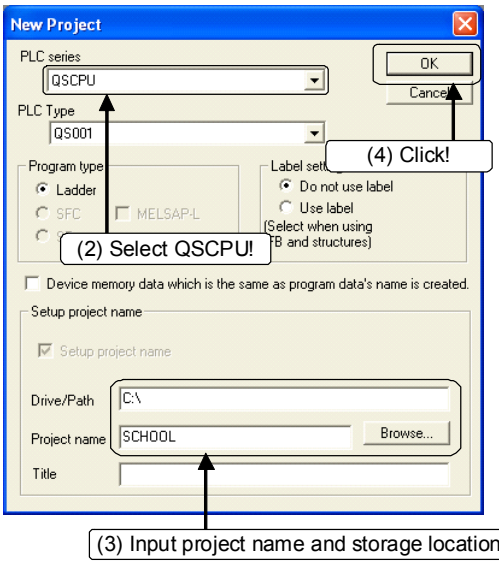
Selection can be done merely by moving the mouse cursor.
(No need to click or double-click.)

(4) Click the [GX Developer] menu.

(5) GX Developer starts up.

3.2.2 Creating New Projects (Selecting CPU and Registering the Administrator User)

(1) Click [ ] on the toolbar or click the [Project] → [New Project] menu.



(2) The New Project dialog box appears. Set the PLC series to "QSCPU".

(3) Input the storage location of the project and the project name.
* The storage location can also be specified by clicking the [参照...] button.

(4) Click [OK].

(5) The dialog box shown on the left appears. Click [Yes].

(6) To create the login user name required for the safety programmable controller project, click [OK].

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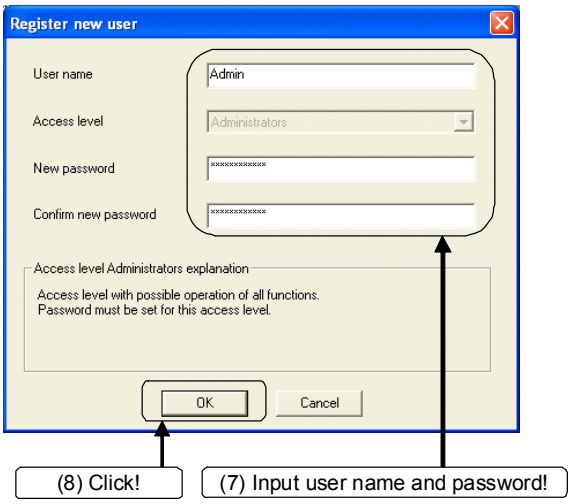
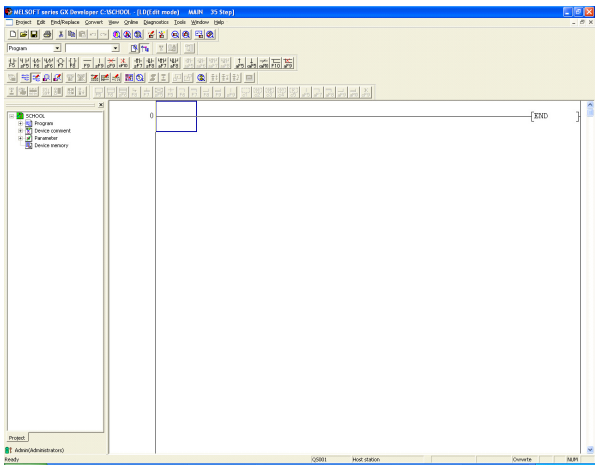


(7) The Register new user dialog box appears.
Input the user name and password.

Input the password "melsecsafety".

(8) Click OK.



(9) The New Project screen is displayed.

* Close the newly created project without saving.

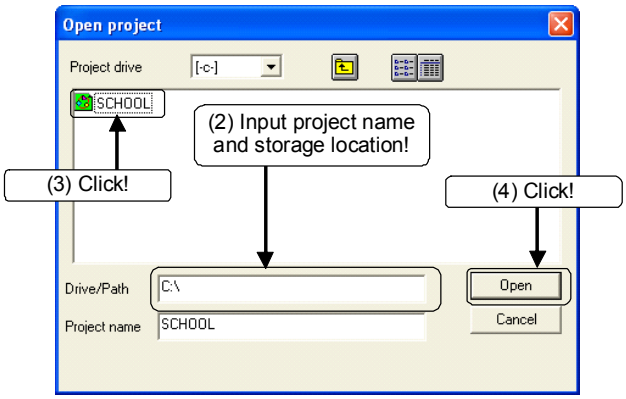
POINT
Register new user dialog box
User name Input a user name up to 20 characters long using alphabet characters, numbers, and symbols corresponding to ASCII codes 20H to 7EH (refer to Appendix 20). (Entry is case-sensitive.) * In the above example, the user name is set to "Admin".
Access level "Administrators" is set. This access level cannot be changed.
New password Input a password from 6 to 14 characters long using alphabet characters, numbers, and symbols corresponding to ASCII codes 20H to 7EH (refer to Appendix 20). (Entry is case-sensitive.)
Confirm new password Input the same password as above for confirmation.

3 - 4

3.2.3 Reading Projects (Login)

Read the sequence program "Safety programmable controller" from the distributed CD.

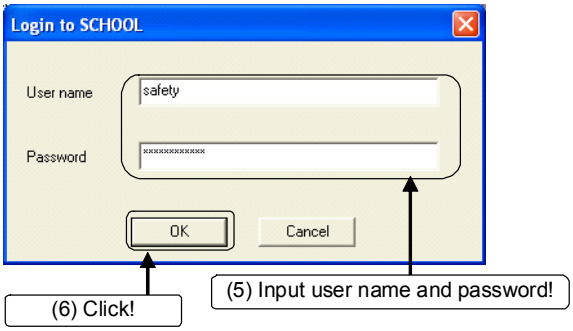
(1) Click on the toolbar or click the [Project] → [Open project] menu (Ctrl + 0).



(2) Specify the location where the project to be read is stored.

(3) Click the project to be read.

(4) Click to read the specified project.



(5) The Login screen is displayed. Input the user name and password as shown below:

User name: safety
Password: melsecsafety

(6) Click OK.

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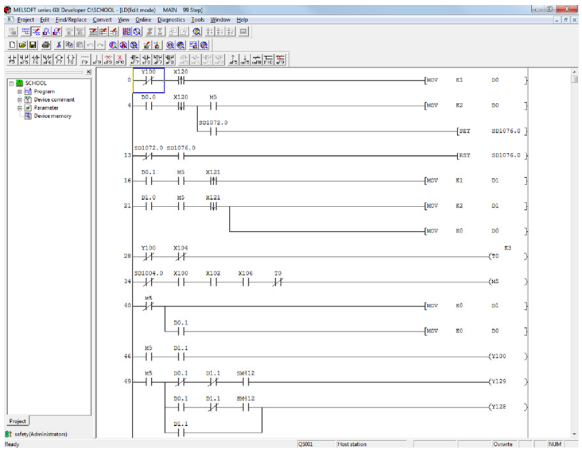

(7) The read ladder is displayed.

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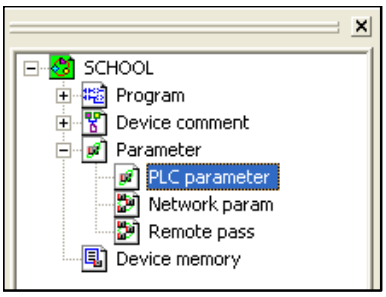
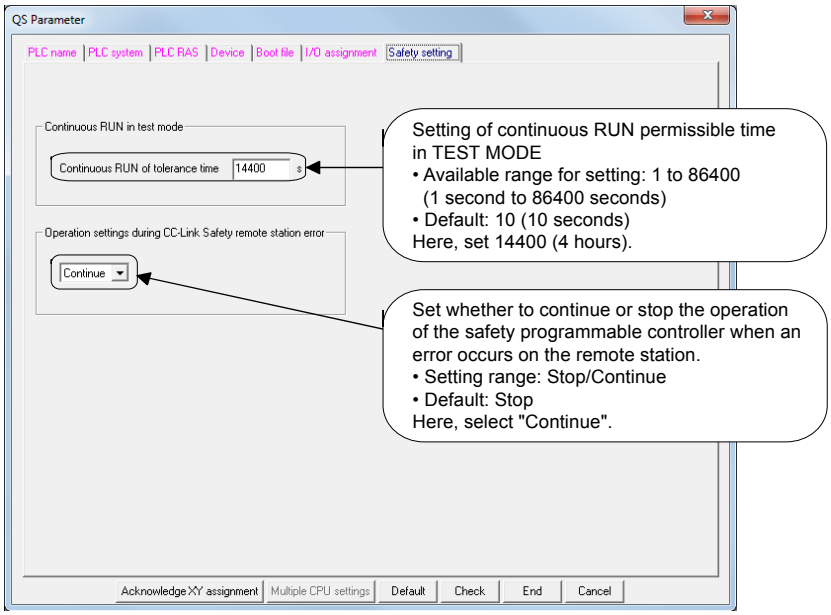
3.2.4 Setting Parameters

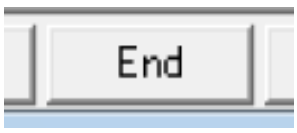
(1) PLC parameter setting



1) Double-click "PLC parameter" on the project data list.

2) The QS Parameter dialog box is displayed. Click the "Safety setting" tab and set as shown below.





3) Click the [End] button on the bottom right of the screen to close the screen.

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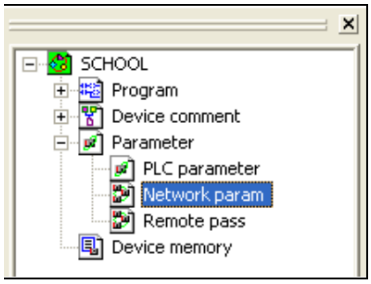
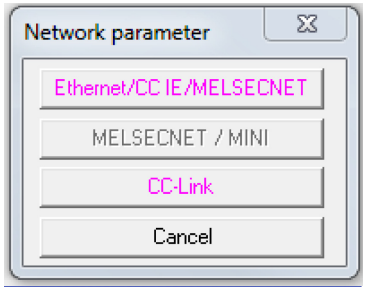
(2) Network parameter setting

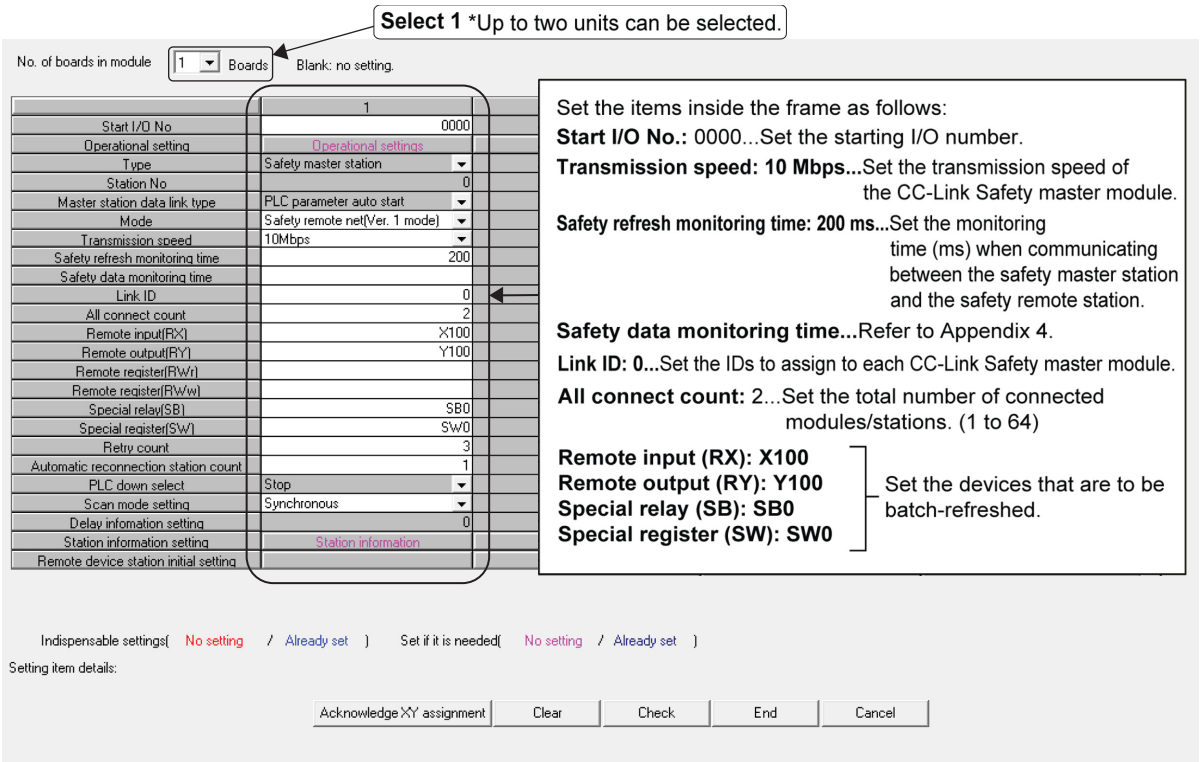


1) Double-click "Network parameter" on the project data list.



2) The network parameter selection screen is displayed. Click the CC-Link button.

3) The Number Setting screen is displayed. Set as shown below.



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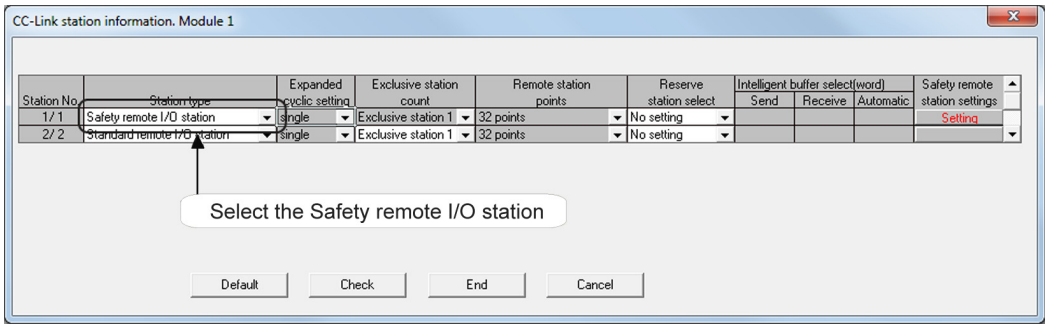
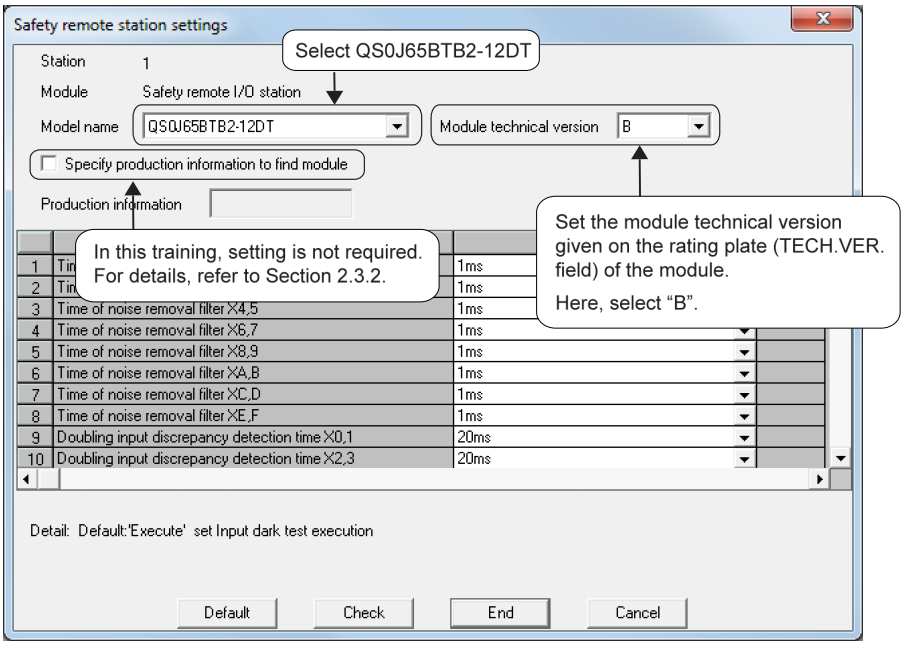
4) Click the Station information button.

5) The CC-Link Station Information screen is displayed. Set as shown below.



6) Click the Setting button.

7) The Safety remote station settings screen is displayed. Set as shown below.
(For details on parameter settings, refer to the next page.)



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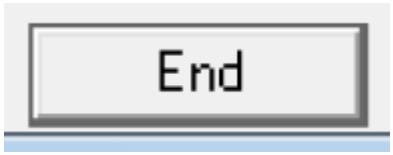


8) Click the End button on the Number Setting screen.
This completes network parameter setting.

(Parameter settings in the Safety Remote Station Settings screen)
* Shaded and bold items indicate locations where initial settings have been changed.

	Parameter item	Setting value	
1	Time of noise removal filter × 0, 1	1 ms	
2	Time of noise removal filter × 2, 3	1 ms	
3	Time of noise removal filter × 4, 5	1 ms	
4	Time of noise removal filter × 6, 7	1 ms	
5	Time of noise removal filter × 8, 9	1 ms	
6	Time of noise removal filter × A, B	1 ms	
7	Time of noise removal filter × C, D	1 ms	
8	Time of noise removal filter × E, F	1 ms	
9	**Dual input mismatch detection time × 0, 1**	**500 ms**	**← Emergency stop switch (maximum value) *1**
10	Dual input mismatch detection time × 2, 3	20 ms	
11	Dual input mismatch detection time × 4, 5	20 ms	
12	**Dual input mismatch detection time × 6, 7**	**500 ms**	**← Door switch (maximum value) *1**
13	Dual input mismatch detection time × 8, 9	20 ms	
14	Dual input mismatch detection time × A, B	20 ms	
15	Dual input mismatch detection time × C, D	20 ms	
16	Dual input mismatch detection time × E, F	20 ms	
17	Input dark test execution selection × 0, 1	Execute	
18	**Input dark test execution selection × 2, 3**	**Do not execute**	**← Light curtain *2**
19	Input dark test execution selection × 4, 5	Execute	
20	Input dark test execution selection × 6, 7	Execute	
21	Input dark test execution selection × 8, 9	Execute	
22	Input dark test execution selection × A, B	Execute	
23	Input dark test execution selection × C, D	Execute	
24	Input dark test execution selection × E, F	Execute	
25	Input dark test pulse OFF time	400 μs	
26	**Output wiring method Y0**	**Dual wiring (source + sink)**	
27	Output wiring method Y1	Not used	
28	Output wiring method Y2	Not used	
29	Output wiring method Y3	Not used	
30	Output dark test execution selection Y0	Execute	
31	Output dark test execution selection Y1	Execute	
32	Output dark test execution selection Y2	Execute	
33	Output dark test execution selection Y3	Execute	
34	Output dark test pulse OFF time Y0	400 μs	
35	Output dark test pulse OFF time Y1	400 μs	
36	Output dark test pulse OFF time Y2	400 μs	
37	Output dark test pulse OFF time Y3	400 μs	

*1 Originally, this was a mechanical switch set to around 100 msec. However, since a dual mismatch can occur due to manual operation, it is now set to the maximum (500 msec) in this practical training so that mismatch can hardly occur.
*2 As the light curtain itself performs similar diagnostics as the dark test, do not perform the input dark test by the parameter settings of the safety programmable controller.

For details on parameter items and setting values, refer to Chapter 2 of this text.

3.2.5 Setting CPU Access Passwords

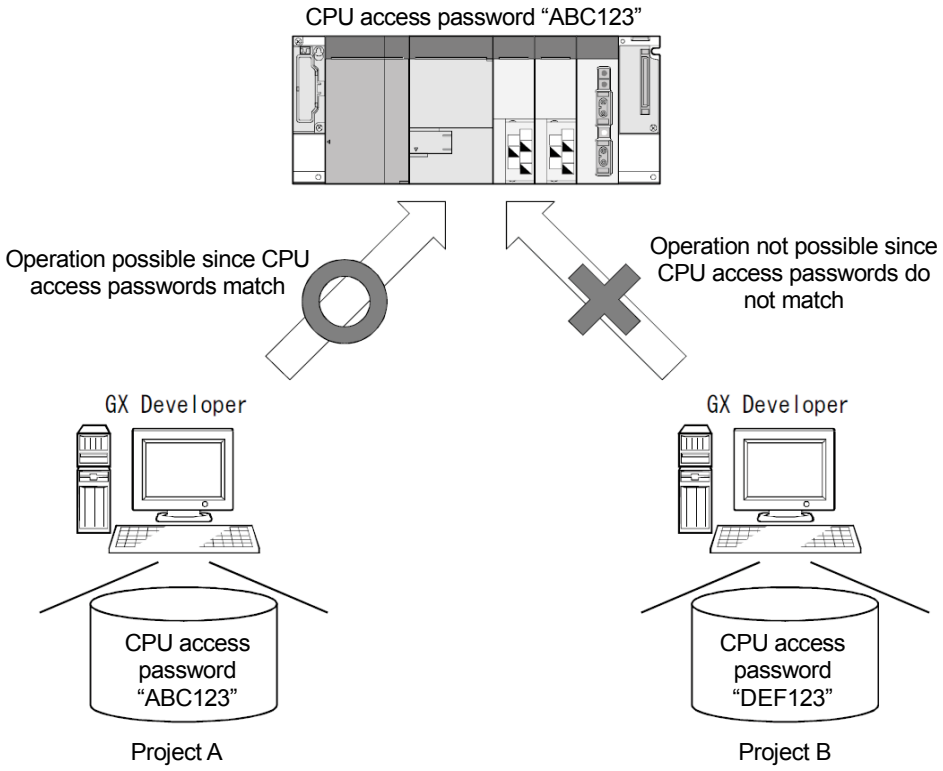
To prevent wrong operation from an incorrectly connected GX Developer, password-based access authentication is performed on the safety programmable controller.

The password for performing this access authentication is called the "CPU access password".

The CPU access password should be set to both the GX Developer project and the safety CPU module.

The safety programmable controller verifies the CPU access password of the GX Developer project and the safety programmable controller when there is an attempt (such as program change, etc.) to make modifications from GX Developer.

Operations from GX Developer are allowed only when verification result is correct.



POINT
Set different CPU access passwords to each safety programmable controller.

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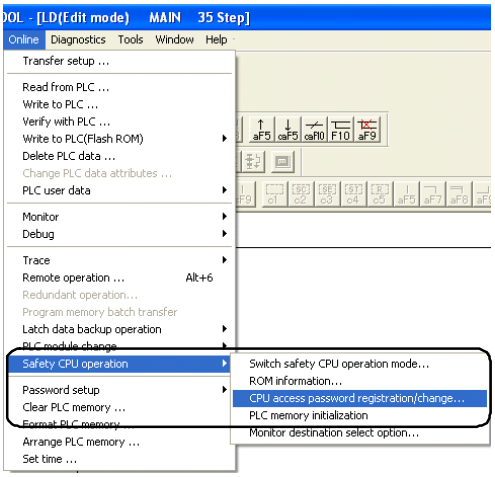
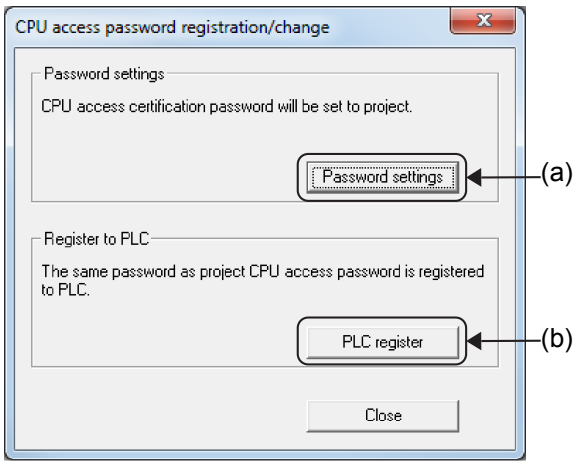
(1) Operating procedure



1) Select [Online] - [Safety CPU operation] - [CPU access password registration/change].



2) The "CPU access password registration/change" dialog box is displayed.

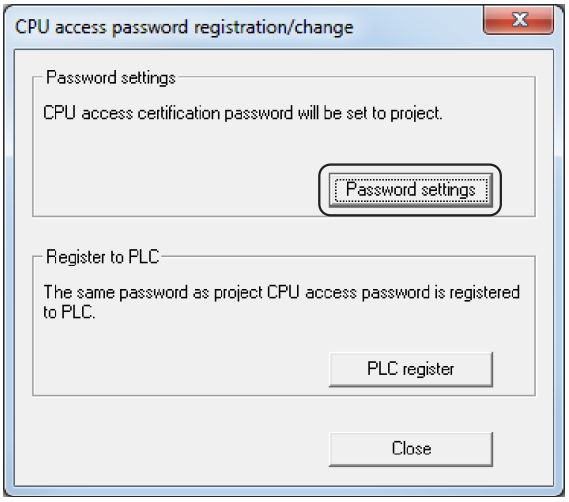
[Item description]

(a) Password settings button
Displays the Password Setting screen.

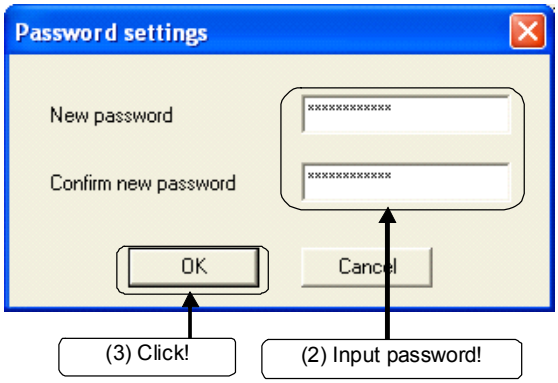
(b) PLC register button
Registers the CPU access password set in the project to the safety CPU.

POINT
Manage CPU access passwords very carefully.

(2) Password setting
Set the CPU access password to the project.



1) Click the Password settings button on the CPU access password registration/change dialog box.



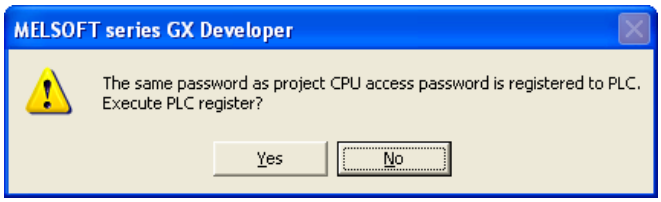
2) The password settings dialog box is displayed.
In the "New password" field, input a password from 6 to 14 characters long using alphabet characters, numbers, and symbols corresponding to ASCII codes 20H to 7EH (refer to Appendix 20).
(Entry is case-sensitive.)
Input the same password in the "Confirm new password" field for confirmation.

* Here, input "melsecsafety".

3) Click OK.

POINT

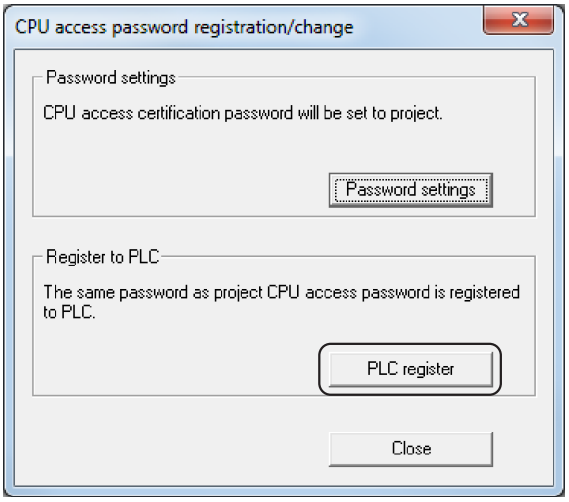
When setup of the CPU access password to the project is complete, a message confirming the registration of the CPU access password to the safety CPU is displayed. ((3) in this section)



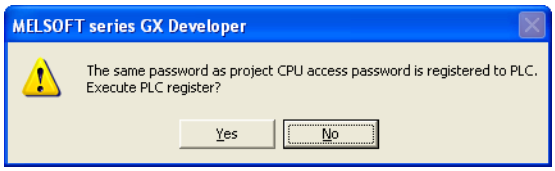
Register the CPU access password to the safety CPU by following the on-screen message.

(3) PLC registration

Register the CPU access password currently set in the project to the safety CPU.



1) Click the PLC register button on the CPU access password registration/change dialog box.



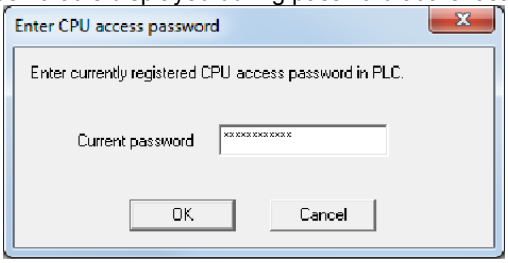
2) The message box on the left is displayed. Click Yes.

The CPU access password set in the project is registered to the safety CPU.

POINT

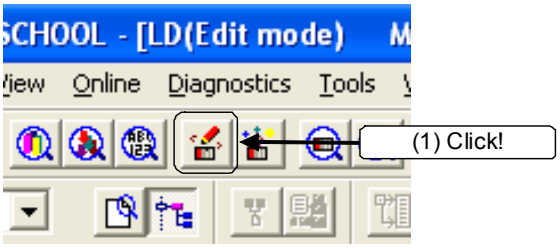
When the CPU access password is registered to the safety CPU, the screen below is displayed during PLC registration.
Input the CPU access password "melsecsafety" currently registered to the safety CPU.

(Screen that is displayed during password authentication)

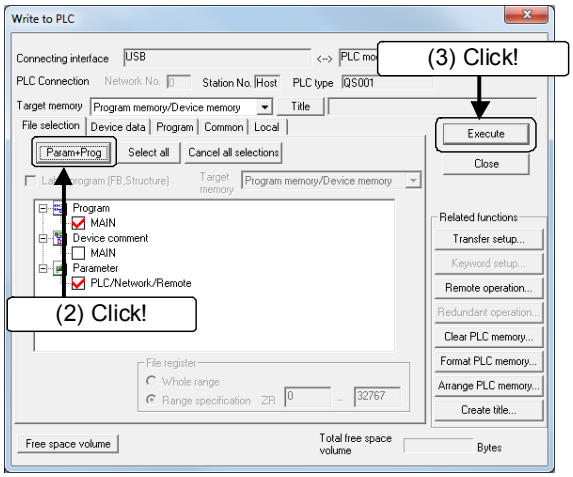


3.2.6 Writing the Safety Sequence Program

Write the safety sequence program to the CPU module.

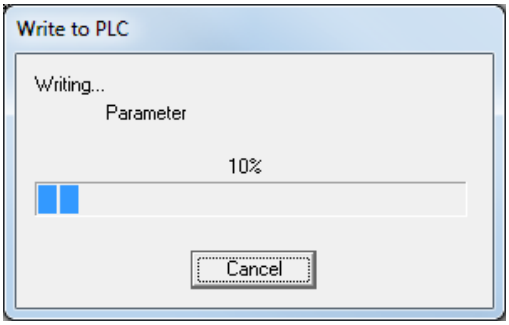


(1) Click on the toolbar or the [Online] → [PLC write] menu.

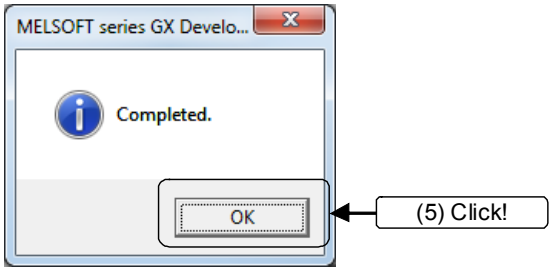


(2) Click Parameter + Program from the data that was read by the "File selection" tab.

(3) Click Execute after selecting the parameters and program.



(4) A dialog box showing the program writing progress.



(5) When writing is completed, the "Completed." message is displayed. Click OK.

Memo

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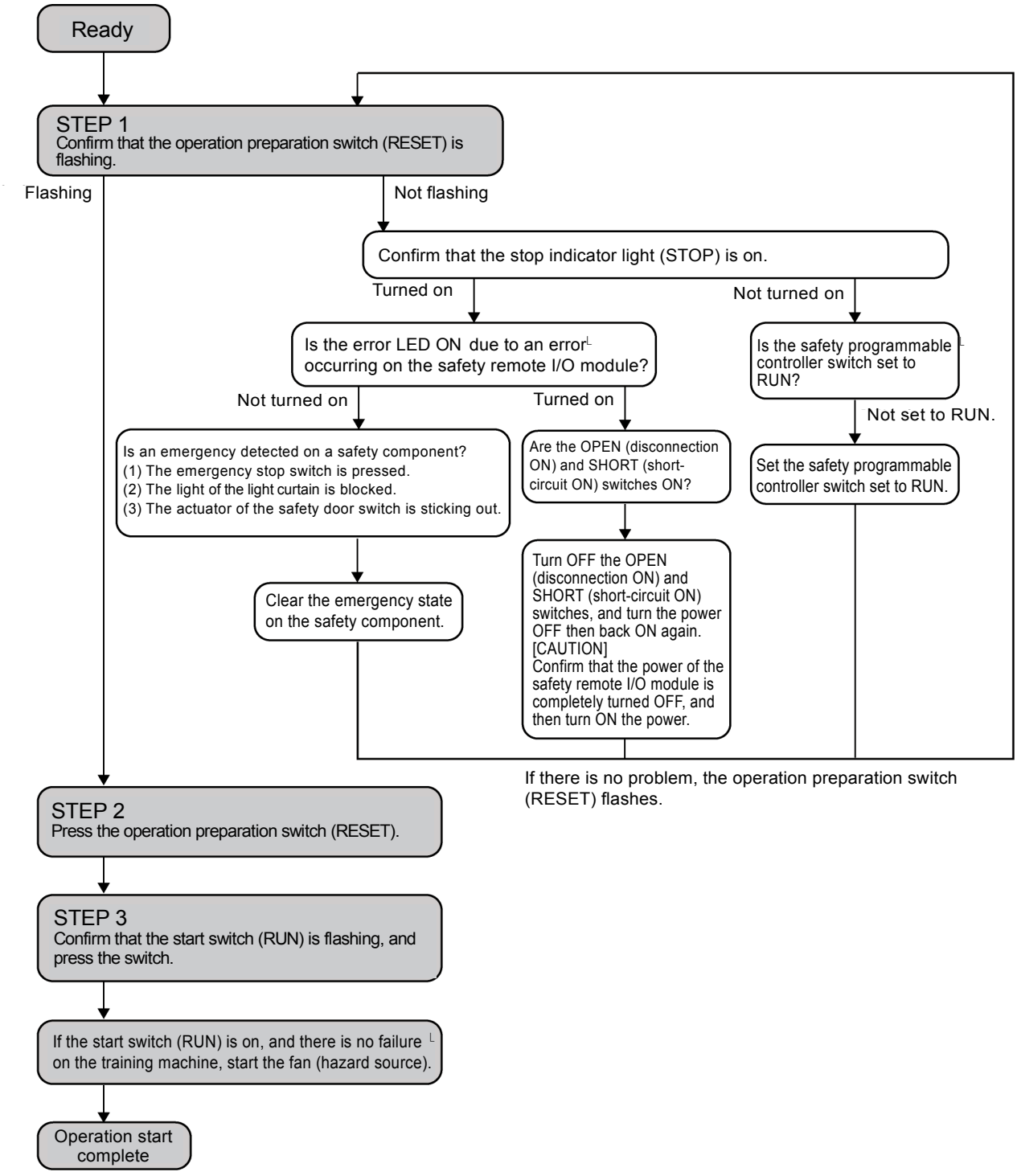
Chapter 4 Operation

4.1 Operating the Training Machine in a Safety System

4.1.1 Starting Operation

Confirm that the indicator lamp (yellow) of the operation preparation switch (RESET) of the training machine (equipment side) is flashing, and perform the following operation.



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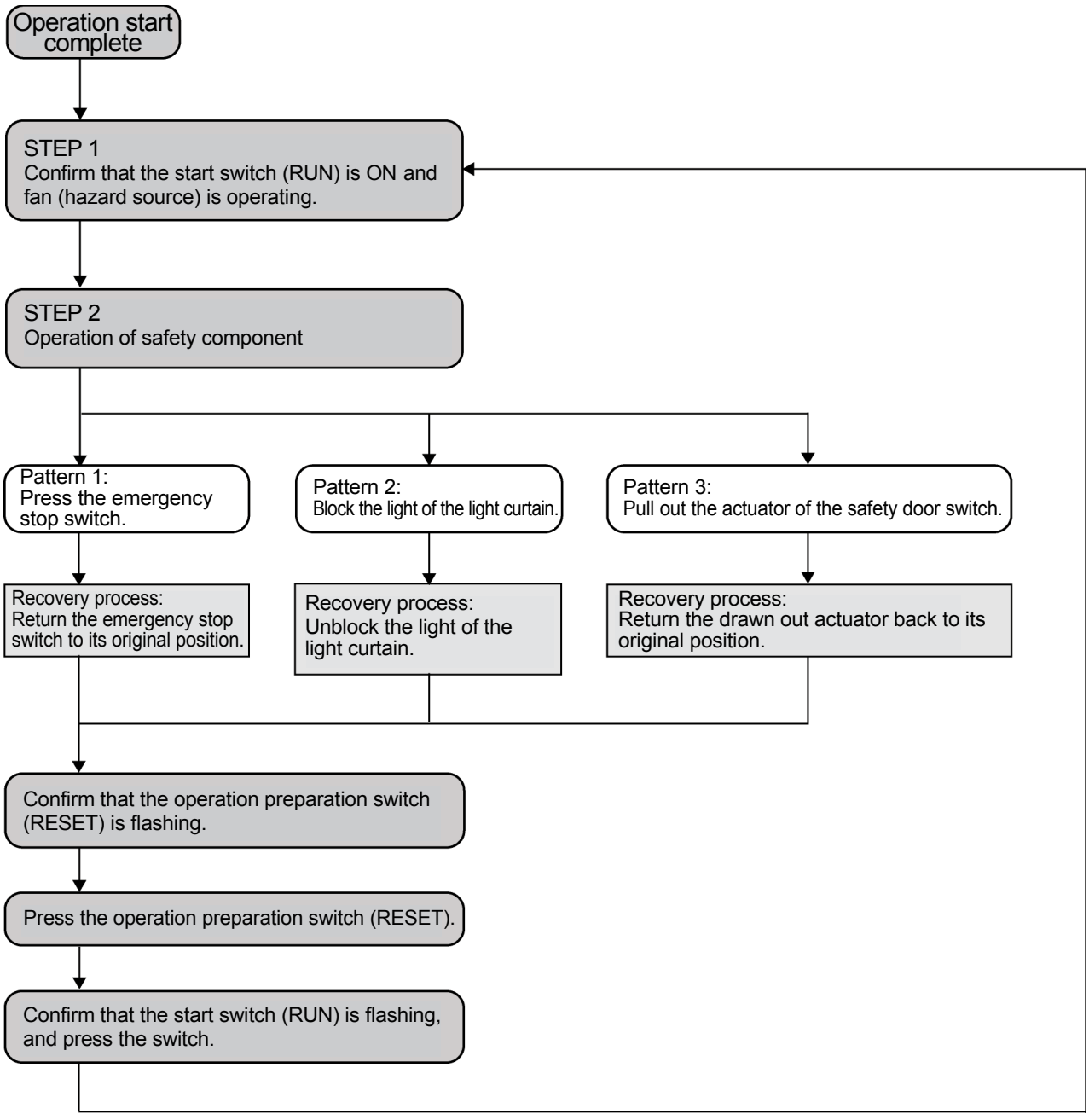
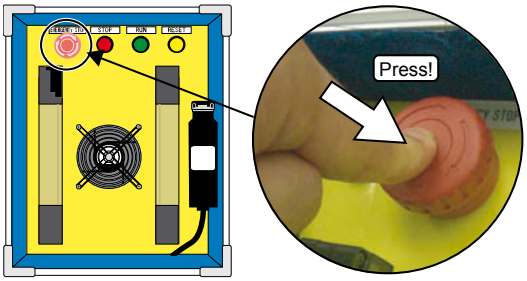
4.1.2 Executing Training Machine Operations

After confirming that the training machine is operating normally in Section 4.1.1, operate the safety components.

The following shows the three operation procedures for the safety components:

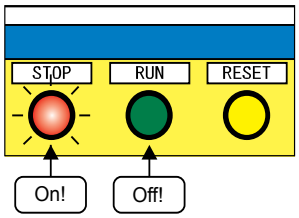


(1) Pattern 1: Press the emergency stop switch



1) Press the emergency stop switch on the training machine (equipment side).

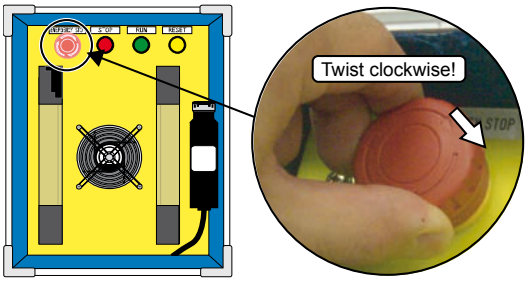
Application: Discover dangerous situation and stop the training machine.



2) The fan stops.

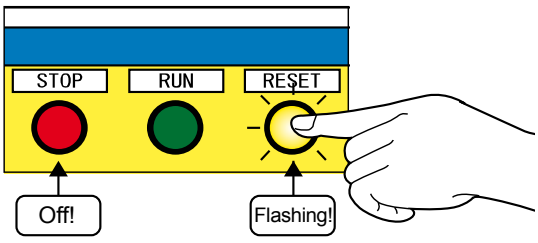
The indicator light of the start switch (RUN) turns off, and the stop indicator light (STOP) turns on.

The safety remote I/O module X0, X1 and Y0 LEDs of the training machine (safety programmable controller) turn off.

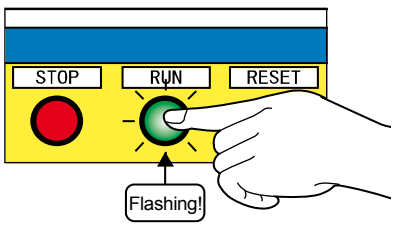


3) Return the emergency stop switch to its original position.

(How to return) Turn the emergency stop switch clockwise.



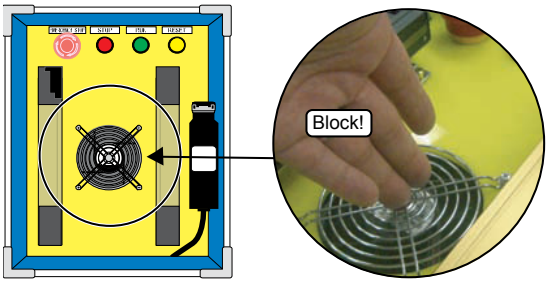
4) After confirming that the stop indicator light (STOP) turns off and the operation preparation switch (RESET) is flashing, press the operation preparation switch (RESET).



5) Confirm that the start switch (RUN) is flashing, and press the start switch (RUN).

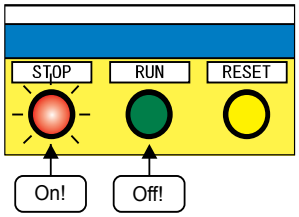
Recovery is completed, and the fan starts to operate.

(2) Pattern 2: Block the light of the light curtain



1) Bring your hand near the fan of the training machine (equipment side) to block the light of the light curtain.

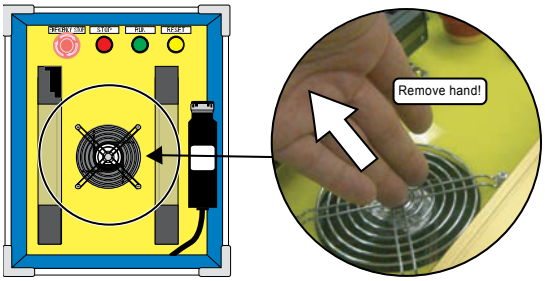
Application: Detect entry of people via the fence opening.



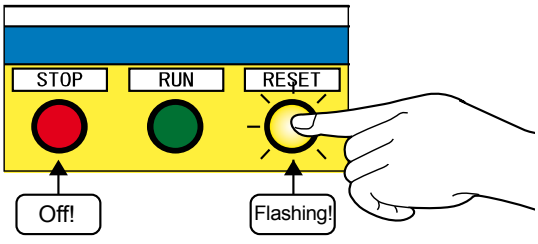
2) The fan stops.

The indicator light of the start switch (RUN) turns off, and the stop indicator light (STOP) turns on.

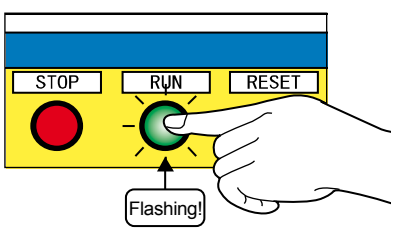
The safety remote I/O module X2, X3 and Y0 LEDs of the training machine (safety programmable controller) turn off.



3) Take your hand away to unblock the light of the light curtain.



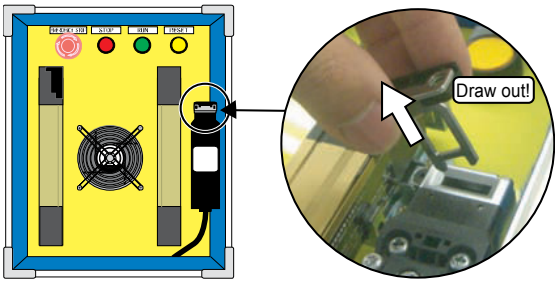
4) After confirming that the stop indicator light (STOP) turns off and the operation preparation switch (RESET) is flashing, press the operation preparation switch (RESET).



5) Confirm that the start switch (RUN) is flashing, and press the start switch (RUN).

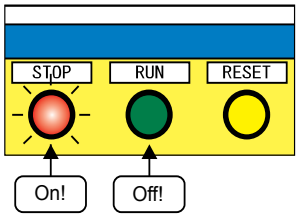
Recovery is completed, and the fan starts to operate.

(3) Pattern 3: Remove the actuator of the safety door switch



1) Remove the actuator of the safety door switch of the training machine (equipment side).

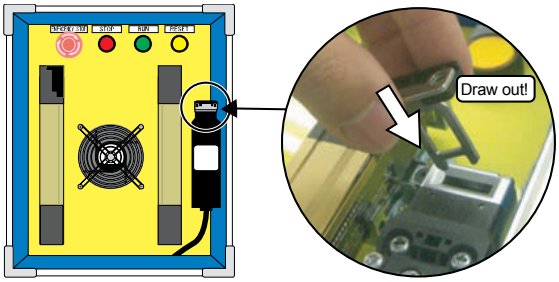
Application: Detect opening of the door installed on the safety fence.



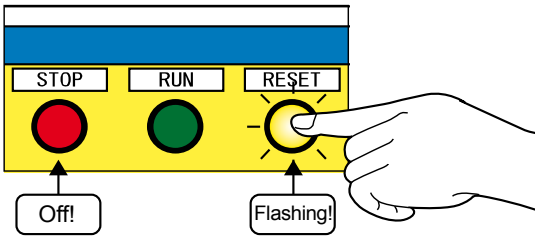
2) The fan stops.

The indicator light of the start switch (RUN) turns off, and the stop indicator light (STOP) turns on.

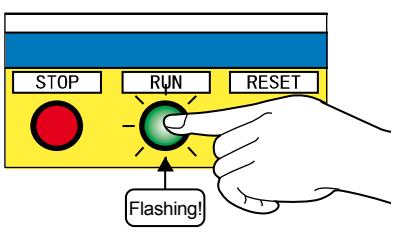
The safety remote I/O module X6, X7 and Y0 LEDs of the training machine (safety programmable controller) turn off.



3) Return the removed actuator back to its original position.



4) After confirming that the stop indicator light (STOP) turns off and the operation preparation switch (RESET) is flashing, press the operation preparation switch (RESET).



5) Confirm that the start switch (RUN) is flashing, and press the start switch (RUN).

Recovery is completed, and the fan starts to operate.

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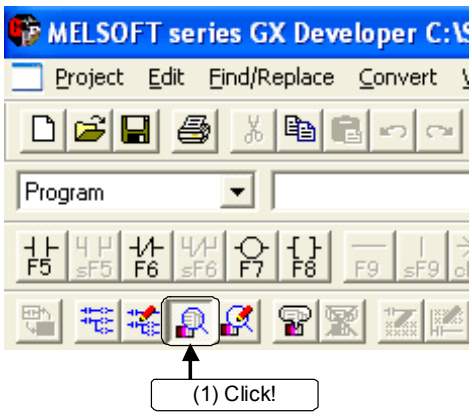
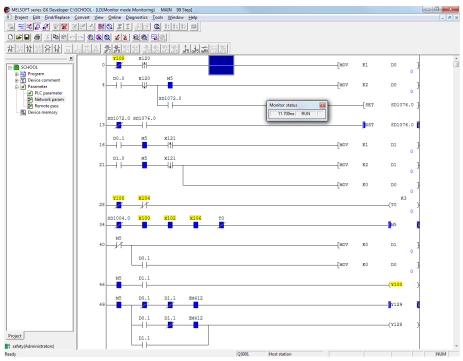
4.1.3 Ladder Monitor

Confirm the occurrence of an emergency state caused by operation of a safety component described in Section 4.1.2 using GX Developer's ladder monitor function.



1) Click  on the toolbar or the [Online] - [Monitor] - [Monitoring mode] menu.



2) Switch to the monitoring mode.

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POINT

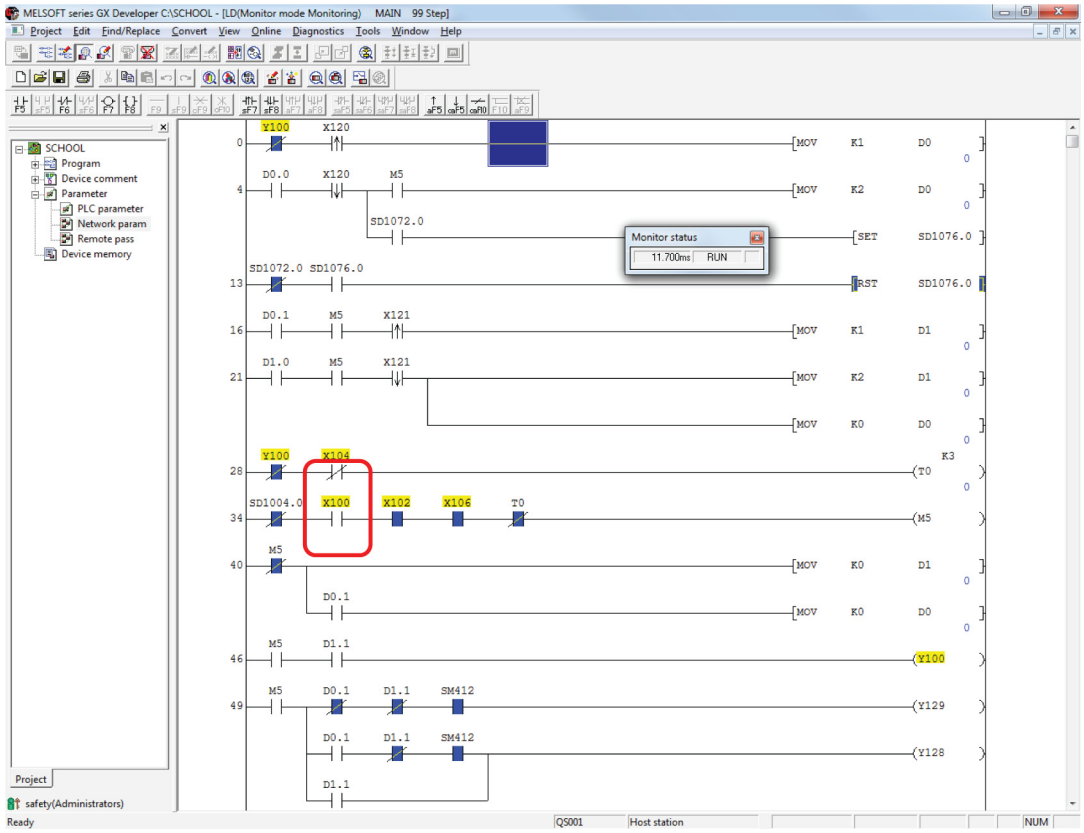
Highlight display of safety device
The safety device is displayed in yellow on the sequence program in the GX Developer screen.
Also, safety device names in the sequence program printed from GX Developer are highlighted with a square frame.

For details, refer to the GX Developer Version 8 Operating Manual (Safety Programmable Controller).

From the previous page

3) The ladder monitor display during operation of each safety component is shown below:

(1) Pattern 1: Press the emergency stop switch



- Device X100 of the emergency stop switch turns OFF.

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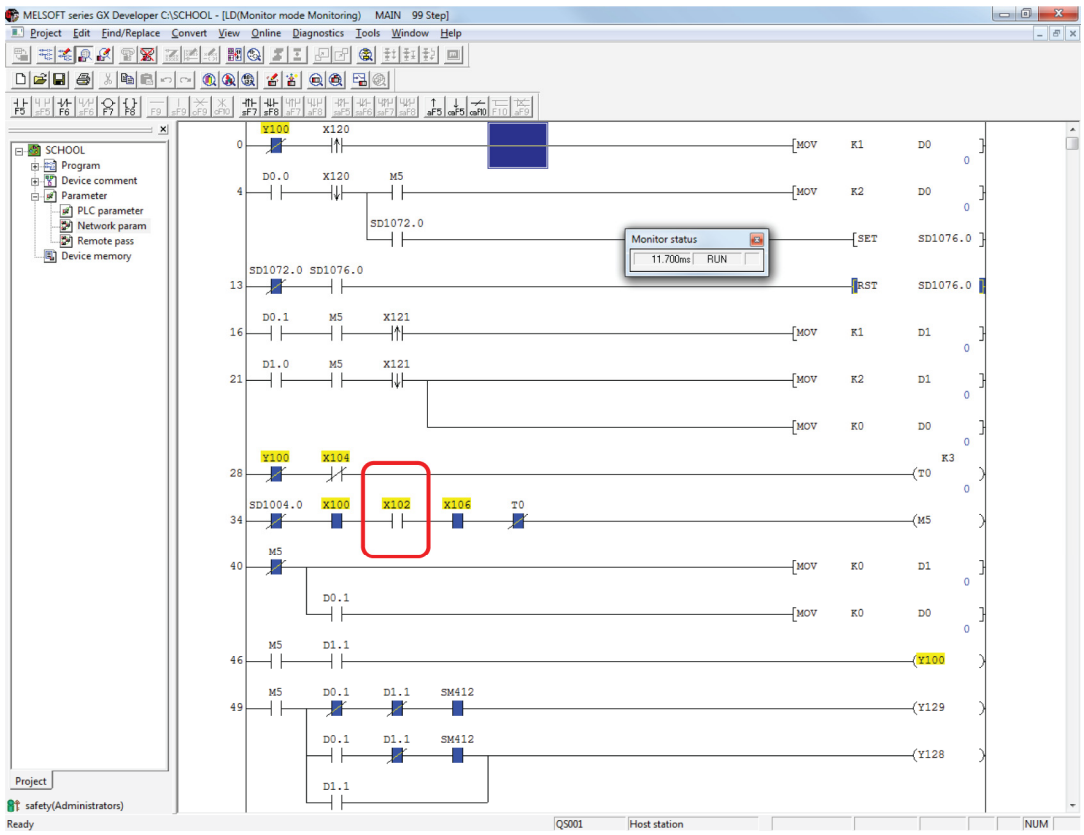
(2) Pattern 2: Block the light of the light curtain



- Device X102 of the light curtain turns OFF.

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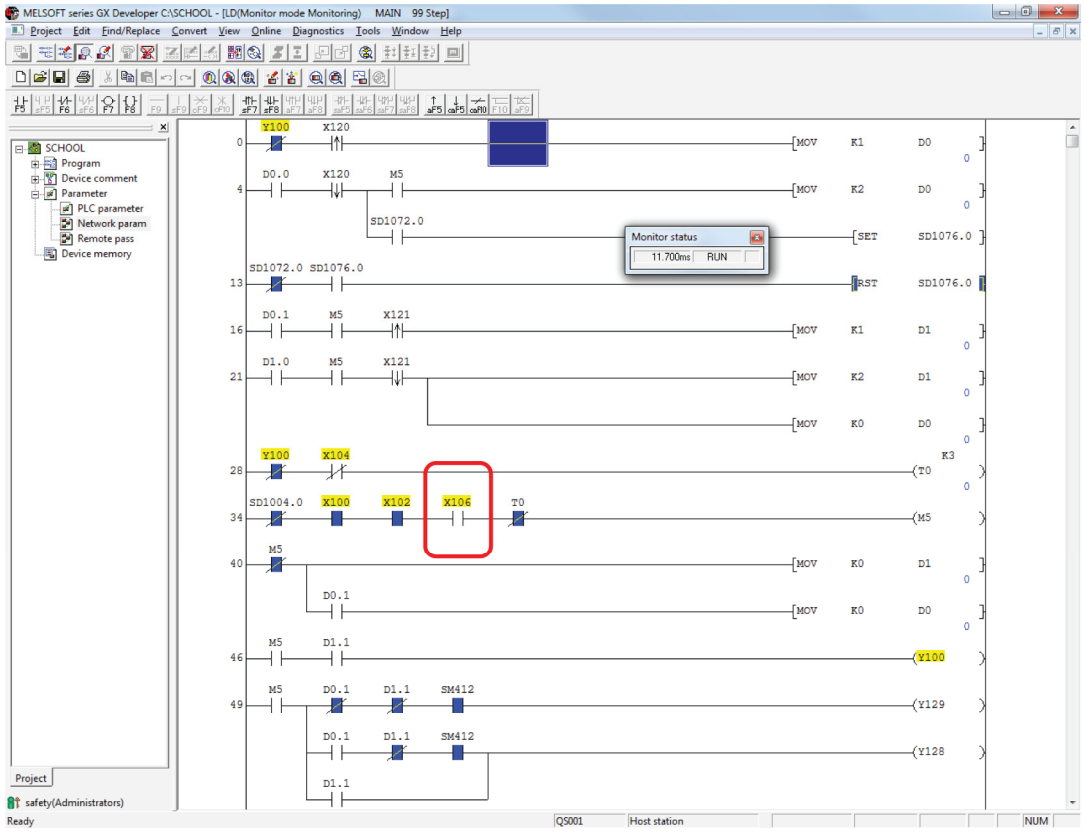
(3) Pattern 3: Remove the actuator of the safety door switch



- Device X106 of the door switch turns OFF.

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Memo

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Chapter 5 Diagnostics

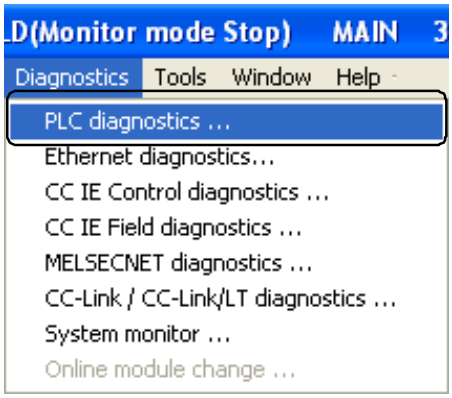
5.1 Confirming the Diagnostics Results in GX Developer During Error Detection

5.1.1 Diagnostic Functions of Safety Programmable Controller

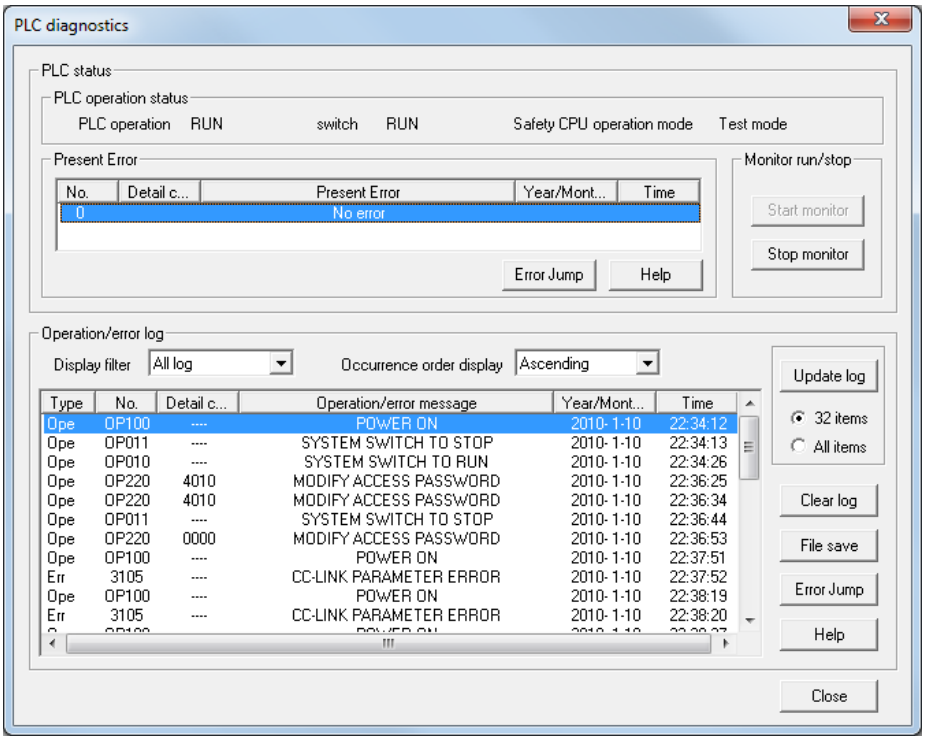
The operating status of the safety CPU, current error, operation and error histories (including the error history of the CC-Link Safety system) can be confirmed using GX Developer's PLC diagnostic functions.
For details, refer to the GX Developer Operating Manual.

(1) Operating procedure

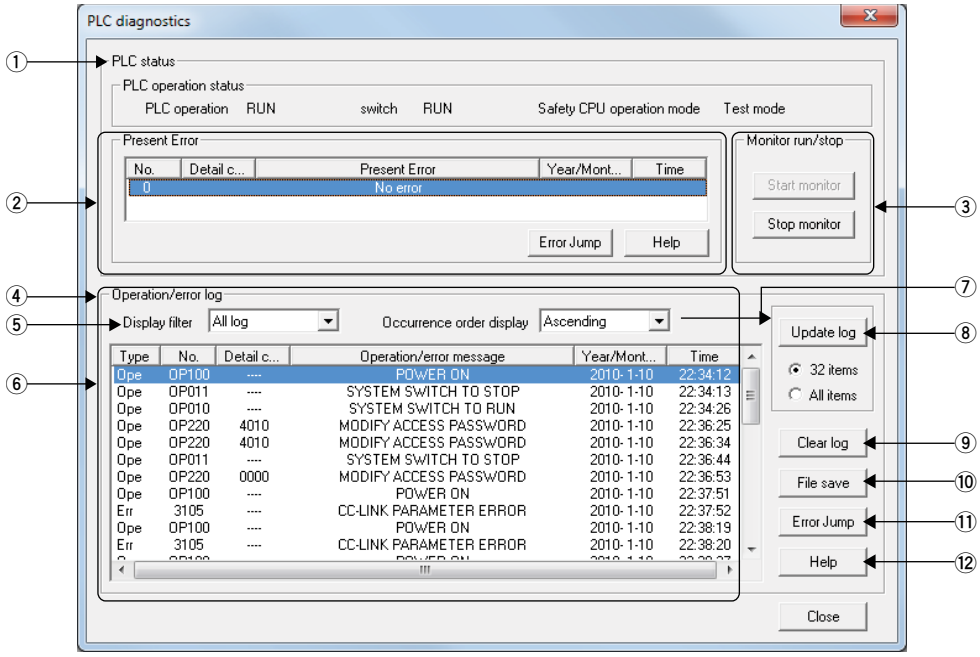
1) Select [Diagnostics] - [PLC diagnostics].



2) The "PLC diagnostics" dialog box is displayed.



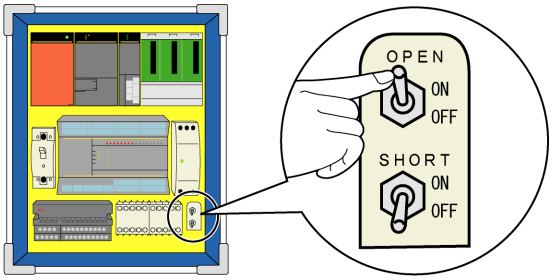
(2) Items in the PLC diagnostics dialog box



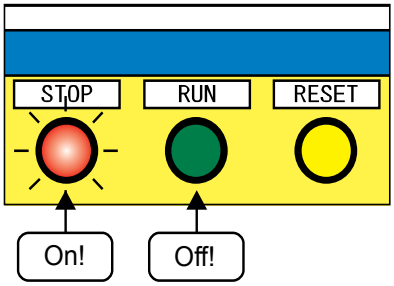
No.	Item	Description
(1)	CPU module operating status	Displays the safety CPU module operating status and the safety CPU operating mode.
(2)	Current error	Displays currently occurring errors. Double-click a currently occurring error to display the Error Details screen. Clicking the [Error JUMP] button jumps to the step number of the displayed error in the sequence program. Click the [Help] button to display the Help screen of the displayed error.
(3)	Monitor start/stop	Clicking the [Start Monitoring] button starts communication with the safety CPU and updates the display contents of the screen. To stop the monitor, click the [Stop Monitoring] button.
(4)	Operation/error history	Displays the operation history for the safety CPU and a history of errors occurring on the safety CPU. (For details, refer to Section 5.2)
(5)	Display filter	Specifies the type of the history to display in the history list.
(6)	History list	Displays the history selected by Display filter.
(7)	Occurrence order display	Switches the display order of the history list in ascending or descending order.
(8)	History update button	Updates the history list display by the selected radio button.
(9)	History clear button	Deletes all histories registered to the safety CPU. Histories can be deleted in the following cases: • When users with access level Administrators or Developers are logged in • When the safety CPU operating mode is TEST MODE
(10)	File save button	Saves the histories displayed in the history list in CSV file format.
(11)	[Error JUMP] button	Jumps to the step number of the currently selected error history in the sequence program.
(12)	[Help] button	The Help screen of the error selected in the current error display field is displayed.

5.1.2 Error Occurrence: In Case of Disconnection

Here, artificially generate a fault (disconnection) on the training machine, and check the monitor.
Before actual training, confirm that the fan of the training machine (equipment side) is operating normally.

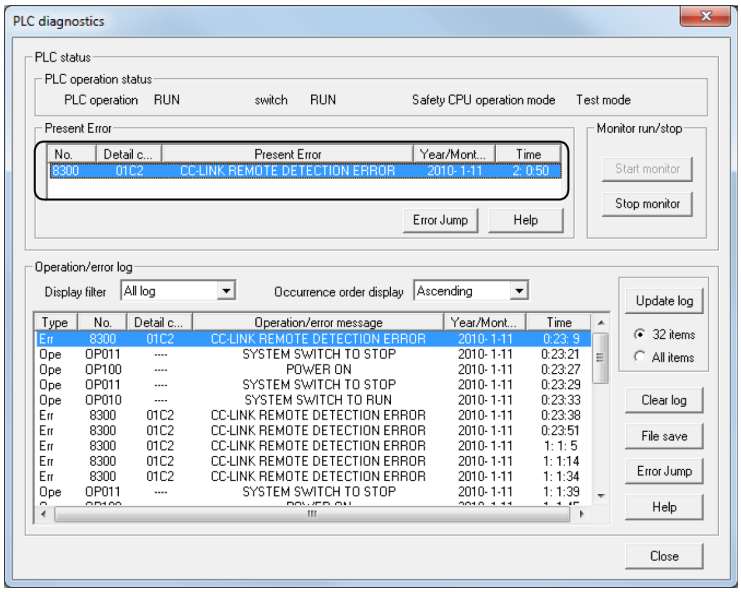


(1) Turn ON the "OPEN (disconnection ON)" toggle switch on the training machine (safety programmable controller side).



(2) The indicator light of the start switch (RUN) turns off, and the stop indicator light (STOP) turns on.

(3) The "Current error" of the "PLC diagnostics" dialog box is displayed as shown below.



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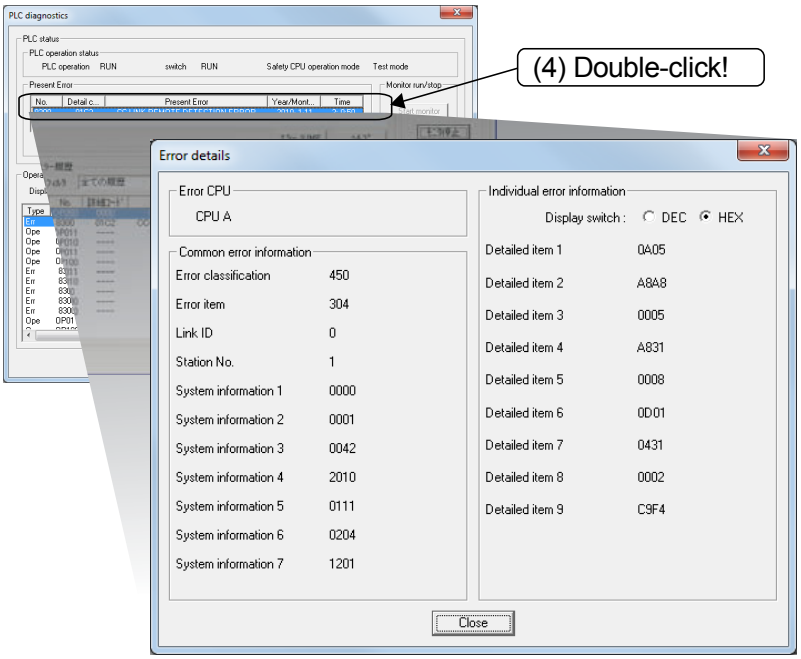
From the previous page

(4) Double-click the error display area to display the error details dialog box.



[Common error information displayed in the error details dialog box]

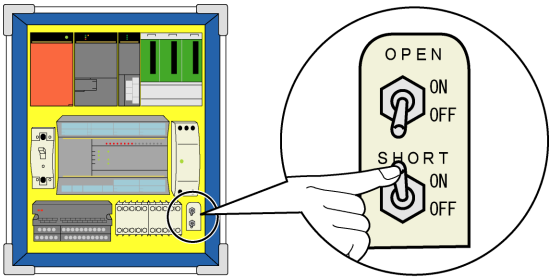
Item	Value/description
Error classification	450
Error item	0102 (Dual input mismatch detected fault)
Error description	A mismatch was detected after the dual mismatch permissible time was exceeded on an input pair (X0 and X1, X2 and X3...).

(Normally ON condition) An error occurs since input turns OFF due to disconnection of one of the wires and input does not match the connected wire.

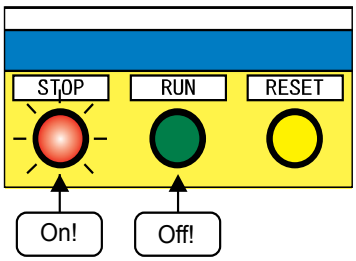
→ For details on error codes, refer to Appendix 16.
→ For details on recovery methods, refer to Section 5.3.

5.1.3 Error Occurrence: In case of Short-circuit

Here, artificially generate a fault (short-circuit) on the training machine, and check the monitor.
Before actual training, confirm that the fan of the training machine (equipment side) is operating normally.

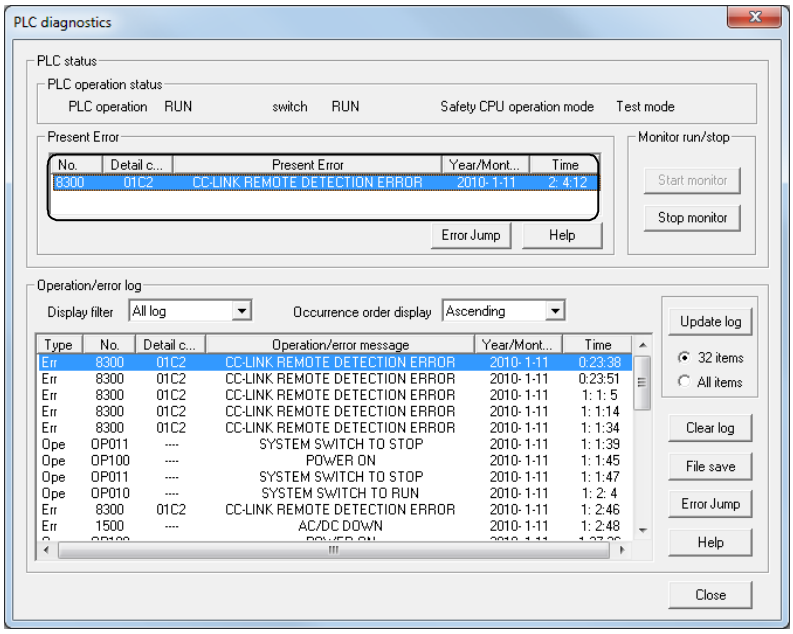


(1) Turn ON the "SHORT (short-circuit ON)" toggle switch of the training machine (safety programmable controller side).



(2) The indicator light of the start switch (RUN) turns off, and the stop indicator light (STOP) turns on.

(3) The "Current error" of the "PLC diagnostics" dialog box is displayed as shown below.



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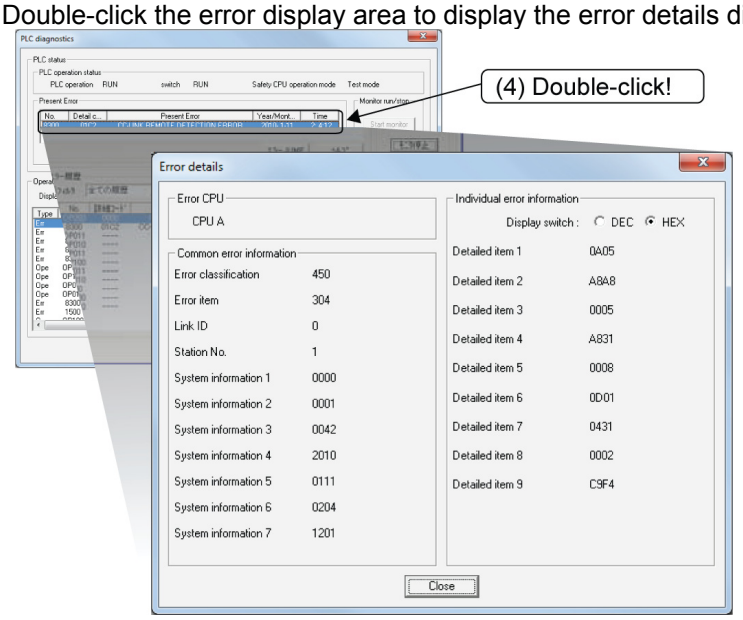
(4) Double-click the error display area to display the error details dialog box.



[Common error information displayed in the error details dialog box]

Item	Value/description
Error classification	450
Error item	0304 (Input dark test fault)
Error description	The test pulse could not be detected during execution of the input dark test.

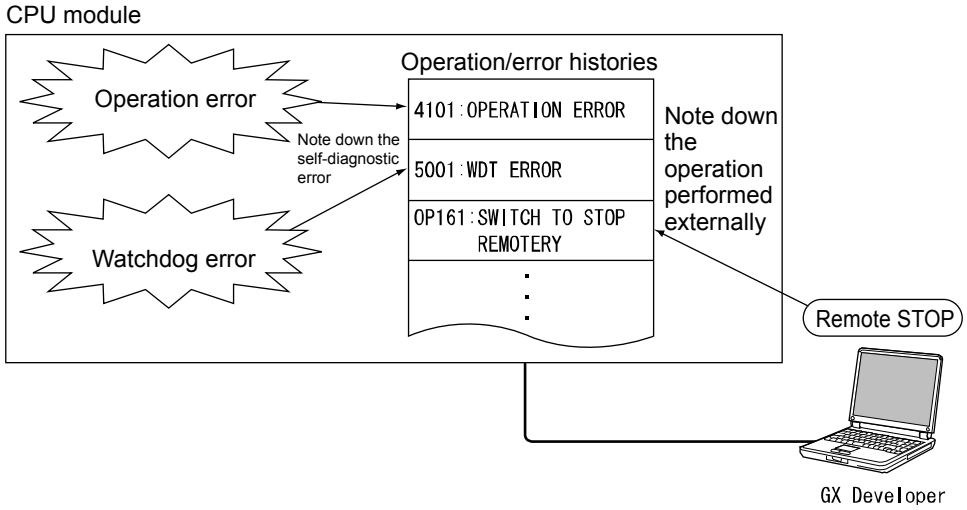
Error occurred since the test pulse could not be detected due to a short-circuit.

→ For details on error codes, refer to Appendix 16.
→ For details on recovery methods, refer to Section 5.3.

5.2 Operation and Error History Functions

Operation and error history functions are intended to make troubleshooting easier as a result of recording operations performed externally on the CPU module or self-diagnostic errors that occurred in the past in the CPU module.

(1) Data stored in operation and error history areas
The CPU module stores operations executed externally on the CPU module and self-diagnostic errors in the operation and error history areas.



(a) Operations executed externally on the CPU module
Operations stored as operations executed externally on the CPU module are as shown below:
- Online operations from GX Developer
- Operations executed using the RUN/STOP/RESET switch of the CPU module
- Input power supply ON/OFF

Operations stored in the operation and error histories are shown below:

Classification	Operation code	Operation message	Explanation
System	OP001	SYSTEM INITIALIZE OPERATION MODE	The CPU module initialized the safety CPU operating mode to the TEST MODE since the safety CPU operating mode could not be retained correctly.
	OP002	SYSTEM INITIALIZE PROGRAM MEMORY	The CPU module formatted program memory since the content of the program memory could not be retained correctly.
	OP003	SYSTEM INITIALIZE OPE./ERROR LOG	The operation and error histories were initialized since the operation and error history contents could not be retained correctly.
	OP004	SYSTEM INITIALIZE SYSTEM CLOCK	The CPU module initialized the system clock data since the system clock data was not correct.
	OP005	SYSTEM INITIALIZE PLC MEMORY	The CPU module executed the PLC memory initialization function.

(Continued on the next page)

(From the previous page)

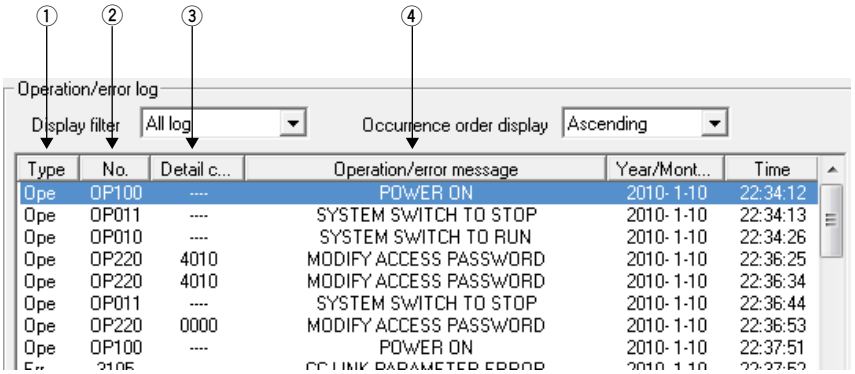
Classification	Operation code	Operation message	Explanation
System	OP006	SYSTEM INITIALIZE ROM WRITE INF.	The CPU module initialized the ROM information as the ROM information could not be retained correctly.
System (CPU module operating status)	OP010	SYSTEM SWITCH TO RUN	The CPU module operating status was switched to the RUN state.
	OP011	SYSTEM SWITCH TO STOP	The CPU module operating status was switched to the STOP state.
Power supply operation	OP100	POWER ON	The power supply of the programmable controller was turned ON. Or, the reset of the CPU module was cleared.
Drive operation	OP144	WRITE PROGRAM MEMORY TO ROM	Program memory was written to standard ROM.
Remote operation	OP160	SWITCH TO RUN REMOTELY	Remote RUN operation was performed.
	OP161	SWITCH TO STOP REMOTELY	The remote STOP operation was performed.
Safety CPU action mode operation	OP180	SWITCH SAFETY PC OPERATION MODE	The safety CPU operating mode was switched.
History operation	OP200	CLEAR OPERATION/ERROR LOG	The operation and error histories of the CPU module were cleared.
Clock operation	OP210	ADJUST SYSTEM CLOCK	The clock of the CPU module was set.
CPU access password operation	OP220	MODIFY ACCESS PASSWORD	The CPU access password of the CPU module was set.

(b) Self-diagnostic error
The contents of the self-diagnostic errors detected by the CPU module are stored.
For details on self-diagnostic errors, refer to the QCPU User's Manual (Hardware Design, Maintenance and Inspection).

(3) Operation and error history capacity
3000 records of operation and error items can be stored in the operation and error histories of the CPU module.
If the total of the operation and error items exceeds 3000 records, the histories are over-written in order from the oldest records.

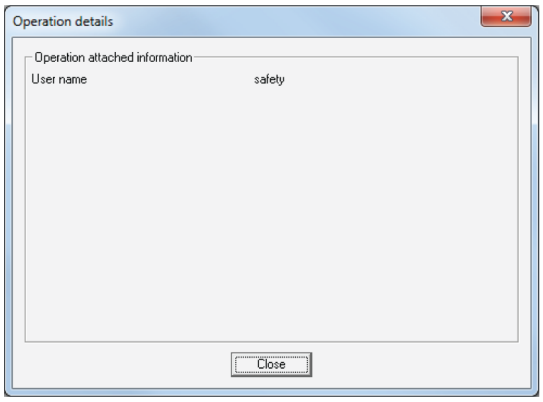
(4) Displaying operation and error histories using GX Developer
The operation and error history contents can be displayed on the PLC diagnostics screen of GX Developer.

(a) PLC diagnostics screen display
The operation and error histories on the PLC diagnostics screen of GX Developer are as shown below:

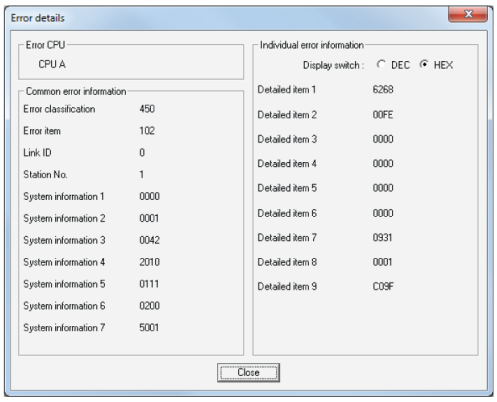


No.	Item	Description
(1)	Type	The history type is displayed. Ope: Operation history Err: Error history
(2)	No.	The operation/error code is displayed.
(3)	Details code	A 4-digit code corresponding to the operation history and the error histories of the CC-Link Safety remote I/O module is displayed. If there is no details code, "----" is displayed.
(4)	Operation/error message	The operation content/error message recorded in the operation and error histories is displayed. When a history is damaged, "BROKEN OPERATION/ERROR LOG" is displayed.

(b) Details screen of operation and error histories
The following details screen can be displayed by double-clicking a currently occurring error on the PLC diagnostics screen or a history in the history list.



Operation history



Error history

(5) Clearing operation and error histories

Operation and error histories on the CPU module can be cleared by clicking the "History clear" button on the PLC diagnostics screen of GX Developer.

Clearing of the operation and error histories is enabled only when the safety CPU operating mode of the CPU module is TEST MODE. When the operation and error histories are cleared, operation item OP200: "CLEAR OPERATION/ERROR LOG" is stored in the operation and error histories on the CPU module.

POINT

The operation and error histories are held in memory by the battery of the CPU module.

The CPU module verifies whether the operation and error histories are lost or corrupted when the power is turned ON or when the CPU module is reset.

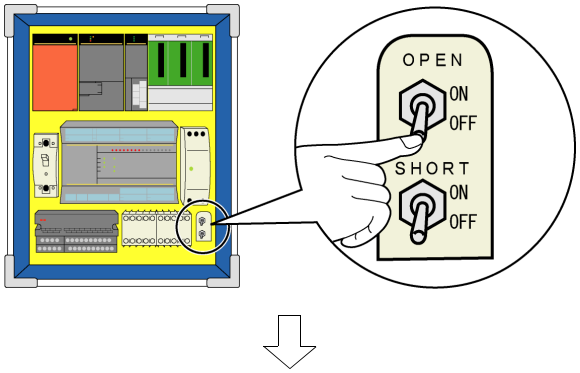
If the CPU module detects that the operation and error histories are lost or have become corrupt due to reduced battery capacity, it initializes the operation and error histories.

When the CPU module initializes the operation and error histories, operation item OP003: "SYSTEM INITIALIZE OPE./ERROR LOG" is stored in the operation and error histories.

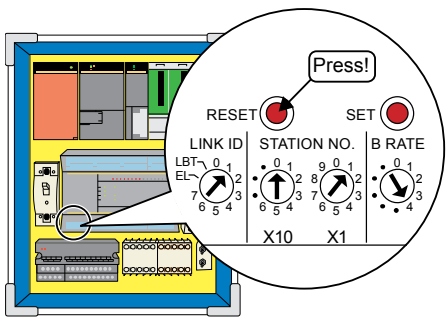
5.3 Fault Recovery Methods

There are two methods as follows for recovering from the faults mentioned in Sections 5.1.2 and 5.1.3.

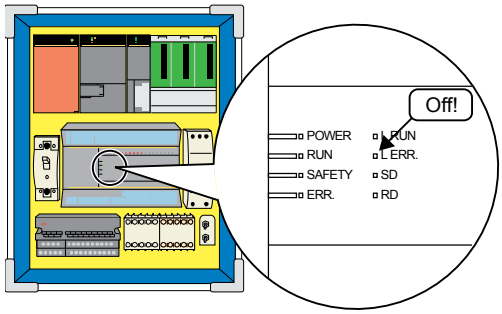
(1) Recovery using the system reset of the safety remote I/O module



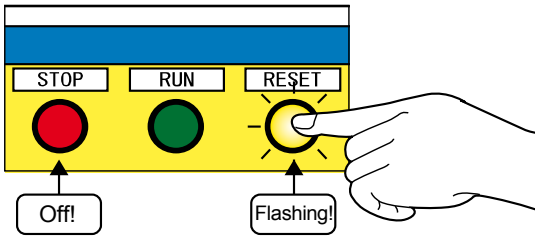
1) Turn OFF the OPEN (disconnection)/SHORT (short-circuit) switch.



2) Open the bottom cover of the safety remote I/O module, and press the RESET switch on the left side.



3) The reset is completed when the "ERR." LED of the panel LEDs of the safety remote I/O module turns off.

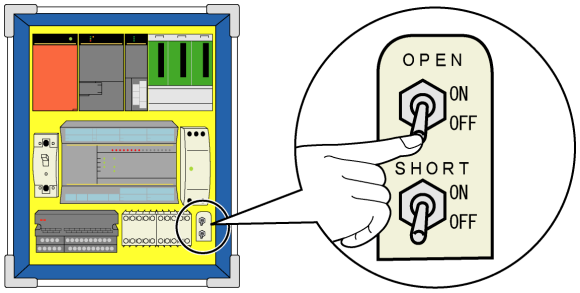


4) Press the operation preparation switch (RESET).

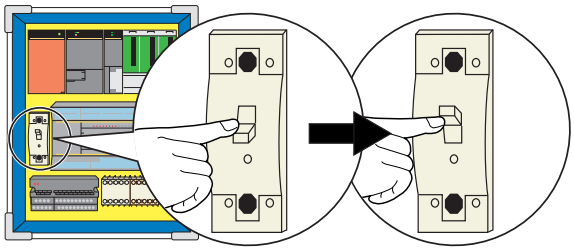
If the stop indicator light (STOP) turns off and the indicator light of the operation preparation switch (RESET) is flashing, the training machine has been recovered.

* This training machine is programmed to recover when the operation preparation switch (RESET) is pressed.

(2) Recovery by Power OFF → ON

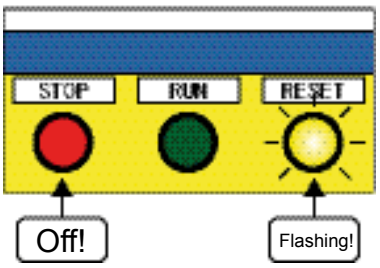


1) Turn OFF the OPEN (disconnection)/SHORT (short-circuit) switch.



2) Turn the main power supply OFF*1 then ON again.

*1: If the power OFF time is short, power may be turned on before the safety remote I/O completely stops.



3) If the indicator light of the operation preparation switch (RESET) is flashing, the training machine has been recovered.

POINT

- For details on clearing CC-Link Safety faults, refer to Section 2.7.2.
- By recovery method (1), the "ERR." LED of the safety programmable controller does not turn off.
  For details on how to clear errors, refer to Appendix 9.
  * This does not affect operation of the training machine.

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Chapter 6 Maintenance

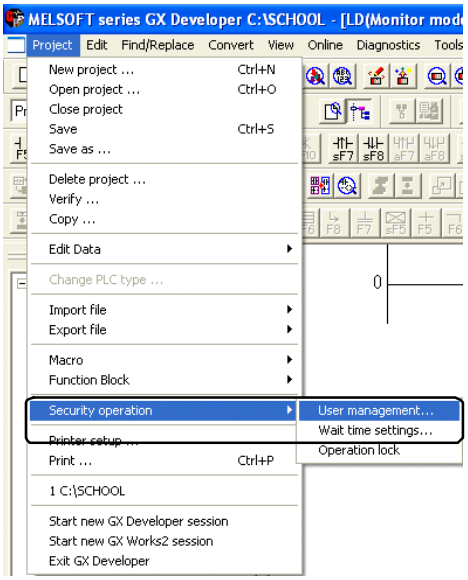
6.1 User Management

GX Developer projects for the safety programmable controller have three levels (Administrators, Developers and Users), and the access level can be set for each user.
The login screen is displayed when a project is opened. Operation restrictions vary according to the access level of the user.

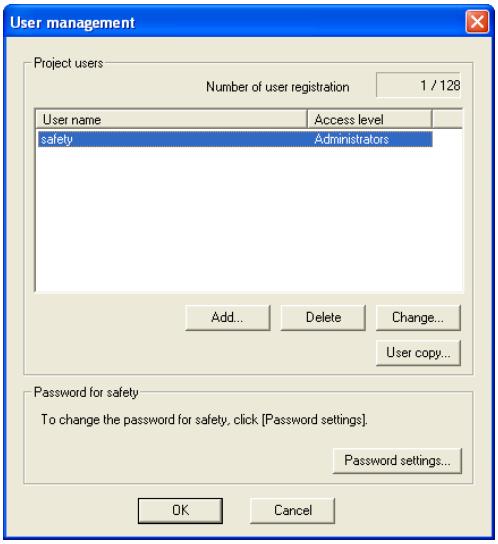
6.1.1 Registering, Deleting and Changing Login Users

Users who log to projects for the safety programmable controller can be registered, deleted or changed.

(1) Operating procedure

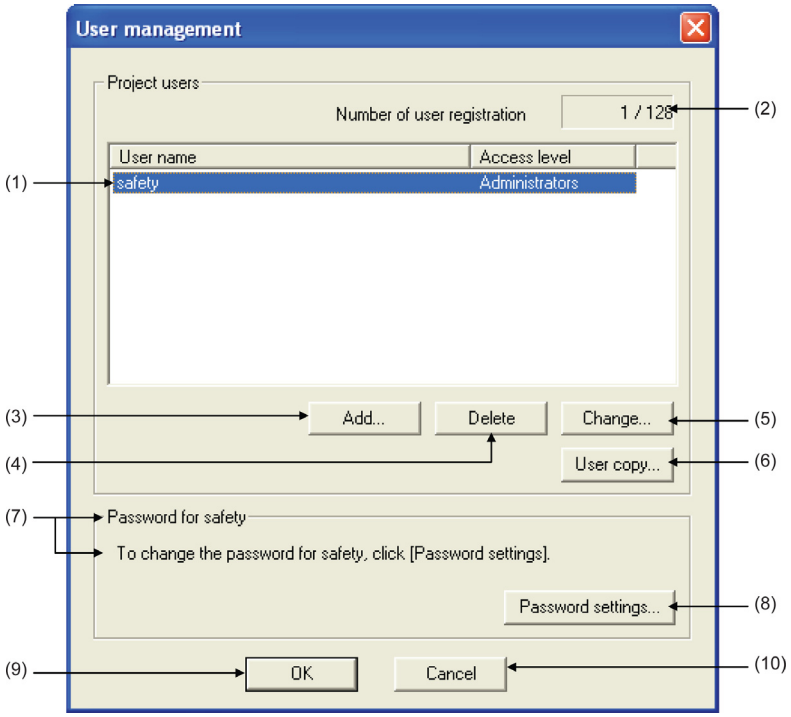


1) Select [Project] - [Security operation] - [User management].



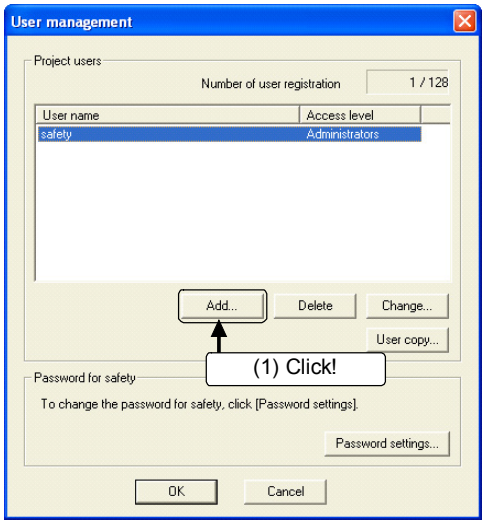
2) The "User management" dialog box is displayed.

(2) Items in the User management dialog box

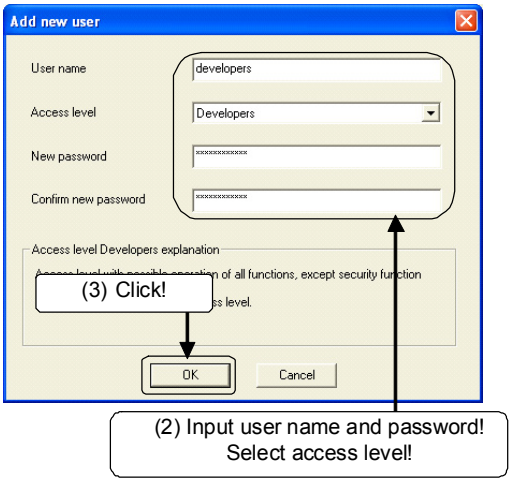


No.	Item	Description
(1)	User list display/selection field	• Display/Selection User names and access levels registered to the project are displayed in a list. Select target users when deleting registered users or changing user information. • Search If the first character of the user name is input as the key, users that match the first character can be searched. • Sorting The list display can be sorted referenced to the clicked title by clicking the title (user name or access level) with the mouse. Sorting is carried out alternately in ascending and descending order.
(2)	Number of user registration	The number of users (maximum 128) registered to the project is displayed.
(3)	Add button	The New user addition screen is displayed. * A maximum of 128 users can be registered to each project.
(4)	Delete button	Deletes the selected user.
(5)	Change button	The Registered user change screen is displayed.
(6)	User copy button	Copies user information registered to other projects to the currently opened project (added or overwritten).
(7)	Password for **********	1) The user name selected in the list in 1) is displayed.
(8)	Password settings button	The Password setting screen is displayed.
(9)	OK button	Registers the set user information and closes the screen.
(10)	Cancel button	Discards the set user information and closes the screen.

(3) Adding new users



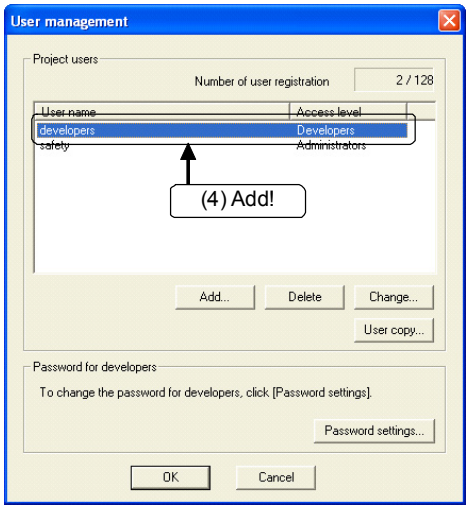
1) Click the Add button in the User management dialog box.



2) The Add new user dialog box is displayed. Input the user name and password, and select the access level.

*1 As an example, select "Developers" as the access level.
*2 Set the user name to "developers" and Password to "melsecsafety".

3) Click OK.



4) A new user is added in the User management dialog box.

POINT

New user registration dialog box

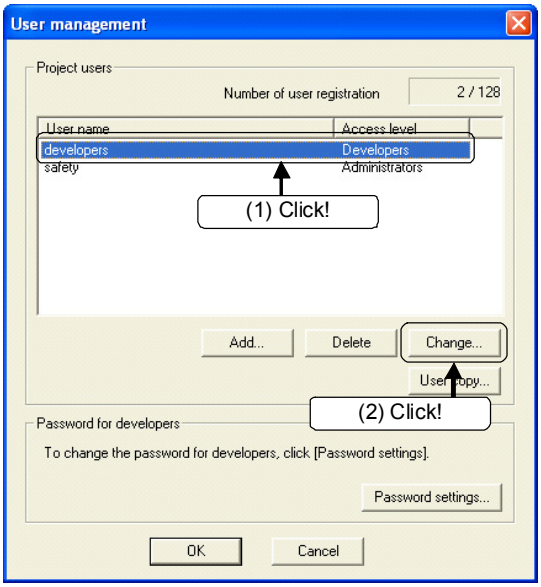
User name Input a user name up to 20 characters long using alphabet characters, numbers, and symbols corresponding to ASCII codes 20H to 7EH (refer to Appendix 20). (Entry is case-sensitive.)

Access level Select the access level from the list box.

New password Input a password from 6 to 14 characters long using alphabet characters, numbers, and symbols corresponding to ASCII codes 20H to 7EH (refer to Appendix 20). (Entry is case-sensitive.)

Confirm new password
Input the same password as above for confirmation.

(4) Changing registered user information
The user name and access level of the user added in (3) can be changed.



1) Click the user to be changed.

2) Click the Change button.

The Change screen is displayed.

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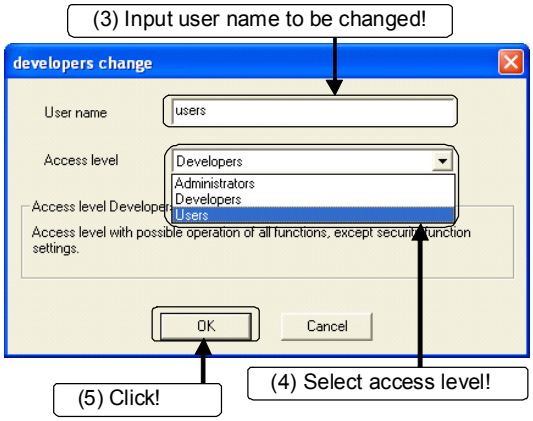


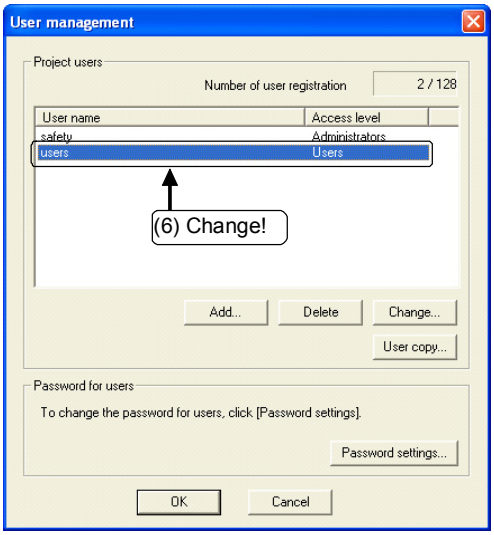
3) Input the user name to be changed.

* As an example, change the user name from "developers" to "users".

4) Select the access level to be changed.

* As an example, change the user access level from "Developers" to "Users".

5) Click OK.



6) The changed user is displayed in the User management dialog box.

POINT

- Changing user information
  The user information (user name, access level) of the currently logged-in user cannot be changed.

- Changing access level
  When the access level is changed to a level other than Users, the "Password settings" screen is displayed. Set the password.
  When a password is already set, the "Password settings" screen is not displayed.
  When the access level is changed to Users, setting of the password can be omitted.

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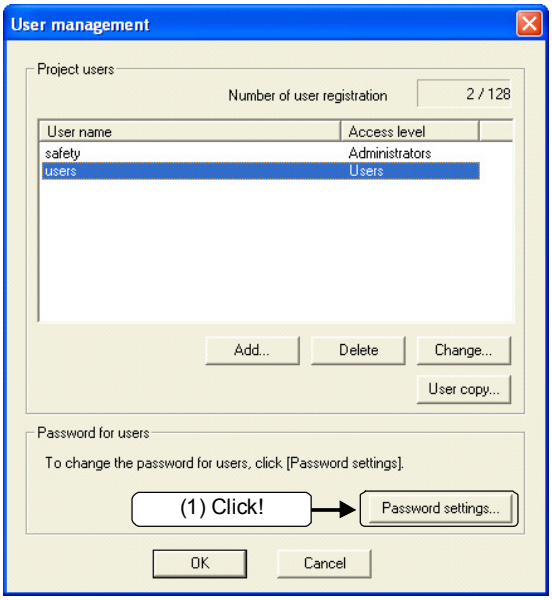
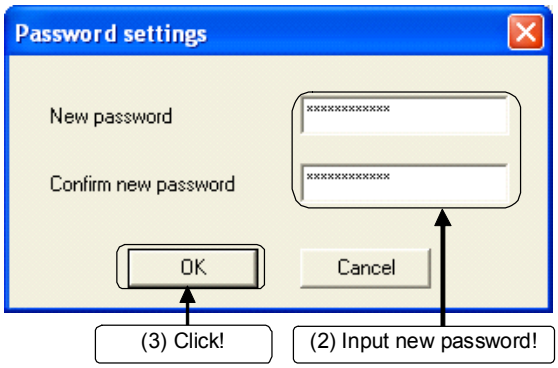
(5) Setting/changing the password
The password of the user changed in (4) can be changed.



1) Click the Password settings button.

The Password settings dialog box is displayed.



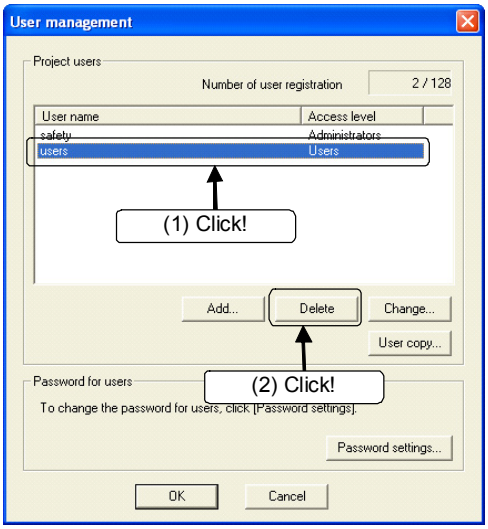
2) Input the new password.
Here, input "melsecsafety".

3) Click OK.

The new password is set.

6 - 6

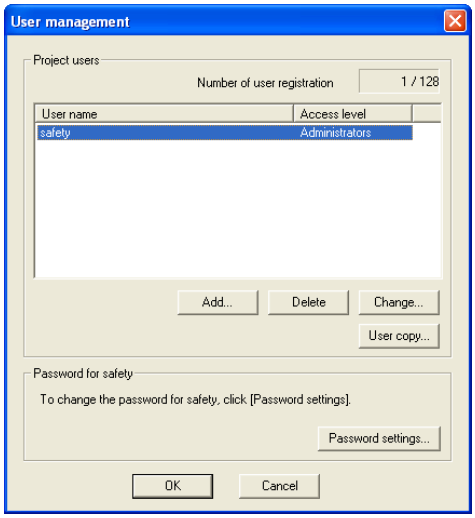
(6) Deleting registered users



1) Click the user to be deleted.

2) Click the Delete button.

3) The Registered user deletion confirmation screen is displayed. Click the Yes button.



4) The user is deleted from the User management dialog box.

6.1.2 User Access Levels

"Access level" refers to operation privileges assigned to users who log to the project. Access levels are divided into the following three levels starting from the level at which all operations can be performed on project data and the safety programmable controller.

Access level		Operation privilege
High ↑	Administrators 	<Administrator level> The user is allowed to perform all operations. Only Administrators can perform user management and security setting.
	Developers 	<Developer level> The user is allowed to perform all operations other than user management and security setting.
↓ Low	User 	<Operator level> The user is allowed to edit project data in the personal computer but is not allowed to overwrite and save data. The user is only allowed to read data, such as monitor data by online operation of safety programmable controller. The user is not allowed to write data.

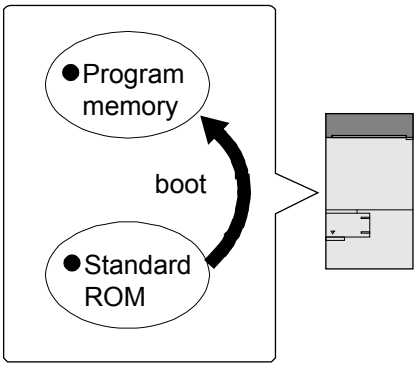
6.2 Copying Program Memory Data to ROM

6.2.1 Executing Standard ROM Programs (Boot Operation)

The CPU module performs operations on the program stored in program memory.

Operations are not performed on programs stored in standard ROM.

Operations are performed on the program stored in standard ROM by booting (reading) the program to program memory.



Before switching the safety CPU operating mode (SAFETY MODE/TEST MODE) that is performed in Section 6.3, Section 6.2.2 "Copying Program Memory Data to ROM" must be performed.

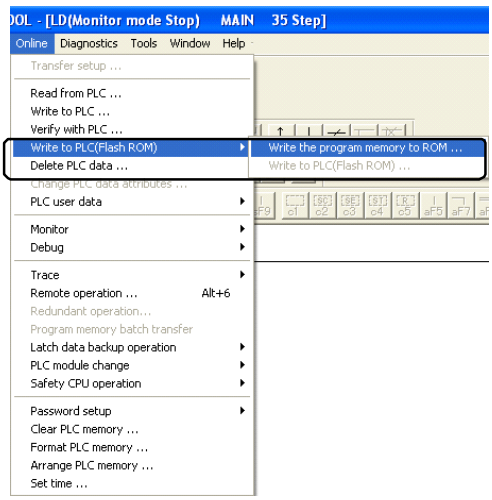
POINT

What is "standard ROM"?
Standard ROM is used when a program or parameters are to be saved without battery backup.
To execute the program saved in standard ROM, the programmable controller must be booted.

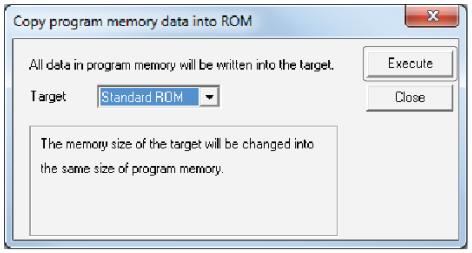
For details, refer to the QSCPU User's Manual (Function Explanation, Program Fundamentals).

6.2.2 Copying Program Memory Data to ROM

Batch-write the data in program memory to standard ROM.

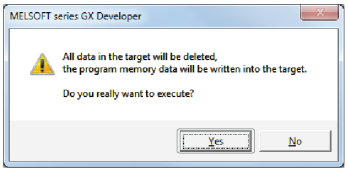


1) Select [Online] - [Write to PLC (Flash ROM)] - [Write the program memory to ROM].

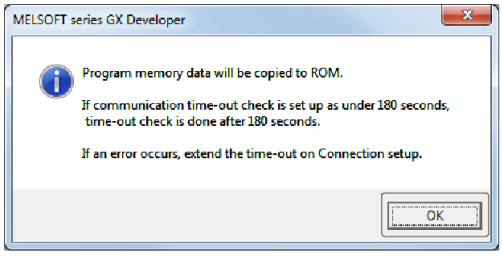


2) The dialog box for writing program memory to ROM is displayed.

Click the Execute button.

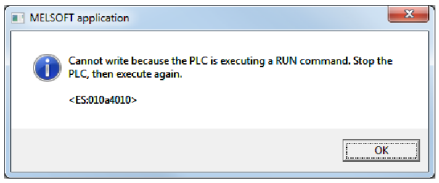


3) The write destination data deletion and program memory writing confirmation screen is displayed. Click the Yes button.



4) The copy to ROM processing execution dialog box is displayed. Click the OK button.

* When the safety programmable controller is running, the following dialog box is displayed and writing is not executed. Execute writing again after the safety programmable controller is changed to the STOP state.



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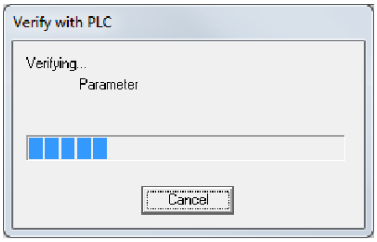

5) Before copying to ROM, verify the program memory with the project data in the personal computer.

   If a mismatch is detected in verification, processing is canceled.

6) When copying to ROM is completed, the "Completed." message is displayed. Click OK.

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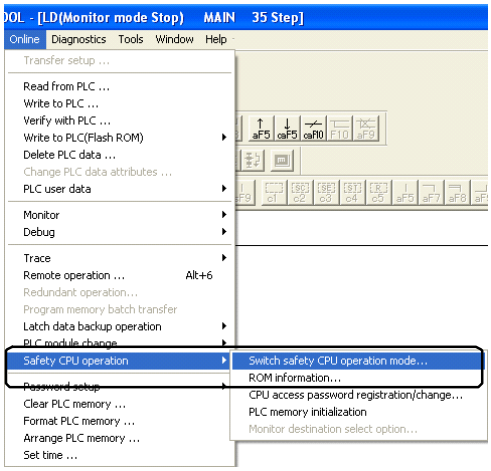
6.3 Changing the CPU Operating Mode

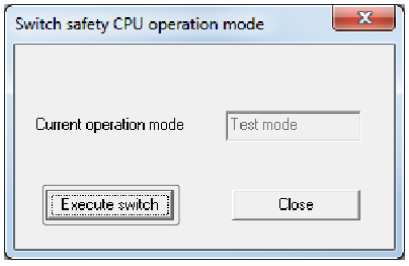
The safety CPU operating mode can be switched between SAFETY MODE and TEST MODE.

(1) SAFETY MODE
This mode is used when the safety system is actually operated.
Since a system in actual operation is protected in the SAFETY MODE, attempts to change the control of the safety programmable controller, such as writing to the PLC and device test, are prohibited.

(2) TEST MODE
This mode is used during system start-up and maintenance.
All GX Developer functions such as writing to PLC and device test can be used.
(The functions that can be used differ according to the access level of the logged-in user.)



1) Select [Online] - [Safety CPU operation] - [Switch safety CPU operation mode].



2) The Switch safety CPU operation mode dialog box is displayed.

Click the Switch button.

When the current operating mode is SAFETY MODE, the mode switches to TEST MODE, and when the current operating mode is TEST MODE, the mode switches to SAFETY MODE.
(The following example explains the operation of switching TEST MODE to SAFETY MODE.)

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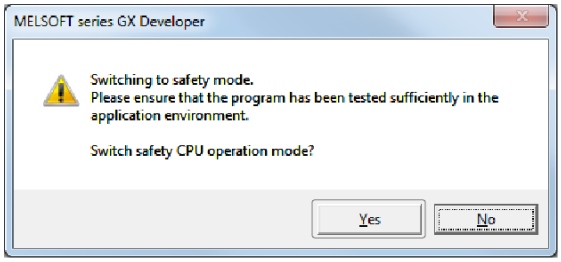
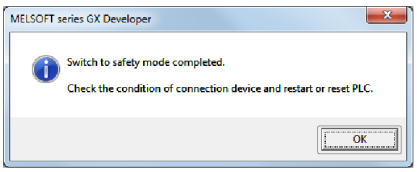
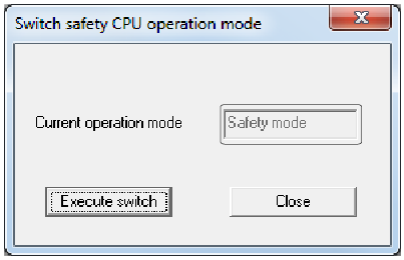


3) The operating mode switching execution confirmation screen is displayed. Click Yes.



4) When switching of the operating mode is completed, the message shown on the left is displayed. Click OK.



5) The current operating mode is switched from TEST MODE to SAFETY MODE.

After switching the operating mode, reset the safety programmable controller or turn the power on again.

POINT

- The safety CPU operating mode can be switched only when the safety programmable controller is in the STOP state.
- When switching from TEST MODE to SAFETY MODE, it is necessary to copy program memory data to ROM beforehand.
- After switching from TEST MODE to SAFETY MODE, the safety programmable controller must be restarted to enable SAFETY MODE. For details on restarting the safety programmable controller, refer to the QSCPU User's Manual (Function Explanation, Program Fundamentals).

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6.4 Operation Limits in SAFETY MODE

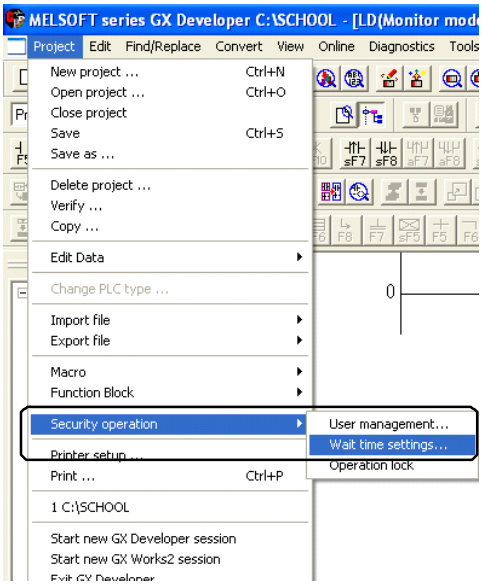
When the safety CPU is in the "SAFETY MODE", restrictions are applied to operation since the operation of changing the control of the safety programmable controller is prohibited.

For details, refer to Appendix 6 "Safe CPU Operating Modes and Operation Limits According to Access Level".

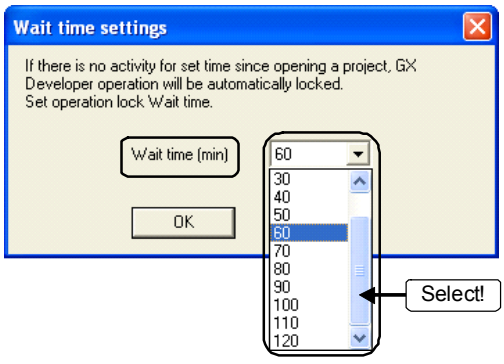
6.5 Operation Lock

"Operation lock" prohibits users who have not logged in from performing operations in GX Developer.
There are two ways of locking operation, automatic operation lock and manual operation lock.

(1) Automatic operation lock (Access level: Administrators)
Set the waiting time after which operation of GX Developer is prohibited by the automatic operation lock.
When GX Developer is not operated for a given time, the Operation lock screen is displayed and operation of GX Developer is locked.



1) Select [Project] - [Security operation] - [Waiting time settings].



2) The Wait time settings dialog box is displayed.

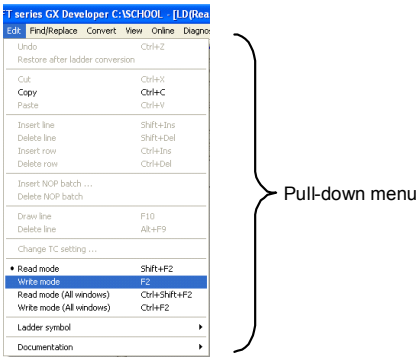
Select from the list the waiting time till operation is automatically locked.
10 to 120 minutes (10-minute intervals) can be set.

Click OK.

POINT

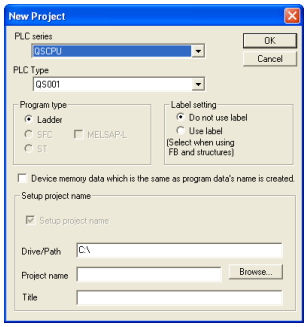
- The waiting time of automatic operation lock is counted while GX Developer operation is not being performed and is reset when a GX Developer operation is performed. Note, however, that the waiting time is not reset in case of the following operations:

<Operation of selection of menu items when a pull-down menu is displayed>
Example) When the project pull-down menu is displayed

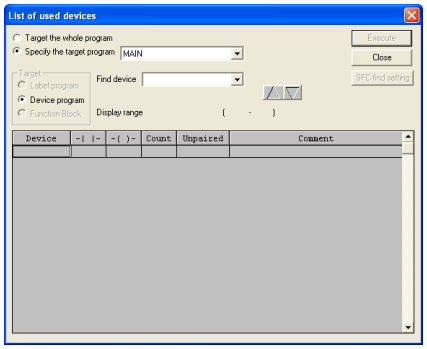


<All operations when message box is displayed>
Example) In case of the message box displayed when GX Developer is exited

<All operations when dialog box is displayed>
Example) When the New Project dialog box is displayed



In the case of dialog boxes for which key operation and mouse operation outside the display range is enabled (called "modeless dialog box"), the monitoring time is reset.
Example) When the List of used devices dialog box is displayed



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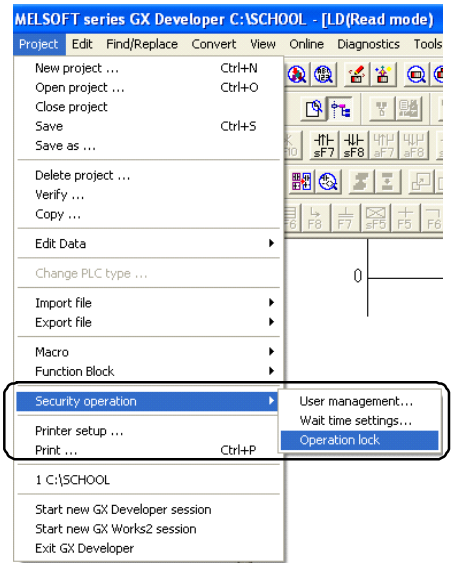
POINT

- Operation of GX Developer is enabled by clearing the operation lock.
- The set waiting time is saved as project data when the project is saved.
- Display of the monitor screen that was displayed before the operation lock is refreshed even during an operation lock.

(2) Manual operation lock



1) Select [Project] - [Security operation] - [Operation lock].

2) The Operation lock confirmation screen is displayed.

Click Yes.

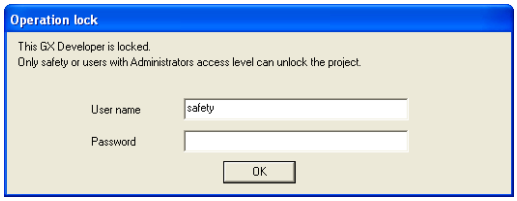
3) The Operation lock screen is displayed and operation of GX Developer is locked.

POINT

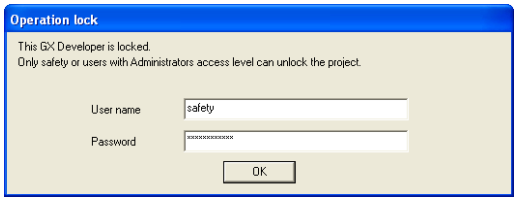
- Display of the monitor screen that was displayed before the operation lock is refreshed even during an operation lock.
- Operation of GX Developer is enabled by clearing the operation lock.

(3) Clearing the operation lock

Clear the operation locked state to enable operation of GX Developer.
An operation lock can be cleared only by login users and users with Administrators access level.



1) When an operation lock is performed, the Operation lock screen is displayed.



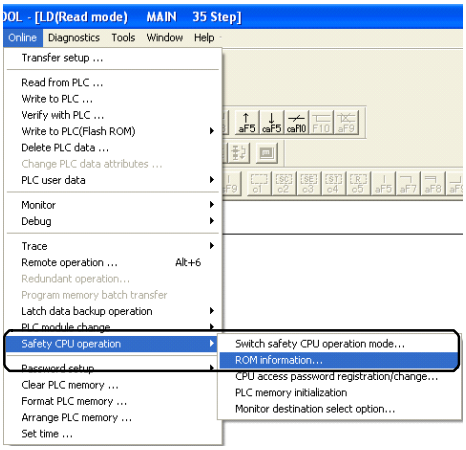
2) Input the user name and password whose operation lock is to be cleared.

Click OK. The user name and password are checked, and the operation lock is switched OFF.

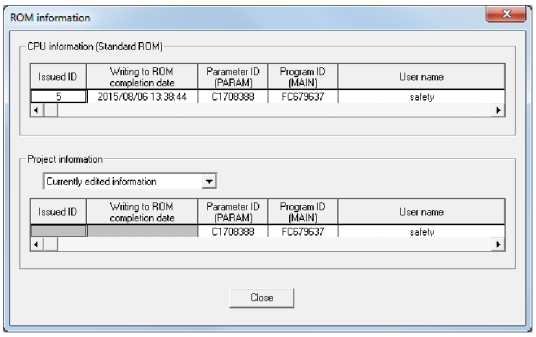
6.6 Displaying Information Copied to ROM

Information copied to ROM on the project side and safety CPU side is displayed in a list.

(1) Operating procedure



1) Select [Online] - [Safety CPU operation] - [ROM information].



2) The [ROM information] dialog box is displayed.

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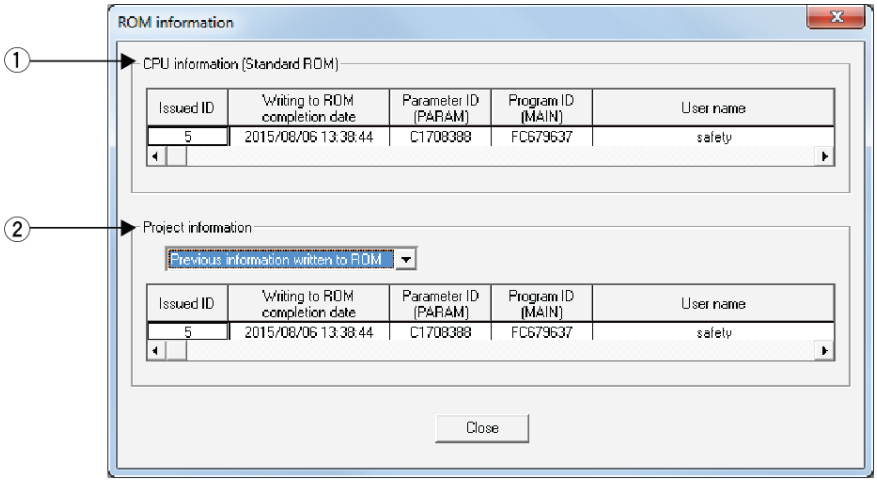
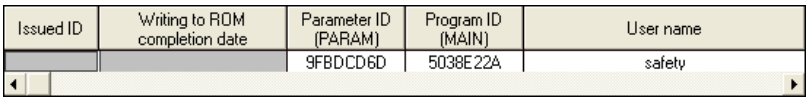
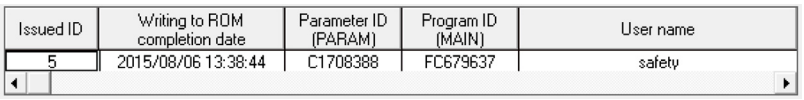
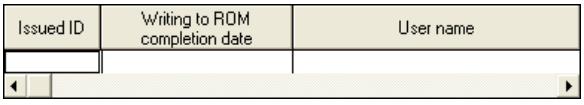
(2) Items in the ROM information dialog box



No.	Item	Description
1)	CPU information (Standard ROM)	Displays a list of the date and time, parameter ID, program ID, and the name of the user who copied to ROM when information was copied to ROM on the currently connected safety CPU side.
2)	Project information	Displays the information copied to ROM of selected items. • When "Information during current editing" is selected displays a list of the parameter ID, program ID, and login user names of the currently opened project. *1  *1: When a program has not been created, the program ID field is not displayed. • When "Information when copied to ROM at the previous time" is selected displays a list of issued ID, date and time, parameter ID, program ID, and the name of the user who copied to ROM in the currently opened project. 

REMARKS

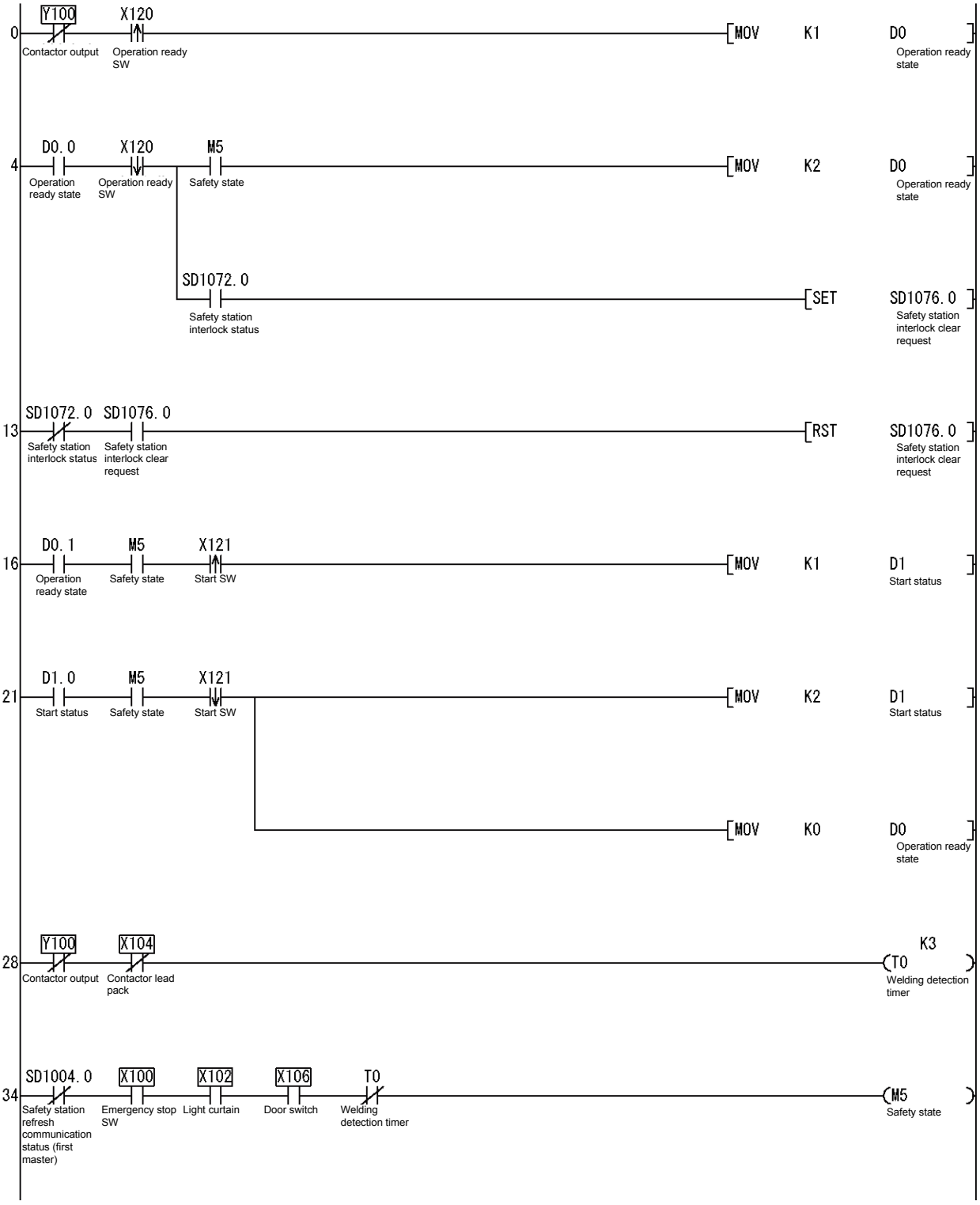
- The display is blank when information has not been copied to ROM even once, when information cannot be obtained from the safety CPU due to a communication error or when information cannot be read from file.



Appendix

Appendix 1 Sequence Program Used in This Text

The following shows the sequence program used in this text.
* Devices with device name enclosed by a square are safety devices.
  Square frames are automatically added when the program is printed from GX Developer.



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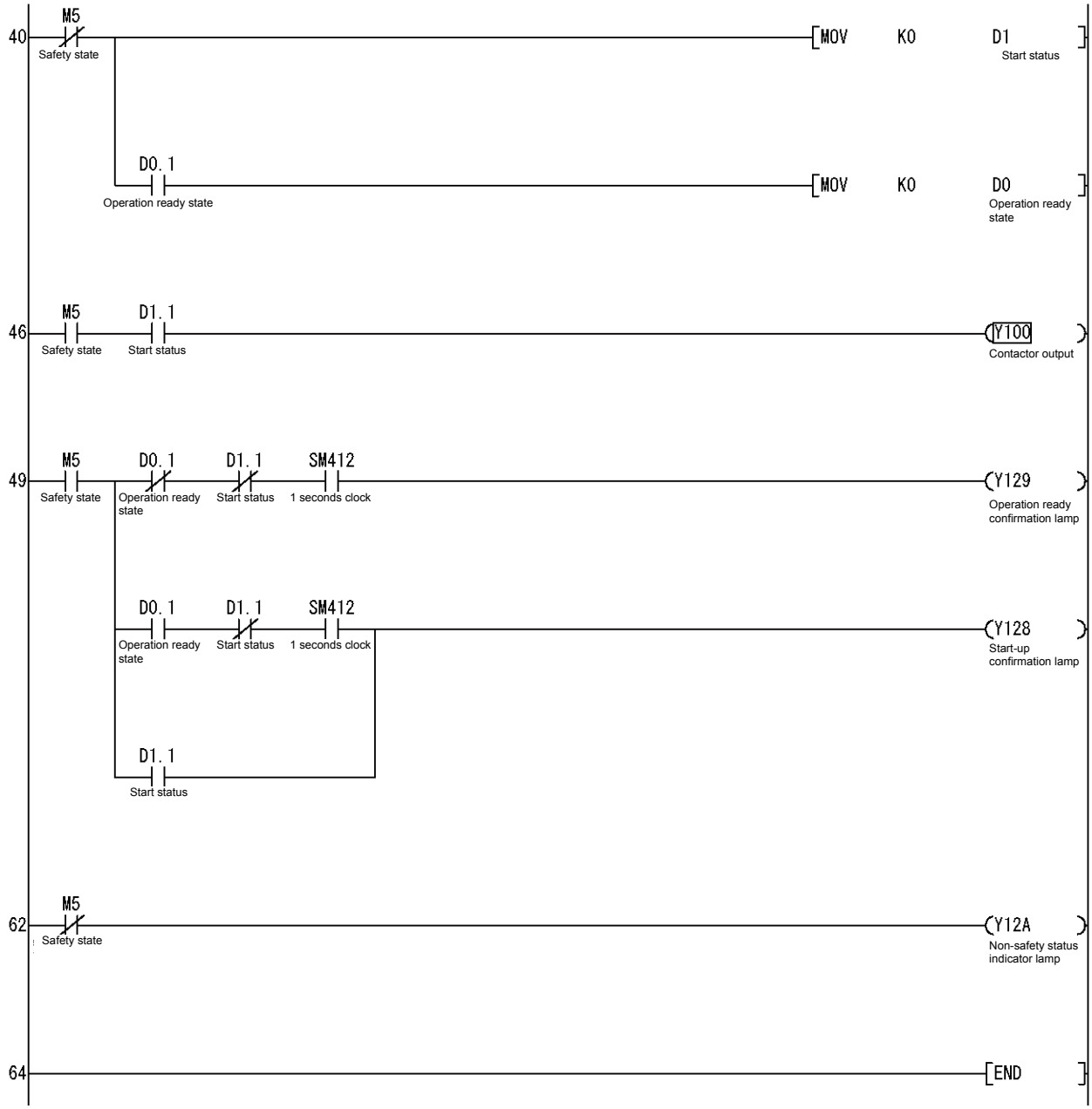

40
M5
Safety state
MOV K0 D1
Start status
D0.1
Operation ready state
MOV K0 D0
Operation ready state
46
M5
Safety state
D1.1
Start status
Y100
Contactor output
49
M5
Safety state
D0.1
Operation ready state
D1.1
Start status
SM412
1 seconds clock
Y129
Operation ready confirmation lamp
D0.1
Operation ready state
D1.1
Start status
SM412
1 seconds clock
Y128
Start-up confirmation lamp
D1.1
Start status
62
M5
Safety state
Y12A
Non-safety status indicator lamp
64
END

Appendix 2 Parameter Settings of Project Used in This Text

Refer to Section 3.2.4.

Appendix 3 Registered User and Password of Project Used in This Text

User name	safety
Password	melsecsafety

Appendix - 3

Appendix 4 How to Calculate Safety Response Time

This appendix explains the maximum value of the safety response time.
When this calculation formula is to be applied, use GX Developer in combination with the module shown in the following table.
For details on the calculation formula when none of the combinations shown in the following table is applicable, refer to the following manual.

- CC-Link Safety System Master Module User's Manual (Details)

GX Developer Version	First five digits of serial number			
	Safety CPU module	Safety master module	Safety remote I/O station	
			QS0J65BTS2-8D, QS0J65BTS2-4T	QS0J65BTB2-12DT
Version 8.65T onwards	10032 onwards	10032 onwards	10031 onwards	10032 onwards

(1) Calculation method

The maximum value of the safety response time is the value obtained by adding up (a) to (e) in the following table.
For the timing when the safety response time is maximum, refer to the timing chart for the safety response time maximum value.

How to calculate the safety response time maximum value

Item	Maximum
(a) Input equipment reaction time	DT1
(b) Input response time of safety remote station	Refer to the user's manual of the used safety remote station.
(c) Monitoring time from safety input to safety output	Safety data monitoring time
(d) Output response time of safety remote station	Refer to the user's manual of the used safety remote station.
(e) Output equipment reaction time	DT2
Total	DT1 + DT2 + Input response time of safety remote station + Safety data monitoring time + Output response time of safety remote station

LS : This is the link scan time.

n : This is the value rounded up to the decimal point of (LS/WDT).
This is the value rounded up to the decimal point of (safety refresh response processing time / (WDT × n)).

m : Safety refresh response processing time:
Refer to the user's manual of the used safety remote station.

DT1, DT2 : This is the reaction time of the sensor and output destination controller. Confirm and add the reaction time of the used device.

Safety refresh monitoring time : This is the time set by network parameters.
As a guideline, set the value obtained by the following calculation formula.
In synchronous mode
(WDT × n) × 3 + ((WDT × n) × m) × 2 + (WDT × α) [ms]
When α: LS ≤ 1.5 ms, 0,
When α: LS > 1.5 ms, 1
In asynchronous mode
(WDT × n) × 3 + LS + ((WDT × n) × m) × 2 + (WDT × α) [ms]
When α: LS ≤ 1.5 ms, 0,
When α: LS > 1.5 ms, 1

Safety data monitoring time : This is the time set by network parameters.
As a guideline, set the value obtained by the following calculation formula.
Safety refresh monitoring time × 2 - ((WDT × n) × m) - 10 [ms]

WDT (Watchdog timer) : This is the time set by PLC parameters.
Calculate SM (scan time) by referring to the QSCPU User's Manual (Function Explanation, Program Fundamentals) and set to the time of the obtained value or more.

Synchronous mode : In this mode, the data link is performed by a scan synchronous with the sequence program.
The sequence scan and link scan start simultaneously.
• CC-Link Safety System Master Module User's Manual (Details)

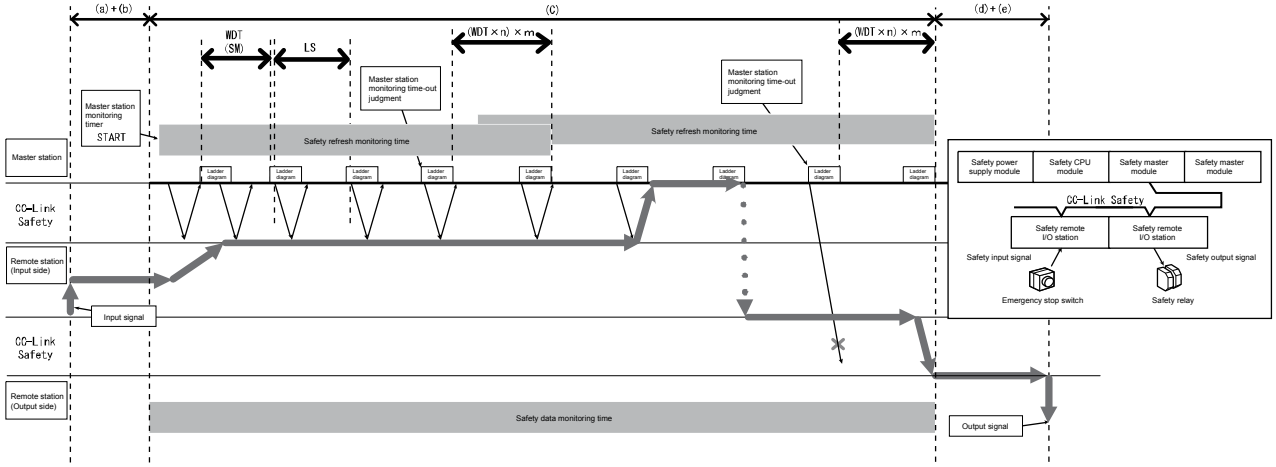
Asynchronous mode : In this mode, the data link is performed by a scan asynchronous with the sequence program.
• CC-Link Safety System Master Module User's Manual (Details)

POINT

(1) When the setting value of the safety data monitoring time is the value calculated above or less, an error may occur even in the normal communication status.
If the setting value of the safety data monitoring time is longer than necessary, the time of (c) is lengthened, for example, when an abnormality occurs on the safety programmable controller and safety response performance may be extremely delayed.

(2) This manual indicates the safety response time maximum value, and so WDT that is the maximum value of SM (scan time) is used in the calculation formula instead of SM (scan time).
In normal calculations, SM is used instead of WDT.

(3) When the safety CPU module detects error codes 8320 to 8322 (CC-LINK DATA RECEPTION TIMEOUT), change the safety refresh monitoring time to a larger value.



Timing chart of safety response time maximum value

(a) Link scan time (LS)

The calculation formula for link scan time of CC-Link Safety (LS) [μs] is shown below.

LS = BT × (27 + (NI × 4.8) + (NW × 9.6) + (N × 30) + (ni × 4.8) + (nw × 9.6) + TR) + ST + RT + F [μs] ···· LS calculation formula

BT: Constant

Transmission speed	156 kbps	625 kbps	2.5 Mbps	5 Mbps	10 Mbps
BT	51.2	12.8	3.2	1.6	0.8

NI: Final station number in A,B (value of A and B, whichever is larger) (Including number of occupied stations, excluding reserved stations. However, a multiple of 8 is used.)

NW: Final station number in B (Including number of occupied stations, excluding reserved stations. However, a multiple of 8 is used.)

A: Final station number of standard remote I/O stations (When standard remote I/O stations are not connected, set A=0.)

B: Final station number of safety remote I/O stations and remote device stations

Final station number	1 to 8	9 to 16	17 to 24	25 to 32	33 to 40	41 to 48	49 to 56	57 to 64
NI, NW	8	16	24	32	40	48	56	64

N: Number of connectable modules (Excluding reserved stations)

ni: a + b (Excluding reserved stations)

a: Total number of occupied stations of standard remote I/O stations

b: Total number of occupied stations of safety remote I/O stations and remote device stations

nw: b (Excluding reserved stations)

TR: Constant

Constant	Numerical value
TR	38.4

ST: Constant (Only in asynchronous mode. In synchronous mode 0) (Value of 1), 2), whichever is larger. However, in case B = 0, 2) is ignored.)
1) 800 + (A × 15)
2) 900 + (B × 50)

RT: Retry processing time (Only when communication error station is detected)

α + β × (Number of modules with detected communication error - 1)

α: Retry processing time for 1st module
BT × ((200 + R) × Setting value of number of retries + 200)

R: 51.6 + (NI × 4.8) + (NW × 9.6)

β: Retry processing time from 2nd module onwards
BT×((200 + P) × Setting value of the number of retries + 200)

P : 10.8

F: Return processing time (Only when communication error station exists)
- Synchronous mode BT × 244.4 + 213.2 × (Number of automatic return modules - 1)
- Asynchronous mode BT × 218 + 213.2 × (Number of automatic return modules - 1)

POINT

If a remote station is connected to the station number set as reserved station and the reserved station setting is cleared, the values of NI, NW, N, ni, and nw in the LS calculation formula change.
For this reason, when a reserved station is changed, re-calculate LS and safety response performance for the newly changed system.
For details of the reserved station function, refer to the CC-Link Safety System Master Module User's Manual (Details).

(2) Example of response time calculation

The following shows an example of the response time calculation when the following parameters are set: WDT setting value = 10 ms, link scan time (synchronous mode) = 0.3 ms, link scan time (asynchronous mode) = 1.4 ms, input response time of safety remote station = 12.2 ms, output response time of safety remote station = 10.4 ms, and safety refresh response processing time = 9.6 ms.

(a) Example of safety refresh monitoring time calculation

1) In synchronous mode

n: LS/WDT = 0.3/10 → 1
m: (Safety refresh response processing time / (WDT × n))
= 9.6 / (10 × 1) → 1
α: LS = 0.3 ≤ 1.5 ms → 0

(WDT × n) × 3 + ((WDT × n)) × m) × 2 + (WDT × α) [ms]
= (10 × 1) × 3 + (10 × 1) × 1) × 2 + (10 × 0)
= 50 [ms]

2) In asynchronous mode

n: LS/WDT = 1.4/10 → 1
m: (Safety refresh response processing time / (WDT × n))
= 9.6 / (10 × 1) → 1
α: LS ≤ 1.5 ms → 0

(WDT × n) × 3 + LS + ((WDT × n) × m) × 2 + (WDT × α) [ms]
= (10 × 1) × 3 + 1.4 + (10 × 1) × 1) × 2 + (10 × 0)
= 51.4 [ms]

(b) Safety data monitoring time

1) In synchronous mode

Safety refresh monitoring time × 2 − ((WDT × n) × m) − 10
= 50 × 2 − (10 × 1 × 1) − 10
= 80 [ms]

2) In asynchronous mode

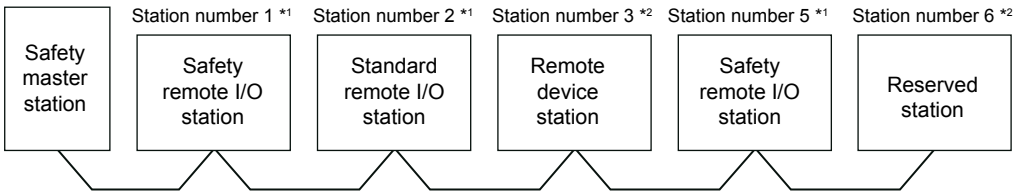
Safety refresh monitoring time × 2 − ((WDT × n) × m) − 10
= 51.8 × 2 − (10 × 1 × 1) − 10
= 82.8 [ms]

(c) Example of response time maximum value calculation

1) In synchronous mode
DT1 + DT2 + Input response time of safety remote station
+ Safety data monitoring time
+ Output response time of safety remote station
= DT1 + DT2 + 12.2 + 80 + 10.4
= DT1 + DT2 + 102.6 [ms]

2) In asynchronous mode
DT1 + DT2 + Input response time of safety remote station
+ Safety data monitoring time
+ Output response time of safety remote station
=DT1 + DT2 + 12.2 + 82.8 + 10.4
=DT1 + DT2 + 105.4 [ms]

(3)Example of scan time calculation
(2) The following example shows the LS (link scan time) calculation used in calculating the response time.
In the following system configuration example, the calculation example in for a transmission speed of 10 Mbps. (However, it is assumed that there are no communication error stations.)



- BT = 0.8
- NI = 5 → 8
- NW = 5 → 8
- N = 4
- ni = 5
- nw = 4
- A = 2, B = 5
- ST = 1350
  1) 800 + (2 × 15) = 830
  2) 900 + (5 × 50) = 1150

1) In synchronous mode
LS = BT × (27 + (NI × 4.8) + (NW × 9.6) + (N × 30) + (ni × 4.8) + (nw × 9.6) + TR) + RT + F
= 0.8 × (27 + (8 × 4.8) + (8 × 9.6) + (4 × 30) + (5 × 4.8) + (4 × 9.6) + 38.4) + 0 + 0
= 290.4 [μs]
= 0.3 [ms]

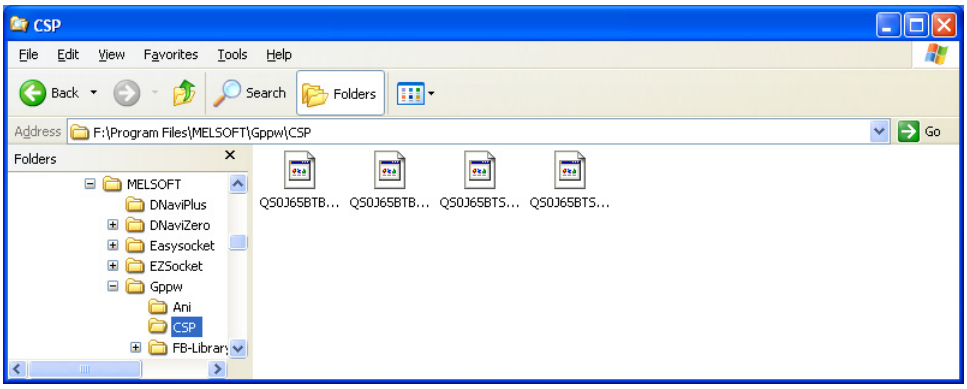
2) In asynchronous mode
LS = BT × (27 + (NI × 4.8) + (NW × 9.6) + (N × 30) + (ni × 4.8) + (nw × 9.6) + TR) + ST + RT + F
= 0.8 × (27 + (8 × 4.8) + (8 × 9.6) + (4 × 30) ＋ (5 × 4.8) + (4 × 9.6) + 38.4) + 1150 + 0 + 0
= 1440.4 [μs]
= 1.4 [ms]

Appendix 5 Registering Safety CSP Files

A safety CSP file defines information for setting the parameters of the safety remote station.
If a safety CSP file compatible with the technical version of the safety remote I/O module is not present, the parameters of the safety remote station cannot be set.
The following describes how to acquire/register safety CSP files compatible with the technical version of the safety remote I/O module.

(1) Downloading safety CSP files
Download the latest safety CSP files from the home page of the CC-Link Partner Association.
For details, refer to the home page of the CC-Link Partner Association: http://www.cc-link.org/.

(2) Registering safety CSP files
Store downloaded safety CSP files in the "CSP" folder in the installation folder of GX Developer.



POINT
Safety CSP files of the safety remote I/O module are automatically registered when GX Developer is installed. For this reason, if GX Developer is installed after safety CSP files are registered, safety CSP files are sometimes updated to older versions automatically. If safety CSP files are updated to older versions, register the latest safety CSP files again.

Appendix 6 Operation Restrictions According to Safe CPU Operating Modes and Access Level

The following describes whether or not GX Developer functions are operable and shows restrictions applied according to combination of safety CPU operating modes and access level.

(1) Common functions

Menu item	SAFETY MODE			TEST MODE			Restriction
	Admin.	Develop.	Users	Admin.	Develop.	Users	
Project							−
Create new project	−	−	−	−	−	−	−
Open project	○	○	○	○	○	○	−
Close project	○	○	○	○	○	○	−
Save project	○	○	×	○	○	×	−
Save project as	Δ	Δ	Δ	Δ	Δ	Δ	Δ: Refer to *1
Delete project	Δ	Δ	Δ	Δ	Δ	Δ	Δ: Refer to *2
Verify	○	○	○	○	○	○	−
Copy	○	○	○	○	○	○	−
Security operations							−
User management	○	×	×	○	×	×	−
Waiting time setting	○	×	×	○	×	×	−
Operation lock	○	○	○	○	○	○	−
Printer setup	○	○	○	○	○	○	−
Print	○	○	○	○	○	○	−
Start new GX Developer	○	○	○	○	○	○	−
Exit GX Developer	○	○	○	○	○	○	−
Display							−
Toolbar	○	○	○	○	○	○	−
Status bar	○	○	○	○	○	○	−
Project data list	○	○	○	○	○	○	−
Project data display format							−
Do not sort	○	○	○	○	○	○	−
Data name ascending sort	○	○	○	○	○	○	−
Data name descending sort	○	○	○	○	○	○	−

(Continued on the next page)

○: Operation enabled Δ: Operation enabled with limitations
×: Operation disabled −: Executable irrespective of access level

*1: When overwriting an existing project, you must log to the existing project.
If the access level of the user to log in is "Administrators" or "Developers", "Save project as" can be executed.

*2: There is a need to login to projects to be deleted.
If the access level of the user to log in is "Administrators" or "Developers", "Delete project as" can be executed.

(From the previous page)

Menu item	SAFETY MODE			TEST MODE			Restriction
	Admin.	Develop.	Users	Admin.	Develop.	Users	
Online							−
Transfer setup	○	○	○	○	○	○	−
PLC read	Δ	×	×	Δ	×	×	Δ: Refer to *3
PLC write	×	×	×	○	○	×	−
Verify with PLC	○	○	○	○	○	○	−
PLC write (flash ROM)							−
Copy program memory data to ROM	×	×	×	○	○	×	−
PLC data deletion	×	×	×	○	○	×	−
Monitor							−
Start Monitoring (All Windows)	○	○	○	○	○	○	−
Stop Monitoring (All Windows)	○	○	○	○	○	○	−
Device batch	○	○	○	○	○	○	−
Device registration	○	○	○	○	○	○	−
Buffer memory batch	○	○	○	○	○	○	−
Program monitor list	○	○	○	○	○	○	−
Debug							−
Device test	×	×	×	○	○	×	Refer to *4
Remote operation	○	○	×	○	○	×	Refer to *4
Safety CPU operation							−
Operation mode switching	○	○	×	○	○	×	−
Copy information to ROM	○	○	○	○	○	○	−
CPU access password registration/change	Δ	×	×	○	×	×	Δ: Refer to *5
PLC memory initialization	○	×	×	○	×	×	−
Monitor destination specification option	Δ	Δ	Δ	Δ	Δ	Δ	Δ: Refer to *6
PLC memory clear	×	×	×	○	○	×	−
PLC memory format	×	×	×	○	○	×	−
Clean up PLC memory	×	×	×	○	○	×	−
Clock setting	○	○	×	○	○	×	−

(Continued on the next page)

○: Operation enabled Δ: Operation enabled with limitations
×: Operation disabled —: Executable irrespective of access level

*3: A new "PLC read" cannot be performed from the safety CPU.

*4: Refer to the GX Developer Version 8 Operating Manual (Safety Programmable Controller).

*5: The CPU access password cannot be registered on the safety CPU.

*6: During monitoring, the CPU to be monitored cannot be switched.

(From the previous page)

Menu item	SAFETY MODE			TEST MODE			Restriction
	Admin.	Develop.	Users	Admin.	Develop.	Users	
Diagnostics							Refer to *7
PLC diagnostics	Δ	Δ	Δ	○	○	Δ	Δ: Refer to *8
Ethernet diagnostics	Δ	Δ	Δ	○	○	Δ	Δ: Refer to *9
CC IE Control diagnostics	Δ	Δ	Δ	○	○	Δ	Δ: Refer to *10
MELSECNET diagnostics	Δ	Δ	Δ	○	○	Δ	Δ: Refer to *11
CC-Link/CC-Link/LT diagnostics	Δ	Δ	Δ	○	○	Δ	Δ: Refer to *12
System monitor	○	○	○	○	○	○	−
Tools							−
Merge data	○	○	○	○	○	○	Refer to *7
Parameter check	○	○	○	○	○	○	−
Unused device comment deletion	○	○	○	○	○	○	−
Clear all parameters	○	○	○	○	○	○	−
Customize key	○	○	○	○	○	○	−
Option	○	○	×	○	○	×	Refer to *7
Create start-up setting file	○	○	○	○	○	○	−
Window							−
Cascade	○	○	○	○	○	○	−
Tile vertically	○	○	○	○	○	○	−
Tile horizontally	○	○	○	○	○	○	−
Arrange icons	○	○	○	○	○	○	−
Close all windows	○	○	○	○	○	○	−
Help							−
CPU fault	○	○	○	○	○	○	−
Special relays/registers	○	○	○	○	○	○	−
Key operation list	○	○	○	○	○	○	−
Product information	○	○	○	○	○	○	−
Connection to MELFANSweb	○	○	○	○	○	○	−

○: Operation enabled Δ: Operation enabled with limitations
×: Operation disabled −: Executable irrespective of access level

*7: Refer to the GX Developer Version 8 Operating Manual (Safety Programmable Controller).

*8: The history cannot be cleared by PLC diagnostics.

*9: The COM.ERR off button in Ethernet diagnostics cannot be selected. The history cannot be cleared on the error history tab.

*10: Error information cannot be cleared on the logging screen in CC IE Control diagnostics.

*11: The error history cannot be cleared on the error history monitor in MELSECNET diagnostics.

*12: The line test cannot be performed by CC-Link/CC-Link/LT diagnostics.

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(2) Ladder editing functions

Menu item	SAFETY MODE			TEST MODE			Restriction
	Admin.	Develop.	Users	Admin.	Develop.	Users	
Project							−
Editing data							−
New addition	○	○	○	○	○	○	−
Delete	○	○	○	○	○	○	−
Rename data	○	○	○	○	○	○	−
Function block							−
Divert	○	○	○	○	○	○	−
Rename FB	○	○	○	○	○	○	−
Module start I/O No. setting	○	○	○	○	○	○	−
Edit							−
Undo	○	○	○	○	○	○	−
Restore after ladder conversion	○	○	○	○	○	○	−
Cut	○	○	○	○	○	○	−
Copy	○	○	○	○	○	○	Refer to *13
Paste	○	○	○	○	○	○	Refer to *13
Insert Row	○	○	○	○	○	○	−
Delete Row	○	○	○	○	○	○	−
Insert Column	○	○	○	○	○	○	−
Delete Column	○	○	○	○	○	○	−
NOP batch insertion	○	○	○	○	○	○	−
NOP batch deletion	○	○	○	○	○	○	−
Edit line	○	○	○	○	○	○	−
Delete line	○	○	○	○	○	○	−
Change TC setting value	○	○	○	○	○	○	Refer to *13
Read Mode	○	○	○	○	○	○	−
Write Mode	○	○	○	○	○	○	−
Ladder symbol	○	○	○	○	○	○	−
Create document	○	○	○	○	○	○	−

(Continued on the next page)

○: Operation enabled △: Operation enabled with limitations
×: Operation disabled −: Executable irrespective of access level

*13: Refer to the GX Developer Version 8 Operating Manual (Safety Programmable Controller).

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(From the previous page)

Menu item	SAFETY MODE			TEST MODE			Restriction
	Admin.	Develop.	Users	Admin.	Develop.	Users	
Find/Replace							−
Find device	○	○	○	○	○	○	−
Find instruction	○	○	○	○	○	○	−
Find step No.	○	○	○	○	○	○	−
Find String	○	○	○	○	○	○	−
Find Contact or Coil	○	○	○	○	○	○	−
Replace device	○	○	○	○	○	○	−
Device batch replacement	○	○	○	○	○	○	−
Replace instruction	○	○	○	○	○	○	−
Change AB contact	○	○	○	○	○	○	−
Replace string	○	○	○	○	○	○	−
Replace module start I/O No.	○	○	○	○	○	○	−
Replace statement/note type	○	○	○	○	○	○	−
Display cross-reference window	○	○	○	○	○	○	−
Cross reference list	○	○	○	○	○	○	−
List of used devices	○	○	○	○	○	○	−
Convert							−
Convert	○	○	○	○	○	○	−
Convert (all programs being edited)	○	○	○	○	○	○	−
Convert (all programs)	○	○	○	○	○	○	−
Convert (online program change)	×	×	×	○	○	×	−
Display							−
Comment display	○	○	○	○	○	○	−
Statement display	○	○	○	○	○	○	−
Note display	○	○	○	○	○	○	−
Device name display	○	○	○	○	○	○	−
Device display	○	○	○	○	○	○	−
Display lines of monitored current value	○	○	○	○	○	○	−
Comment display format	○	○	○	○	○	○	−
Device name display format	○	○	○	○	○	○	−
Device display format	○	○	○	○	○	○	−
Number of lines of device comment	○	○	○	○	○	○	−
Zoom	○	○	○	○	○	○	−
Contacts setting	○	○	○	○	○	○	−
Display step synchronization	○	○	○	○	○	○	−

(Continued on the next page)

○: Operation enabled △: Operation enabled with limitations
×: Operation disabled −: Executable irrespective of access level

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(From the previous page)

Menu item			SAFETY MODE			TEST MODE			Restriction
			Admin.	Develop.	Users	Admin.	Develop.	Users	
Online									−
	Monitor								−
		Monitoring mode	○	○	○	○	○	○	−
		Monitor (write mode)	○	○	×	○	○	×	−
		Start Monitoring	○	○	○	○	○	○	−
		Stop Monitoring	○	○	○	○	○	○	−
		Switch the current value monitoring (decimal)	○	○	○	○	○	○	−
		Switch the current value monitoring (Hex)	○	○	○	○	○	○	−
		Entry ladder monitor	○	○	○	○	○	○	−
		Delete all registered circuits	○	○	○	○	○	○	−
Tools									−
	Program check		○	○	○	○	○	○	−
	Change display color		○	○	○	○	○	○	−

○: Operation enabled △: Operation enabled with limitations
×: Operation disabled −: Executable irrespective of access level

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(3) Label program editing functions

Menu item	SAFETY MODE			TEST MODE			Restriction
	Admin.	Develop.	Users	Admin.	Develop.	Users	
Project							−
Editing data							−
New addition	○	○	○	○	○	○	−
Copy	○	○	○	○	○	○	−
Delete	○	○	○	○	○	○	−
Rename data	○	○	○	○	○	○	−
Edit							−
Undo	○	○	○	○	○	○	−
Cut	○	○	○	○	○	○	−
Copy	○	○	○	○	○	○	−
Paste	○	○	○	○	○	○	−
Insert Row	○	○	○	○	○	○	−
Add row	○	○	○	○	○	○	−
Delete Row	○	○	○	○	○	○	−
Delete Auto External (Au)	○	○	○	○	○	○	−
Delete all	○	○	○	○	○	○	−
Auto device setting	○	○	○	○	○	○	−
Global variable setting	○	○	○	○	○	○	−
Import device comment	○	○	○	○	○	○	−
Export device comment	○	○	○	○	○	○	−
Find/Replace							−
Find device	○	○	○	○	○	○	−
Find String	○	○	○	○	○	○	−
Replace device	○	○	○	○	○	○	−
Replace string	○	○	○	○	○	○	−
Convert							
Convert/Compile	○	○	○	○	○	○	−
Convert/Compile (all programs being edited)	○	○	○	○	○	○	−
Convert/Compile (all programs)	○	○	○	○	○	○	−
Tools							−
Sort							−
Label order	○	○	○	○	○	○	−
Device/constant order	○	○	○	○	○	○	−
Device type order	○	○	○	○	○	○	−

○: Operation enabled △: Operation enabled with limitations
×: Operation disabled −: Executable irrespective of access level

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(4) Device comment editing functions

Menu item			SAFETY MODE			TEST MODE			Restriction
			Admin.	Develop.	Users	Admin.	Develop.	Users	
Project									−
	Editing data								−
		New addition	○	○	○	○	○	○	−
		Copy	○	○	○	○	○	○	−
		Delete	○	○	○	○	○	○	−
		Rename data	○	○	○	○	○	○	−
Edit									−
	Cut		○	○	○	○	○	○	−
	Copy		○	○	○	○	○	○	−
	Paste		○	○	○	○	○	○	−
	Clear all (all devices)		○	○	○	○	○	○	−
	Clear all (all displayed devices)		○	○	○	○	○	○	−
	Comment setting		○	○	○	○	○	○	−
	Comment range setting		○	○	○	○	○	○	−
Find/Replace									−
	Find String		○	○	○	○	○	○	−
	Replace string		○	○	○	○	○	○	−

○: Operation enabled　△: Operation enabled with limitations
×: Operation disabled　−: Executable irrespective of access level

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(5) Device memory editing functions

Menu item			SAFETY MODE			TEST MODE			Restriction
			Admin.	Develop.	Users	Admin.	Develop.	Users	
Project									−
	Editing data								−
		New addition	○	○	○	○	○	○	−
		Copy	○	○	○	○	○	○	−
		Delete	○	○	○	○	○	○	−
		Rename data	○	○	○	○	○	○	−
Edit									−
	Cut		○	○	○	○	○	○	−
	Copy		○	○	○	○	○	○	−
	Paste		○	○	○	○	○	○	−
	Clear all (all devices)		○	○	○	○	○	○	−
	Clear all (all displayed devices)		○	○	○	○	○	○	−
	FILL		○	○	○	○	○	○	−
Find/Replace									−
	Find data		○	○	○	○	○	○	−
	Find String		○	○	○	○	○	○	−
	Replace data		○	○	○	○	○	○	−
	Replace string		○	○	○	○	○	○	−

○: Operation enabled △: Operation enabled with limitations
×: Operation disabled −: Executable irrespective of access level

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Appendix 7 Performance Specifications of Safety Programmable Controller
(CPU Module + Master Module, Power Supply Module, Safety Remote I/O Module, Base Unit)

Appendix 7.1 General Specifications

The general specifications of the QS series programmable controller are shown in the table below.

General specifications

<table>
<tr><th>Item</th><th colspan="6">Specifications</th></tr>
<tr><td>Operating ambient temperature</td><td colspan="6">0 to 55°C</td></tr>
<tr><td>Storage ambient temperature</td><td colspan="6">-40 to 75°C</td></tr>
<tr><td>Operating ambient humidity</td><td colspan="6">5 to 95% RH, non-condensing</td></tr>
<tr><td>Storage ambient humidity</td><td colspan="6">5 to 95% RH, non-condensing</td></tr>
<tr><td rowspan="6">Vibration resistance</td><td rowspan="6">JIS B 3502,
IEC 61131-2
compliant</td><td></td><td>Frequency range</td><td>Constant acceleration</td><td>Half amplitude</td><td>The number of sweeps</td></tr>
<tr><td rowspan="2">In case of intermittent vibrations</td><td>5 to 9 Hz</td><td>-</td><td>3.5 mm</td><td rowspan="4">X, Y, Z
10 times in each direction</td></tr>
<tr><td>9 to 150 Hz</td><td>9.8 m/s^2</td><td>-</td></tr>
<tr><td rowspan="2">In case of continuous vibrations</td><td>5 to 9 Hz</td><td>-</td><td>1.75 mm</td></tr>
<tr><td>9 to 150 Hz</td><td>4.9 m/s^2</td><td>-</td></tr>
<tr><td>Shock resistance</td><td colspan="6">JIS B 3502, IEC 61131-2 compliant
(147 m/S^2, actuation time 11 ms, three times in each
of three directions XYZ at a sine half-wave pulse)</td></tr>
<tr><td>Operating atmosphere</td><td colspan="6">No corrosive gas</td></tr>
<tr><td>Operating altitude*3</td><td colspan="6">2000 m or lower</td></tr>
<tr><td>Installation location</td><td colspan="6">In control panel</td></tr>
<tr><td>Overvoltage category*1</td><td colspan="6">II or below</td></tr>
<tr><td>Pollution degree*2</td><td colspan="6">2 or less</td></tr>
<tr><td>Equipment class</td><td colspan="6">Class I</td></tr>
</table>

*1: It is assumed that the device is connected to a power distribution panel somewhere along the circuit from the public electrical power distribution network up to on-plant machinery.
Category II is applicable to devices to which electrical power is supplied from fixed facilities.
The surge voltage withstand of devices up to the rated 300 V is 2500 V.

*2: This index indicates the degree of occurrence of conductive materials in the environment in which that device is used.
Pollution degree 2 indicates that only non-conductive pollution is generated. Note, however, that it is possible that temporary conduction caused by occasional condensation may occur in this environment.

*3: Do not use or store the programmable controller in an environment that is pressurized to atmospheric pressure or higher at altitude 0 m.
If used in this way, the programmable controller may malfunction.
When the programmable controller is to be used at high pressure, please contact your nearest Mitsubishi representative.

Appendix 7.2 Specifications of CPU Module

The following describes the performance specifications of the CPU module.

Performance specifications of CPU module

Item		QS001CPU	Remarks
Control method		Repetitive operation of stored program	-
I/O control mode		Refresh mode	-
Programming language	Sequence control language	Ladder diagram, function block	-
Processing speed (sequence instructions)	LD X0	0.10 μs	-
	MOV D0 D1	0.35 μs	-
Constant scan (function for keeping scan time constant)		1 to 2000 ms (set in increments of 1 ms)	Set in parameters
Program capacity*1		14 kstep (56 kbyte)	-
Memory capacity	Program memory (drive 0)	128 kbyte	-
	Standard ROM (drive 4)	128 kbyte	-
Maximum number of stored files Number of files	Program memory	3*2	-
	Standard ROM	3*2	-
Number of writes to standard ROM		Maximum 100,000 times	-
Number of I/O device points		6,144 points (X/Y0 to 17FF)	Number of points available in program
Number of I/O points		1024 points (X/Y0 to 3FF)	Number of points accessible with actual I/O module

*1: The maximum number of sequence steps that can be executed is calculated by the following formula:
(program capacity) - (file header size (default: 34 steps))
For details on program capacity and files, refer to the manual below.
- QSCPU User's Manual (Function Explanation, Program Fundamentals)

*2: Parameters, sequence program and device comments can be stored to each single file.

Performance specifications of CPU module

Item			QS001CPU	Remarks
Device points	Internal relay [M]		Default 6144 points (M0 to 6143) (changeable)	The number of points used can be changed within the setting range (QSCPU User's Manual (Function Explanation, Program Fundamentals))
	Link relay [B]		Default 2048 points (B0 to 7FF) (changeable)	
	Timer [T]		Default 512 points (T0 to 511) (changeable) (shared by low-speed timer/high-speed timer)	
			Low-speed timer/high-speed timer are specified by instructions Measurement unit of low-speed timer/high-speed timer is specified in parameters (low-speed timer: 1 to 1000 ms, 1 ms unit, default 100 ms) (high-speed timer: 0.1 to 100 ms, 0.1 ms unit, default 10 ms)	
	Retentive timer [ST]		Default 0 points (shared by low-speed retentive timer/high-speed retentive timer) (changeable) Low-speed retentive timer/high-speed retentive timer are specified by instructions Measurement unit of low-speed retentive timer/high-speed retentive timer is specified in parameters (low-speed retentive timer: 1 to 1000 ms, 1 ms unit, default 100 ms) (high-speed retentive timer: 0.1 to 100 ms, 0.1 ms unit, default 10 ms)	
	Counter [C]		Standard counter: Default 512 points (C0 to 511) (changeable)	
	Data register [D]		Default 6144 points (D0 to 6143) (changeable)	
	Link register [W]		Default 2048 points (W0 to 7FF) (changeable)	
	Annunciator [F]		Default 1024 points (F0 to 1023) (changeable)	
	Edge relay [V]		Default 1024 points (V0 to 1023) (changeable)	Number of device points fixed
	Link special relay [SB]		1536 points (SB0 to 5FF)	
	Link special register [SW]		1536 points (SW0 to 5FF)	
	Special relay [SM]		5120 points (SM0 to 5119)	
	Special register [SD]		5120 points (SD0 to 5119)	
RUN/PAUSE contact			1 RUN contact can be set from X0 to 17FF, no PAUSE contact.	Set in parameters
Clock function			Year, month, day, hour, minute, second, day of the week (automatic leap year detection) Accuracy -3.18 to +5.25 s (TYP. +2.14 s)/d at 0°C Accuracy -3.18 to +2.59 s (TYP. +2.07 s)/d at 25°C Accuracy -12.97 to +3.63 s (TYP. -3.16 s)/d at 55°C	-
Allowable momentary power failure time			Power supply module	-
Internal current consumption (5 VDC)			0.43 A	-
External dimensions		H	98 mm	-
		W	55.2 mm	-
		D	113.8 mm	-
Weight			0.29 kg	-
Protection degree			IP2X	-

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Appendix 7.3 Specifications of Power Supply Module

The following describes the specifications of the power supply module.

Power supply module specifications

Item		Performance specifications	
		QS061P-A1	QS061P-A2
Base mount position		QS series power supply module mounting slot	
Applicable base unit		QS034B	
Input power supply		100 to 120 VAC $^{+10\%}_{-15\%}$ (85 V to 132 VAC)	200 to 240 VAC $^{+10\%}_{-15\%}$ (170 to 264 VAC)
Input frequency		50/60 Hz ±5%	
Input voltage distortion factor		Within 5%	
Maximum input apparent power		125 VA	
Inrush current		Within 20A 8 ms*4	
Rated output current	5 VDC	6 A	
Overcurrent protection*1	5 VDC	6.6 A or more	
Overvoltage protection*2	5 VDC	5.5 to 6.5 V	
Efficiency		70% or more	
Allowable momentary power failure time*3		Within 20 ms	
Withstand voltage		Input/LG batch - output/FG batch 1,780 VAC rms/3 cycles (altitude 2,000 m)	Input/LG batch - output/FG batch 2,830 VAC rms/3 cycles (altitude 2,000 m)
Insulation resistance		Input/LG batch - output/FG batch, input batch - LG Output batch - FG 10 MΩ or more when tested by 500 VDC insulation resistance tester	
Noise immunity		• Noise voltage 1500 Vp-p, noise width 1 μs, noise frequency 25 to 60 Hz noise simulator • Noise voltage IEC61000-4-4, 2 kV	
Operation indication		LED display (Normal: lit green Fault: Off)	
Fuse		Built-in (cannot be replaced by user)	
Contact output unit	Application	ERR. contact	
	Rated switching voltage/current	24 VDC, 0.5 A	
	Minimum switching load	5 VDC, 1 mA	
	Response time	OFF → ON: 10 ms or less ON → OFF: 12 ms or less	
	Life	Mechanical: 20 million times or more Electrical: rated switching voltage/current 100,000 times or more	
	Surge suppressor	None	
	Fuse	None	
Terminal screw size		M3.5 screw	
Applicable wire size		0.75 to 2 mm^2	
Applicable solderless terminal		RAV1.25-3.5, RAV2-3.5 (thickness 0.8 mm or less)	
Applicable tightening torque		0.66 to 0.89 N·m	
External dimensions	H	98 mm	
	W	55.2 mm	
	D	115 mm	
Weight		0.40 kg	

POINT

*1: Overcurrent protection
If current exceeding the specifications flows to the 5 VDC circuit, the overcurrent protection function shuts off the circuit to stop the system.
The LED display on the power supply module turns off or lights dimly in green due to voltage drops.
If this equipment is actuated, turn the input power supply OFF, eliminate the cause such as insufficient current capacity or short-circuit, then turn the power ON after several minutes and start-up the system.
If the current value returns to normal, the system is initialized and starts up.

*2: Overvoltage protection
If an overvoltage of 5.5 VDC or higher is applied to the 5 VDC circuit, the overvoltage protection function shuts off the circuit to stop the system.
The LED display on the power supply module turns off.
To restart the system, turn the input power supply OFF and turn it back ON again after several minutes. The system is initialized and starts up. If the system does not start up and the LED display remains off, the power supply module needs to be replaced.

*3: Allowable momentary power failure time
- In case of an instantaneous power failure of within 20 ms, AC down is detected but operation is continued.
- In case of an instantaneous power failure exceeding 20 ms, operation may be continued or the system may be initialized and started up depending on the power supply load.

*4: Inrush current
When the power supply is turned on again immediately after a power off (within 5 seconds), inrush current (2 ms or less) exceeding the specified value sometimes flows. Allow at least 5 seconds before turning the power supply on again after turning it off.
When selecting the fuse or circuit breaker of an external circuit, consider the blown/detection characteristics and the above particulars in the design.

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Appendix 7.4 Specifications of Safety Remote I/O Module

(1) to (3) describes the performance specifications of the safety remote I/O module.

(1) QS0J65BTS2-8D

Performance specifications of QS0J65BTS2-8D

Item		DC input module
		QS0J65BTS2-8D
Number of input points		8 (input terminal 16 points*2)
Isolation method		Photocoupler isolation
Rated input voltage		24 VDC
Rated input current		Approx. 5.9 mA
Operating voltage range		19.2 to 28.8 VDC (ripple ratio within 5%)
Maximum number of simultaneous input points		100%
ON voltage/ON current		15 VDC or more/2 mA or more
OFF voltage/OFF current		5 VDC or less/0.5 mA or less
Input resistance		Approx. 4.3 kΩ
Input type		Negative common (source type)
Response time	OFF → ON	0.4 ms or less (for 24 VDC)
	ON → OFF	0.4 ms or less (for 24 VDC)
Safety remote station input response time		11.2 ms or less + time of noise removal filter (1 ms, 5 ms, 10 ms, 20 ms, 50 ms)
External power supply	Voltage	19.2 to 28.8 VDC (ripple ratio within 5%)
	Current	40 mA (24 VDC, all points ON, not including external load current)
	Protective functions	External power supply overvoltage protection function, external power supply overcurrent protection function
	Fuse	8 A (not replaceable)
Wiring method for common		Input 16 points 1 common (spring clamp terminal block two-wire type)
Number of occupied stations		1
Number of accesses to non-volatile memory in module		10^{12} times
Safety refresh response processing time		9.6 ms
Module power supply*1	Voltage	19.2 to 28.8 VDC (ripple ratio within 5%)
	Current	120 mA or less (24 VDC, all points ON)
	Protective functions	Module power supply overvoltage protection function, module power supply overcurrent protection function
	Fuse	0.8 A (not replaceable)
	Momentary power failure time	10 ms or less
Noise immunity		DC type noise voltage 500 Vp-p, noise width 1 μs, noise frequency 25 to 60 Hz noise simulator
Withstand voltage		500 VDC between all DC external terminals - ground, for 1 minute
Insulation resistance		10 MΩ or more between all DC external terminals - ground with 500 VDC insulation resistance tester
Protection degree		IP2X
Weight		0.46 kg

*1: Connect a power supply that satisfies the following conditions to QS0J65BTB2-8D:
- Having reinforced isolation SELV (Safety Extra Low Voltage) with hazardous potential areas (48 V or more)
- Compatible with the LVD command
- Having an output voltage specification of 19.2 to 28.8 VDC (ripple ratio within 5%)

*2: Because of dual wiring, use two input terminal points per single input.

QS0J65BTS2-8D performance specifications (continued)

Item			DC input module
			QS0J65BTS2-8D
External connection system	Communication part, module power supply part		7-point two-piece terminal block [transmission path, module power supply, FG] M3 × 5.2 tightening torque 0.425 to 0.575 N·m Number of applicable solderless terminals inserted two or less
	External power supply part, input part		Two-piece spring clamp [external power supply, input part]
Module mounting screw			M4 screw with plain washer finished round (tightening torque range 0.824 to 1.11 N·m) DIN rail mountable, mountable in 6 directions
Applicable DIN rail			TH35-7.5Fe, TH35-7.5Al (JIS C 2812 compliant)
Applicable wire size	Communication part, module power supply part		0.3 to 2.0 mm^2
		Applicable solderless terminal	• RAV1.25-3 (JIS C 2805 compliant) [applicable wire size: 0.3 to 1.25 mm^2] • V2-MS3 (manufactured by JST Mfg. Co. Ltd.), RAP2-3SL (Nippon Tanshi Co.,Ltd.), TGV2-3N (NICHIFU Co.,Ltd.) [Applicable wire size: 1.25 to 2.0 mm^2]
	External power supply part, input part		Stranded wire 0.08 to 1.5 mm^2 (AWG 28 to 16)*3 Applicable wire - Wire strip length: 8 to 11 mm
		Applicable solderless terminal	• TE0.5 (NICHIFU Co.,Ltd.) [applicable wire size: 0.5 mm^2] • TE0.75 (NICHIFU Co.,Ltd.) [applicable wire size: 0.75 mm^2] • TE1 (NICHIFU Co.,Ltd.) [applicable wire size: 0.9 to 1.0 mm^2] • TE1.5 (NICHIFU Co.,Ltd.) [applicable wire size: 1.25 to 1.5 mm^2] • FA-VTC125T9 (Mitsubishi Electric Engineering Co., Ltd.) [applicable wire size: 0.3 to 1.65 mm^2] • FA-VTC125T9 (Mitsubishi Electric Engineering Co., Ltd.) [applicable wire size: 0.3 to 1.65 mm^2]

*3: Do not insert two or more wires in one terminal.

(2) QS0J65BTS2-4T

Performance specifications of QS0J65BTS2-4T

Item		Transistor output module
		QS0J65BTS2-4T
Number of output points		4 (when source + sink type is selected) 2 (when source + source type is selected)
Isolation method		Photocoupler isolation
Rated load voltage		24 VDC
Operating load voltage range		19.2 to 28.8 VDC (ripple ratio within 5%)
Maximum load current		0.5 A/1 point
Maximum inrush current		1.0 A 10 ms or less
Leakage current at OFF		0.5 mA or less
Maximum voltage drop at ON		1.0 VDC or less
Protective functions		Output overload protection function
Output type		Source + sink type Source + source type
Response time	OFF → ON	0.4 ms or less (for 24 VDC)
	ON → OFF	0.4 ms or less (for 24 VDC)
Safety remote station output response time		10.4 ms or less (ON → OFF), 11.2 ms or less (OFF → ON)
Surge suppressor		Zener diode
External power supply	Voltage	19.2 to 28.8 VDC (ripple ratio within 5%)
	Current	45 mA (24 VDC, all points ON, not including external load current)
	Protective functions	External power supply overvoltage protection function, external power supply overcurrent protection function
	Fuse	8 A (not replaceable)
Wiring method for common		Output 4 points 1 common (spring clamp terminal block two-wire type)
Common current		Maximum 2 A
Number of occupied stations		1
Number of accesses to non-volatile memory in module		10^{12} times
Safety refresh response processing time		9.6 ms
Module power supply*1	Voltage	19.2 to 28.8 VDC (ripple ratio within 5%)
	Current	95 mA or less (24 VDC, all points ON)
	Protective functions	Module power supply overvoltage protection function, module power supply overcurrent protection function
	Fuse	0.8 A (not replaceable)
	Momentary power failure time	10 ms or less
Noise immunity		DC type noise voltage 500 Vp-p, noise width 1 μs, noise frequency 25 to 60 Hz noise simulator
Withstand voltage		500 VDC between all DC external terminals - ground, for 1 minute
Insulation resistance		10 MΩ or more between all DC external terminals - ground with 500 VDC insulation resistance tester
Protection degree		IP2X
Weight		0.45 kg
External connection system	Communication part, module power supply part	7-point two-piece terminal block [transmission path, module power supply, FG] M3 × 5.2 tightening torque 0.425 to 0.575 N·m Number of applicable solderless terminals inserted 2 or less
	External power supply unit, output unit	Two-piece spring clamp [external power source, output unit]
Module mounting screw		M4 screw with plain washer finished round (tightening torque range 0.824 to 1.11 N·m) DIN rail mountable, mountable in 6 directions

*1: Connect a power supply that satisfies the following conditions to QS0J65BTB2-4T.
- Having reinforced isolation SELV (Safety Extra Low Voltage) with hazardous potential areas (48 V or more)
- Compatible with the LVD command
- Having an output voltage specification of 19.2 to 28.8 VDC (ripple ratio within 5%)

QS0J65BTB2-4T performance specifications (continued)

Item			Transistor output module
			QS0J65BTS2-4T
Applicable DIN rail			TH35-7.5Fe, TH35-7.5Al (JIS C 2812 compliant)
Applicable wire size	Communication part, module power supply part		0.3 to 2.0 mm^2
		Applicable solderless terminal	• RAV1.25-3 (JIS C 2805 compliant) [applicable wire size: 0.3 to 1.25 mm^2] • V2-MS3 (JST Mfg. Co. Ltd.), RAP2-3SL (Nippon Tanshi Co.,Ltd.), TGV2-3N (NICHIFU Co.,Ltd.) [Applicable wire size: 1.25 to 2.0 mm^2]
	External power supply unit, output unit		Stranded wire 0.08 to 1.5 mm^2 (AVG 28 to 16)*2 Applicable wire - Wire strip length: 8 to 11 mm
		Applicable solderless terminal	• TE0.5 (NICHIFU Co.,Ltd.) [applicable wire size: 0.5 mm^2] • TE0.75 (NICHIFU Co.,Ltd.) [applicable wire size: 0.75 mm^2] • TE1 (NICHIFU Co.,Ltd.) [applicable wire size: 0.9 to 1.0 mm^2] • TE1.5 (NICHIFU Co.,Ltd.) [applicable wire size: 1.25 to 1.5 mm^2] • FA-VTC125T9 (Mitsubishi Electric Engineering Co.,Ltd.) [applicable wire size: 0.3 to 1.65 mm^2] • FA-VTC125T9 (Mitsubishi Electric Engineering Co.,Ltd.) [applicable wire size: 0.3 to 1.65 mm^2]

*2: Do not insert two or more wires in one terminal.

(3) QS0J65BTB2-12DT

Performance specifications of QS0J65BTB2-12DT

Item		DC input/transistor output combined module		
		QS0J65BTB2-12DT		
Input specifications			Output specifications	
Number of input points		8 (input terminal 16 points[*2])	Number of output points	4 (when source + sink type is selected) 2 (when source + source type is selected)
Isolation method		Photocoupler isolation	Isolation method	Photocoupler isolation
Rated input voltage		24 VDC	Rated load voltage	24 VDC
Rated input current		Approx. 4.6mA	Operating load voltage range	19.2 to 28.8 VDC (ripple ratio within 5%)
Operating voltage range		19.2 to 28.8 VDC (ripple ratio within 5%)	Maximum load current	0.5 A/1 point
Maximum number of simultaneous input points		100%	Maximum inrush current	1.0 A 10 ms or less
ON voltage/ON current		15 VDC or more/2 mA or more	Leakage current at OFF	0.5 mA or less
OFF voltage/OFF current		5 VDC or less/0.5 mA or less	Maximum voltage drop at ON	1.0 VDC or less
Input resistance		Approx. 5.6 kΩ	Protective functions	Output overload protection function
Input type		Negative common (source type)	Output type	Source + sink type Source + source type
Response time	OFF → ON	0.4 ms or less (for 24 VDC)	Response time: OFF → ON	0.4 ms or less (for 24 VDC)
	ON → OFF	0.4 ms or less (for 24 VDC)	Response time: ON → OFF	0.4 ms or less (for 24 VDC)
Safety remote station input response time		11.2 ms[*3] or less + noise removal filter time (1 ms, 5 ms, 10 ms, 20 ms, 50 ms)	Safety remote station output response time	10.4 ms or less (ON → OFF), 11.2 ms or less (OFF → ON)[*4]
			Surge suppressor	Zener diode
External power supply	Voltage	19.2 to 28.8 VDC (ripple ratio within 5%)		
	Current	60 mA (24 VDC, all points ON, not including external load current)		
	Protective functions	External power supply overvoltage protection function, external power supply overcurrent protection function		
	Fuse	8 A (not replaceable)		
Wiring method for common		Input 16 points 1 common, output 4 points 1 common (terminal block two-wire type)		
Common current		Maximum 4 A (input, output total)		
Number of occupied stations		1		
Number of accesses to non-volatile memory in module		10^{12} times		
Safety refresh response processing time		9.6 ms[*5]		
Module power supply[*1]	Voltage	19.2 to 28.8 VDC (ripple ratio within 5%)		
	Current	140 mA or less (24 VDC, all points ON)		
	Protective functions	Module power supply overvoltage protection function, module power supply overcurrent protection function		
	Fuse	0.8 A (not replaceable)		
	Momentary power failure time	10 ms or less		

*1: Connect a power supply that satisfies the following conditions to QS0J65BTB2-12DT.
- Having reinforced isolation SELV (Safety Extra Low Voltage) with hazardous potential areas (48 V or more)
- Compatible with the LVD command
- Having an output voltage specification of 19.2 to 28.8 VDC (ripple ratio within 5%)

*2: Because of dual wiring, use two input terminal points per single input.
*3: In case of technical version A, the safety remote station input response time is "32 ms or less + noise removal filter time".
*4: In case of technical version A, the safety remote station output response time is 32 ms or less.
*5: In case of technical version A, the safety refresh response processing time is 38 ms.

Performance specifications of QS0J65BTB2-12DT

Item		DC input/transistor output combined module
		QS0J65BTB2-12DT
Noise immunity		DC type noise voltage 500 Vp-p, noise width 1 μs, noise frequency 25 to 60 Hz noise simulator
Withstand voltage		500 VDC between all DC external terminals - ground, for 1 minute
Insulation resistance		10 MΩ or more between all DC external terminals - ground with 500 VDC insulation resistance tester
Protection degree		IP2X
Weight		0.67 kg
External connection system	Communication part, module power supply part	7-point two-piece terminal block [transmission path, module power supply, FG] M3 × 5.2 tightening torque 0.425 to 0.575 N·m Number of applicable solderless terminals inserted two or less
	External power supply part, I/O part	18 point two-piece terminal block × 3 [external power supply, I/O signal] M3 × 5.2 tightening torque 0.425 to 0.575 N·m Number of applicable solderless terminals inserted 2 or less
Module mounting screw		M4 screw with plain washer finished round (tightening torque range 0.824 to 1.11 N·m) DIN rail mountable, mountable in six directions
Applicable DIN rail		TH35-7.5Fe, TH35-7.5Al (JIS C 2812 compliant)
Applicable wire size		0.3 to 2.0 mm^2
Applicable solderless terminal		• RAV1.25-3 (JIS C 2805 compliant) [applicable wire size: 0.3 to 1.25 mm^2] • V2-MS3 (manufactured by JST Mfg. Co. Ltd.), RAP2-3SL (Nippon Tanshi Co.,Ltd.), TGV2-3N (NICHIFU Co.,Ltd.) [Applicable wire size: 1.25 to 2.0 mm^2]

Appendix 7.5 Specifications of Base Unit

The following describes the specifications of the base units that can be used in the programmable controller system.

Base unit specifications

Item		Model
		QS034B
Number of mountable I/O modules		4
Extension possibilities		Not extendable
Applicable module		QS series module
Internal current consumption (5 VDC)		0.10 A
Mounting hole size		M4 screw hole or φ4.5 hole (for M4 screw)
External dimensions	H	98 mm
	W	245 mm
	D	44.1 mm
Weight		0.28 kg
Accessory		Mounting screws M4×14 4 screws (DIN rail adapter sold separately)
DIN rail adapter model		Q6DIN2

The modules that can be mounted on the base unit are shown in the table below.
The number of modules mounted and functions are restricted depending on the type of module.

Modules that can be mounted on base unit

Name	Model	Maximum number of mountable modules per system	Remarks
CPU module	• QS001CPU	Only one	-
Power supply module	• QS061P-A1 • QS061P-A2	Either one only	-
CC-Link Safety master module (*)	• QS0J61BT12	Up to two	-
CC-link IE Controller Network module	• QJ71GP21-SX • QJ71GP21S-SX	Either one in combination of CC-Link IE Controller Network module and MELSECNET/H module	• First five digits of serial N.: 10041 onwards • Function version: D onwards
MELSECNET/H module	• QJ71LP21-25 • QJ71LP21S-25 • QJ71LP21G • QJ71LP21GE • QJ71BR11		-
Ethernet module	• QJ71E71-B2 • QJ71E71-B5 • QJ71E71-B100	Either one only	-
Blank cover	• QG60	Up to four	-

(*): Slave stations that can be used on QS0J61BT12 are safety remote I/O station, standard remote I/O station (Ver. 1 compatible) and standard remote device station (Ver. 1 compatible).

POINT

- The extension base unit cannot be connected.
- A multi CPU system cannot be configured.
- Only the CC-Link Safety master module, CC-Link IE Controller network module, MELSECNET/H module, Ethernet module, and blank cover can be mounted in I/O slots.
  When modules other than these are mounted, the "MODULE LAYOUT ERROR" (error code: 2125) is detected. Note, however, that the "MODULE LAYOUT ERROR" is not detected for slots whose set as "empty" at "type" in the PLC parameter I/O assignment settings.
- Though a bus connection cannot be made to a GOT, MELSECNET/H connection, Ethernet connection and CC-Link connection can be made.

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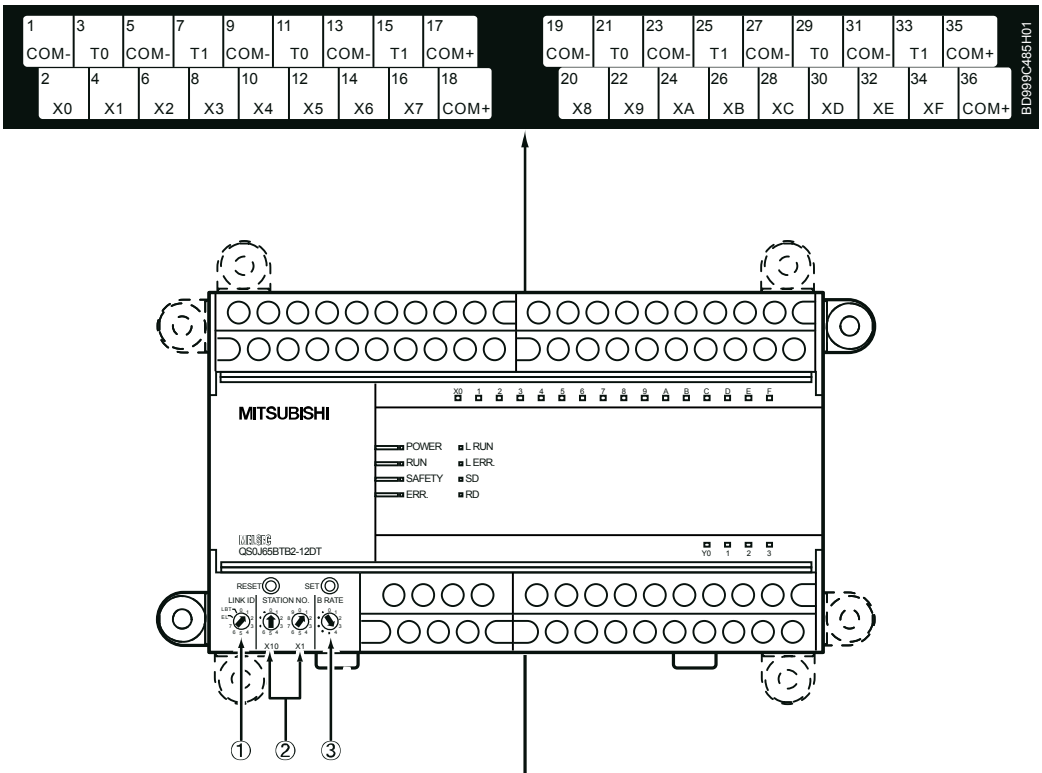
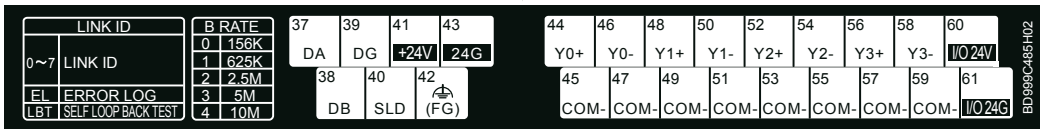
Appendix 8 Safety Remote I/O Module Terminal Layout

The main unit switch settings of the safety remote I/O module (QS0J65BTB2-12DT) installed on the training machine used in this school text are as follows.
* Do not change the settings as this will cause an error.

[Terminal number and signal name]



[Terminal number and signal name]



No.	Name	Setting value
(1)	LID	1
(2)	Station number	1
(3)	Transmission speed	4 (10 Mbps)

For details, refer to the CC-Link Safety System Remote I/O Module User's Manual (Details).

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Appendix 9 Clearing Safety Programmable Controller Errors

In the CPU module, errors can be cleared by the program only in the case of errors that allow continuation of program operation.
Continuation errors can be confirmed by bits of SD81 (error cause) in a "1" state.
Error causes corresponding to SD81 bit Nos. and continuation error are shown in the table below.

SD81 bit No. corresponding to the continuation error and error cause		Continuation error corresponding to SD81 bit No.	
Bit No.	Error cause	Error code	Error message
0	Momentary power failure	1500	AC/DC DOWN
1	Battery low	1600	BATTERY ERROR
2	Number of writes to standard ROM exceeded	1610	EXCEED MAX FLASH ROM REWRIT.ERR.
3	Test mode continuous RUN permissible time exceeded	8100	TEST MODE TIME EXCEEDED
4	Scan time exceeded	5010	PROGRAM SCAN TIME OVER
5	Annunciator ON	9000	F**** (**** is annunciator No.)
6	Safety remote station detection error	8300	CC-LINK REMOTE DETECTION ERROR
7	Safety remote station product information mismatch	8310	CC-LINK PRODUCT INFO. MISMATCH
8	Initial monitoring time-out error Safety monitoring time-out error Error monitoring time-out error	8320 8321 8322	CC-LINK DATA RECEPTION TIMEOUT
9	Safety remote station command error Safety remote station data split error Safety remote station link ID error Safety remote station running No. error Safety remote station received data error	8330 8331 8332 8333 8334	CC-LINK RECEIVED DATA ERROR

(1) Error clear procedure
Clear errors by the following procedure.

(a) Read SD81 using GX Developer, and confirm the cause of the continuation error occurring in the CPU module.
(b) Resolve the cause of the error.
(c) Store the error codes to be cleared in the special register SD50.
(d) Turn the special relay SM50 OFF then ON.
(e) Again read SD81 using GX Developer, and check that the bit corresponding to the cleared continuation error is OFF.
(f) Turn the special relay SM50 OFF.

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(2) Status after error clear
When the CPU module is recovered by an error clear, the special relays, special registers and LED related to the error return to the state that was active before the error occurred.
The error history does not change.
When the same error re-occurs after an error clear, the error is registered again to the operation and error histories.

(3) Clearing annunciators
In case when multiple annunciators are detected, only the F number first is cleared.

(4) Error clear when multiple continuation errors occur
When an error clear is performed for multiple continuation errors, operation of the LED display on the CPU module and error information are as follows.

Error clear state	LED display *1 (ERR. LED, BAT/LED, USER LED)	Error information (SM0, SM15, SM16, SD0 to 26)
Before error clear	ON	The error information of the last occurring continuation error is stored.
↓		
The last occurring continuation error is cleared. (Uncleared continuation errors remain.)	ON	Return to no error state.
All errors except the last occurring continuation error are cleared. (Uncleared continuation errors remain.)	ON	No change. (The information of the last occurring error is retained.)
↓		
All continuation errors are cleared.	OFF	No error.

*1: (1) When error code: 1600 ("BATTERY ERROR") occurs, only the "BAT." LED turns ON.
When error code: 1600 is cleared, the "BAT." LED turns OFF.
(2) When error code: 9000 (F****) occurs, only the "USER" LED turns ON.
When error code: 9000 is cleared, the "USER" LED turns OFF.

POINT

(1) When the error code is cleared by storing it in SD50, the code number of the last digit is ignored.
(Ex)
When error codes 2100 and 2106 occur, error code 2106 is also cleared when error code 2100 is cleared.
When error codes 2100 and 2125 occur, error code 2125 is not cleared even if error code 2100 is cleared.

(2) In case of errors occurring due to causes other than the CPU module, the error cause cannot be resolved even by clearing errors by special relay (SM50) and special register (SD50).
(Ex)
Since the "INTELLIGENT FUNCTION MODULE DOWN" error occurs on a base unit, intelligent function module, etc., the error cause cannot be resolved even by clearing errors by special relay (SM50) and special register (SD50).
Resolve error causes by referring to the list of error codes described in the QSCPU User's Manual (Hardware Design, Maintenance and Inspection).

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Appendix 10 List of Parameters

This appendix describes the parameters of the safety remote I/O module.
It is possible to set input parameters for input modules, output parameters for output modules, and both input and output parameters for combined modules.

(1) Input parameters

(a) Applicable model
The following table shows the models to which input parameters can be set.

Type	Model
Input module	• QS0J65BTS2-8D
Combined module	• QS0J65BTB2-12DT

(b) Input parameter list

Input parameter list

Parameter name	Parameter item	Description
Time of noise removal filter	1. Time of noise removal filter X0,1 ≀ 8. Time of noise removal filter XE,F	The time of noise removal filter function sets the filter time for reducing noise in input signals. Set the filter time so that it is longer than the input dark test pulse OFF time. Default: 1 ms Setting range: 1 ms, 5 ms, 10 ms, 20 ms, 50 ms
Dual input mismatch detection time	9. Dual input mismatch detection time X0, 1 ≀ 16. Dual input mismatch detection time XE, F	Set the ON/OFF transient state time in units of 20 ms in case of dual wiring. An error occurs if the ON/OFF mismatch state continues for the set time or longer. Default: 1 ms Setting range*1: 20 ms, 40 ms, 60 ms, 80 ms, 100 ms, 120 ms, 140 ms, 160 ms, 180 ms, 200 ms, 220 ms, 240 ms, 260 ms, 280 ms, 300 ms, 320 ms, 340 ms, 360 ms, 380 ms 400 ms, 420 ms, 440 ms 460 ms, 480 ms, 500 ms, 1 s, 2 s, 5 s, 10 s, 20 s, 30 s, 60 s
Input dark test execution selection	17. Input dark test execution selection X0, 1 ≀ 24. Input dark test execution selection XE, F	Set whether the "Input dark test function" of the diagnostic functions of the safety remote I/O module is to be executed or not. Default: Execute Setting range: Execute : Do not execute
Input dark test pulse OFF time	25. Input dark test pulse OFF time	Set the OFF pulse width that is output by the T0, T1 terminals. Default: 400 μs Setting range: 400μs, 1 ms, 2 ms

*1: Input a numerical value between 1 and 25 (× 20 ms) on the QS0J65BTB2-12DT.

(2) Output parameters

(a) Applicable model

The following table shows the models to which output parameters can be set.

Type	Model
Output module	• QS0J65BTS2-4T
Combined module	• QS0J65BTB2-12DT

(b) Output parameter list

Output parameter list

Parameter name	Parameter item	Description
Output wiring method	26. Output wiring method Y0 ≀ 29. Output wiring method Y3	Sets the output wiring method. Default: Unused Setting range: Unused : Dual wiring (source + sink) : Dual wiring (source + source)
Output dark test execution selection	30. Output dark test execution selection Y0 ≀ 33. Output dark test execution selection Y3	Set whether the "Output dark test function" of the diagnostic functions of the safety remote I/O module is to be executed or not. Default: Execute Setting range: Execute : Do not execute
Output dark test pulse OFF time	34. Output dark test pulse OFF time Y0 ≀ 37. Output dark test pulse OFF time Y3	Set the OFF pulse width used in the output dark test. Default: 400 μs Setting range: 400μs, 1 ms, 2 ms

For the details of parameters, refer to the CC-Link Safety System Master Module User's Manual (Details).

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Appendix 11 List of Instructions

Appendix 11.1 Instruction Classification

The instructions of the safety CPU module are broadly classified into sequence instructions, basic instructions, application instructions, and QSCPU dedicated instructions. The following table shows the instruction categories.

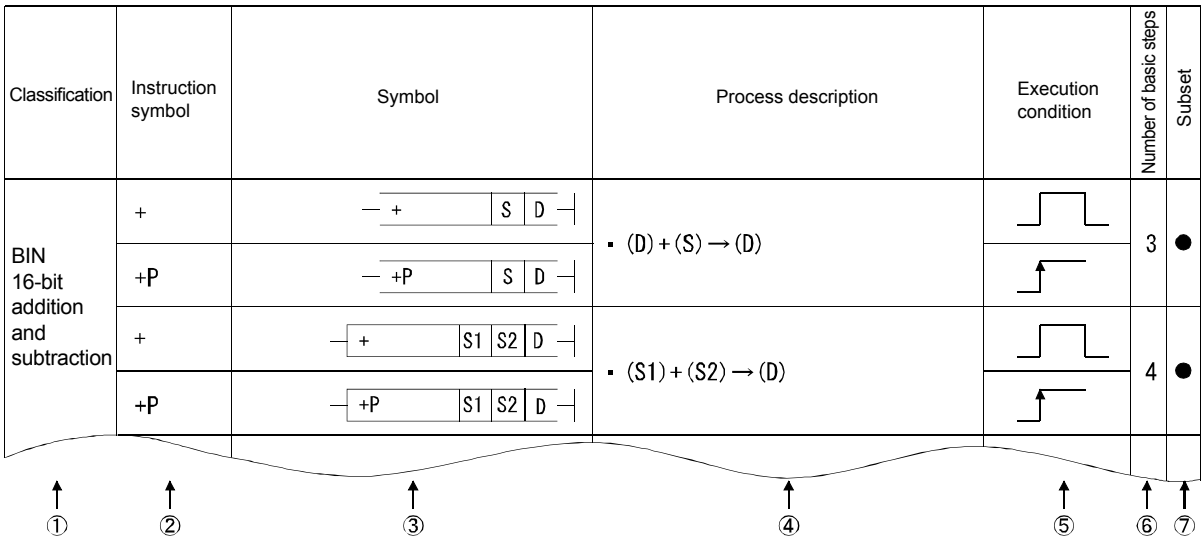
Instruction categories

Instruction categories		Description
Sequence instructions	Contact instructions	Operation start, series connection, parallel connection
	Association instructions	Connection of ladder block, storing/reading of operation result, pulse conversion of operation result
	Output instructions	Output of bit device, output inversion
	Master control instructions	Master control
	Termination instructions	Termination of program
	Other instructions	Instructions that do not fall into the above categories, such as non-processing instructions
Basic instructions	Comparison operation instructions	Comparisons such as =, >, <
	Arithmetic operation instructions	BIN addition, subtraction, multiplication and division
	BCD ↔ BIN conversion instruction	BCD → BIN, BIN → BCD conversion
	Data transfer instructions	Transfer of specified data
Application instructions	Logical operation instructions	Logical operations such as logical sum, logical product
QSCPU dedicated instructions	QSCPU dedicated instruction	Forced control stop

Appendix 11.2 How to View the List of Instructions

Instruction lists from Appendix 11.3 to Appendix 11.6 are in the following format.

How to view lists of instructions

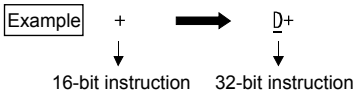


Description

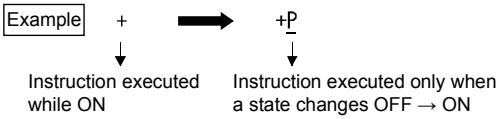
(1) Instructions are classified according to application.

(2) This shows the instruction symbol used in the program.
Instruction symbols are based on 16-bit instructions
The results are as follows in the case of 32-bit instructions and instructions that are executed only when a state changes OFF → ON.

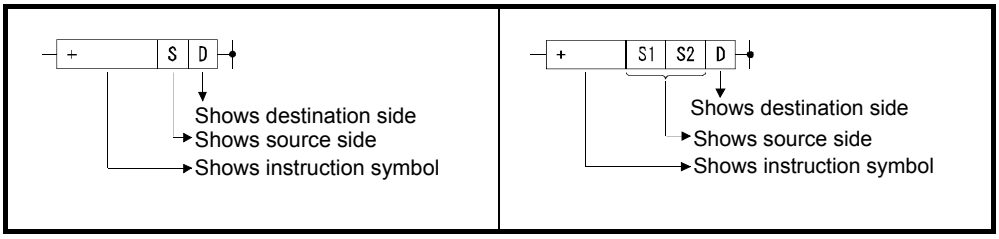
- 32-bit instructions: The instruction is prefixed with "D".



- In case of instructions that are executed only when a state changes OFF → ON: The instruction is appended with "P".



(3) This shows the symbol figure on the ladder.



Symbol figures on ladders

Destination: This indicates the destination of the data after operation.
Source: This stores the data before an operation.

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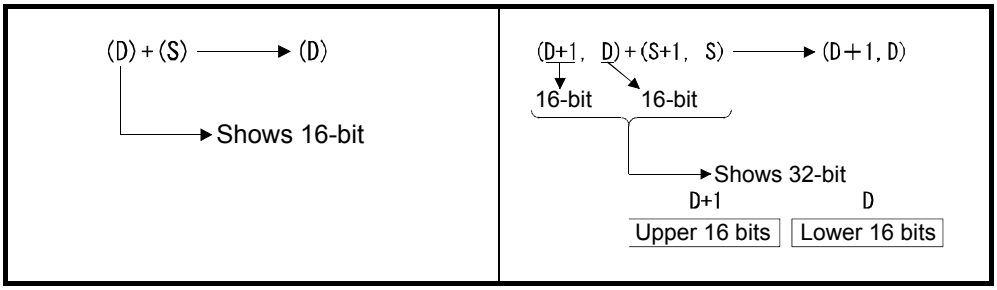
(4) This shows the content of each instruction.



Content of each instruction

(5) Details are as follows according to the execution conditions of each instruction:

Symbol	Execution condition
Blank	This type of instruction is executed at all times. It is executed at all times irrespective of whether the precondition of the instruction is ON/OFF. When the precondition is OFF, the instruction executes the OFF process.
	This type of instruction is executed while ON. It is executed while the precondition of the instruction is ON. When the precondition is OFF, that instruction is neither executed nor processed.
	This type of instruction is executed once while ON. It is executed only at the rise (state OFF → ON) of the precondition of the instruction. Even if the precondition is ON from then on, that instruction is neither executed nor processed.
	This type of instruction is executed while OFF. It is executed while the precondition of the instruction is OFF. When the prior condition is ON, the instruction is neither executed nor processed.
	This type of instruction is executed once while OFF. It is executed only at the rise (state ON → OFF) of the precondition of the instruction. Even if the precondition stays OFF, that instruction is neither executed nor processed.

(6) This shows the number of basic steps of each instruction.

(7) The ● mark shows that the instruction can be processed in subsets.

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Appendix 11.3 Sequence Instructions

(1) Contact instructions

Contact instructions

Classification	Instruction symbol	Symbol	Process description	Execution condition	Basic number of steps	Subset
Contact	LD		• Logical operation start (Normally open contact logical operation start)		1	•
	LDI		• Logical NOT operation start (Normally closed contact logical operation start)			
	AND		• logical product (Normally open contact series connection)			
	ANI		• Logical product NOT (Normally closed contact series connection)			
	OR		• Logical sum (Normally open contact parallel connection)			
	ORI		• Logical sum NOT (Normally closed contact parallel connection)			
	LDP		• Rise pulse operation start		1	•
	LDF		• Fall pulse operation start			
	ANDP		• Rise pulse series connection			
	ANDF		• Fall pulse series connection			
	ORP		• Rise pulse parallel connection			
	ORF		• Fall pulse parallel connection			

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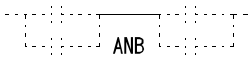
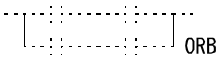
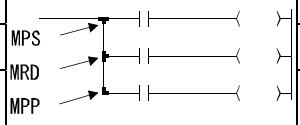
(2) Association instructions

Association instructions

Classifi-cation	Instruction symbol	Symbol	Process description	Execution condition	Basic number of steps	Subset
Association	ANB		• AND between logical blocks (Series connection between logical blocks)		1	-
	ORB		• OR between logical blocks (Series connection between logical blocks)			
	MPS		• Operation result recording		1	-
	MRD		• Reading of operation results stored by MPS			
	MPP		• Reading and resetting of operation results stored by MPS			
	INV		• Operation result inversion		1	-
	MEP		• Operation result rise pulse conversion		1	-
	MEF		• Operation result fall pulse conversion			
	EGP		• Operation result rise pulse conversion (Stored in Vn)		1	-
	EGF		• Operation result fall pulse conversion (Stored in Vn)		2	

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(3) Output instructions

Output instructions

Classification	Instruction symbol	Symbol	Process description	Execution condition	Basic number of steps	Subset
Output	OUT	—( )—	• Device output		*1	-
	SET	SET D	• Device setting	*2	*1	
	RST	RST D	• Device resetting	*2	*1	-
	PLS	PLS D	• Pulse of one program cycle is generated at the rise of the input signal.		2	-
	PLF	PLF D	• Pulse of one program cycle is generated at the fall of the input signal.			
	FF	FF D	• Device output inversion		2	-

*1: The number of steps differs according to the used device.
For details on the number of steps, refer to the page that describes the respective instruction.
*2: Only when annunciator (F) is used.

(4) Master control instructions

Master control instructions

Classification	Instruction symbol	Symbol	Process description	Execution condition	Basic number of steps	Subset
Master control	MC	MC n D	• Master control start		2	-
	MCR	MCR n	• Master control clear		1	

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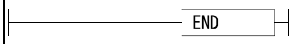
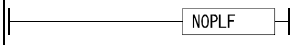
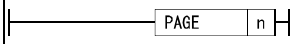
(5) Termination instructions

Termination instructions

Classification	Instruction symbol	Symbol	Process description	Execution condition	Basic number of steps	Subset
Termination	END		• Termination of sequence program		1	-

(6) Other instructions

Other instructions

Classification	Instruction symbol	Symbol	Process description	Execution condition	Basic number of steps	Subset
Non-processing	NOP		• Non-processing (for cancellation of program or space)		1	-
	NOPLF		• Non-processing (for page return during printing)			
	PAGE		• Non-processing (Subsequent program is managed as step 0 onwards of nth page)			

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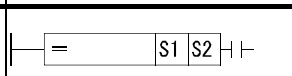
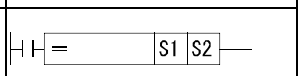
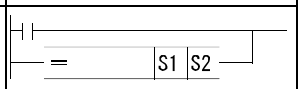
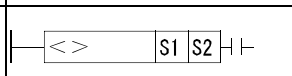
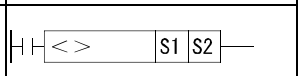
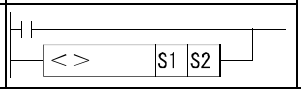
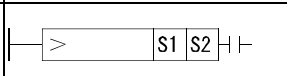
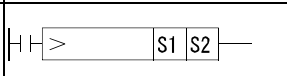
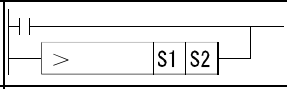
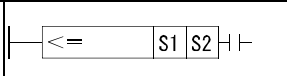
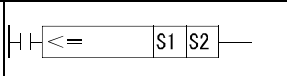
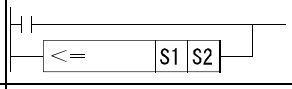
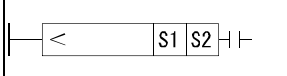
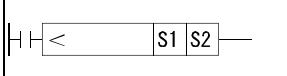
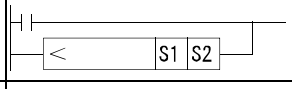
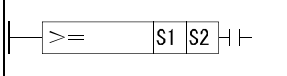
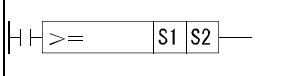
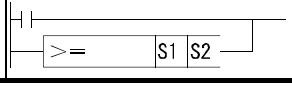
Appendix 11.4 Basic Instructions

(1) Comparison operation instructions

Comparison operation instructions

Classification	Instruction symbol	Symbol	Process description	Execution condition	Basic number of steps	Subset
BIN 16-bit data comparison	LD=		• When (S1) = (S2), continuity state • When (S1) ≠ (S2), non-continuity state		3	•
	AND=					
	OR=					
	LD<>		• When (S1) ≠ (S2), continuity state • When (S1) = (S2), non-continuity status		3	•
	AND<>					
	OR<>					
	LD>		• When (S1) > (S2), continuity state • When (S1) ≤ (S2), non-continuity state		3	•
	AND>					
	OR>					
	LD<=		• When (S1) ≤ (S2), continuity state • When (S1) > (S2), non-continuity state		3	•
	AND<=					
	OR<=					
	LD<		• When (S1) < (S2), continuity state • When (S1) ≥ (S2), non-continuity state		3	•
	AND<					
	OR<					
	LD>=		• When (S1) ≥ (S2), continuity state • When (S1) < (S2), non-continuity state		3	•
	AND>=					
	OR>=					

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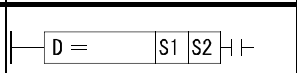
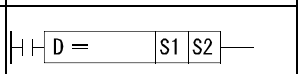
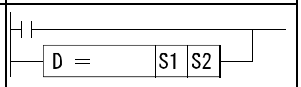
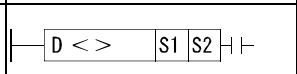
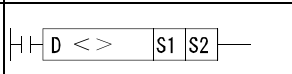
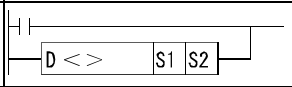
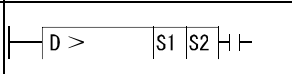
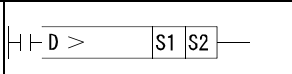
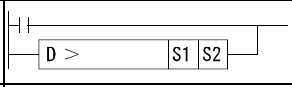
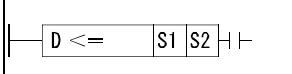
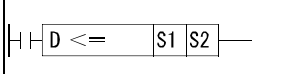
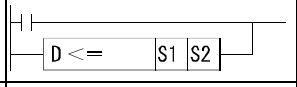
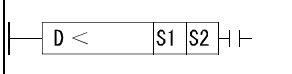
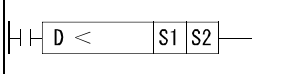
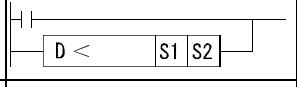
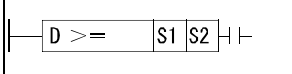
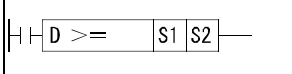
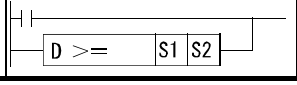
Comparison operation instructions (Continued)

Classification	Instruction symbol	Symbol	Process description	Execution condition	Basic number of steps	Subset
BIN 32-bit data comparison	LDD=		• When (S1 + 1, S1) = (S2 + 1, S2) Continuity state • When (S1 + 1, S1) ≠ (S2 + 1, S2) Non-continuity state		3	•
	ANDD=					
	ORD=					
	LDD<>		• When (S1 + 1, S1) ≠ (S2 + 1, S2) Continuity state • When (S1 + 1, S1) = (S2 + 1, S2) Non-continuity state		3	•
	ANDD<>					
	ORD<>					
	LDD>		• When (S1 + 1,S1) > (S2 + 1,S2) Continuity state • When (S1 + 1,S1) ≤ (S2 + 1,S2) Non-continuity state		3	•
	ANDD>					
	ORD>					
	LDD<=		• When (S1 + 1,S1) ≤ (S2 + 1,S2) Continuity state • When (S1 + 1,S1) > (S2 + 1,S2) Non-continuity state		3	•
	ANDD<=					
	ORD<=					
	LDD<		• When (S1 + 1,S1) < (S2 + 1,S2) Continuity state • When (S1 + 1,S1) ≥ (S2 + 1,S2) Non-continuity state		3	•
	ANDD<					
	ORD<					
	LDD>=		• When (S1 + 1,S1) ≥ (S2 + 1,S2) Continuity state • When (S1 + 1,S1) < (S2 + 1,S2) Non-continuity state		3	•
	ANDD>=					
	ORD>=					

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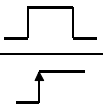
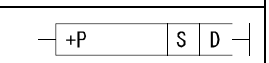
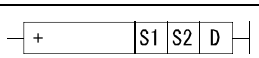
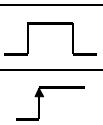
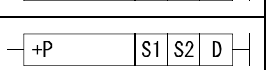
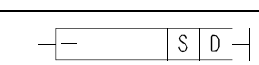
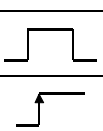
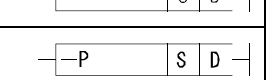
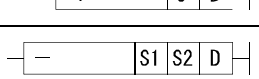
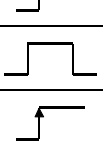
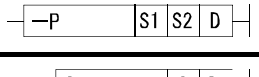
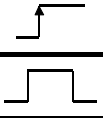
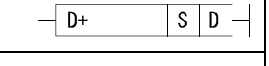
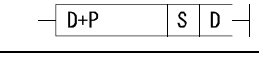
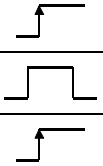
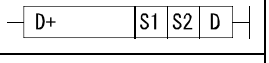
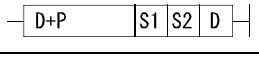
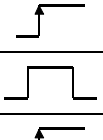
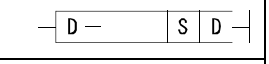
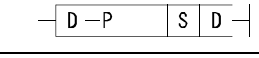
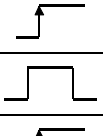
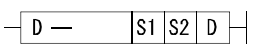
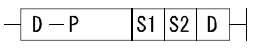
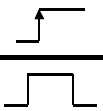
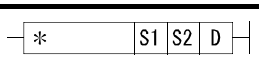
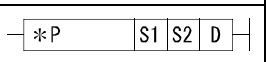
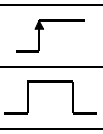
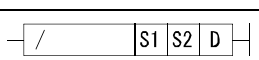
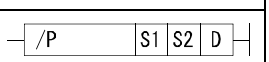
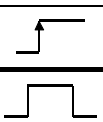
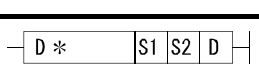
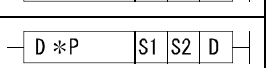
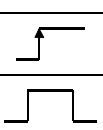
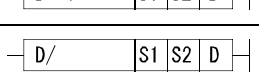
(2) Arithmetic operation instructions

Arithmetic operation instructions

Category	Instruction symbol	Symbol	Process description	Execution condition	Basic number of steps	Subset
BIN 16-bit addition and subtraction	+		• (D) + (S) → (D)		3	•
	+P					
	+		• (S1)+(S2)→(D)		4	•
	+P					
	-		• (D) - (S) → (D)		3	•
	-P					
	-		• (S1) - (S2) → (D)		4	•
	-P					
BIN 32-bit addition and subtraction	D+		• (D + 1, D) + (S + 1, S) → (D + 1, D)		3	•
	D+P					
	D+		• (S1 + 1, S1) + (S2 + 1, S2) → (D + 1, D)		4	•
	D+P					
	D-		• (D + 1, D) - (S + 1, S) → (D + 1, D)		3	•
	D-P					
	D-		• (S1 + 1, S1) - (S2 + 1, S2) → (D + 1, D)		4	•
	D-P					
BIN 16-bit multiplication and division	*		• (S1) × (S2) → (D + 1, D)		4	•
	*P					
	/		• (S1) ÷ (S2) → Quotient (D), Remainder (D + 1)		4	•
	/P					
BIN 32-bit multiplication and division	D*		• (S1 + 1, S1) × (S2 + 1, S2) → (D + 3, D + 2, D + 1, D)		4	•
	D*P					
	D/		• (S1 + 1, S1) ÷ (S2 + 1, S2) → Quotient (D + 1, D), Remainder (D + 3, D + 2)		4	•
	D/P					

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Arithmetic operation instructions (Continued)

Classification	Instruction symbol	Symbol	Process description	Execution condition	Basic number of steps	Subset
BIN data increment	INC	INC D	• (D) +1 → (D)		2	•
	INCP	INCP D				
	DINC	DINC D	• (D + 1, D) + 1 → (D + 1, D)		2	•
	DINCP	DINCP D				
	DEC	DEC D	• (D) - 1 → (D)		2	•
	DECP	DECP D				
	DDEC	DDEC D	• (D + 1, D) - 1 → (D + 1, D)		2	•
	DDECP	DDECP D				

(3) Data conversion instructions

Data conversion instructions

Classification	Instruction symbol	Symbol	Process description	Execution condition	Basic number of steps	Subset
BCD conversion	BCD	BCD S D	• (S) BCD conversion (D); (S) BIN (0～9999)		3	•
	BCDP	BCDP S D				
	DBCD	DBCD S D	• (S+1, S) BCD conversion (D+1, D); (S+1, S) BIN (0～99999999)		3	•
	DBCDP	DBCDP S D				
BIN conversion	BIN	BIN S D	• (S) BIN conversion (D); (S) BCD (0～9999)		3	•
	BINP	BINP S D				
	DBIN	DBIN S D	• (S+1, S) BIN conversion (D+1, D); (S+1, S) BCD (0～99999999)		3	•
	DBINP	DBINP S D				
2's complement	NEG	NEG D	• (D) → (D); (D) BIN data		2	-
	NEGP	NEGP D				
	DNEG	DNEG D	• (D+1, D) → (D+1, D); (D+1, D) BIN data		2	-
	DNEGP	DNEGP D				

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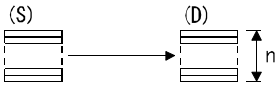
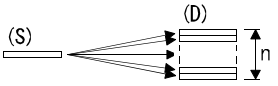
(4) Data transfer instructions

Data transfer instructions

Classification	Instruction symbol	Symbol	Process description	Execution condition	Basic number of steps	Subset
16-bit data transfer	MOV	MOV S D	• (S) → (D)		*1	•
	MOVP	MOVP S D				
32-bit data transfer	DMOV	DMOV S D	• (S+1,S) → (D+1,D)		*2	•
	DMOVP	DMOVP S D				
16-bit data no transfer	CML	CML S D	• $\overline{(S)}$ → (D)		*1	•
	CMLP	CMLP S D				
32-bit data no transfer	DCML	DCML S D	• $\overline{(S+1,S)}$ → (D+1,D)		*2	•
	DCMLP	DCMLP S D				
Block transfer	BMOV	BMOV S D n			4	•
	BMOVP	BMOVP S D n				
Same data block transfer	FMOV	FMOV S D n			4	•
	FMOVP	FMOVP S D n				

*1: The number of steps differs according to the used device.

Used device	Number of steps
• Word device: Internal device • Bit device: Device No. is multiple of 16, and digit specification is K4. • Constant: No restriction	2
When a device other than above is used	3

*2: The number of steps differs according to the used device.

Used device	Number of steps
• Word device: Internal device • Bit device: Device No.is multiple of 16, and digit specification is K4. • Constant: No restriction	3
When a device other than above is used	3 Note 1)

Note 1) The number of steps may increase according to the conditions in Section 3.6.

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Appendix 11.5 Application Instructions

(5) Logical operation instructions

Logical operation instructions

Classification	Instruction symbol	Symbol	Process description	Execution condition	Basic number of steps	Subset
logical product	WAND	WAND S D	• (D) ∧ (S) → (D)		3	•
	WANDP	WANDP S D				
	WAND	DMOV S D	• (S1) ∧ (S2) → (D)		4	•
	WANDP	WANDP S1 S2 D				
	DAND	DAND S D	• (D+1, D) ∧ (S+1, S) → (D+1, D)		*1 3	•
	DANDP	DECP D				
	DAND	DAND S1 S2 D	• (S1+1, S1) ∧ (S2+1, S2) → (D+1, D)		*1 4	•
	DANDP	DCMLP S D				
Logical sum	WOR	WOR S D	• (D) ∨ (S) → (D)		3	•
	WORP	WORP S D				
	WOR	WOR S1 S2 D	• (S1) ∨ (S2) → (D)		4	•
	WORP	WORP S1 S2 D				
	DOR	DOR S D	• (D+1, D) ∨ (S+1, S) → (D+1, D)		*1 3	•
	DORP	DORP S D				
	DOR	DOR S1 S2 D	• (S1+1, S1) ∨ (S2+1, S2) → (D+1, D)		*1 4	•
	DORP	DOR S1 S2 D				
Exclusive logical sum	WXOR	WXOR S D	• (D) ⊻ (S) → (D)		3	•
	WXORP	WXORP S D				
	WXOR	WXOR S1 S2 D	• (S1) ⊻ (S2) → (D)		4	•
	WXORP	WXORP S1 S2 D				
	DXOR	DXOR S D	• (D+1, D) ⊻ (S+1, S) → (D+1, D)		*1 3	•
	DXORP	DXORP S D				
	DXOR	DXOR S1 S2 D	• (S1+1, S1) ⊻ (S2+1, S2) → (D+1, D)		*1 4	•
	DXORP	DXORP S1 S2 D				

*1: The number of steps may increase according to the conditions in Section 3.6.

Logical operation instructions (Continued)

Classification	Instruction symbol	Symbol	Process description	Execution condition	Basic number of steps	Subset
Not exclusive logical sum	WXNR	WXNR S D	• $\overline{(D) \veebar (S)} \rightarrow (D)$		3	•
	WXNRP	WXNRP S D				
	WXNR	WXNR S1 S2 D	• $\overline{(S1) \veebar (S2)} \rightarrow (D)$		4	•
	WXNRP	WXNRP S1 S2 D				
	DXNR	DXNR S D	• $\overline{(D+1, D) \veebar (S+1, S)} \rightarrow (D+1, D)$		*1 3	•
	DXNRP	DXNRP S D				
	DXNR	DXNR S1 S2 D	• $\overline{(S1+1, S1) \veebar (S2+1, S2)} \rightarrow (D+1, D)$		*1 4	•
	DXNRP	DXNRP S1 S2 D				

*1: The number of steps may increase according to the conditions in Section 3.6.

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Appendix 11.6 QSCPU Dedicated Instructions

(6) Forced control stop instruction

Forced control stop instruction

Classifi-cation	Instruction symbol	Symbol	Process description	Execution condition	Basic number of steps	Subset
Forced control stop	S.QSABORT		• Stops execution of the program. • The status of the safety CPU module changes to stop error status.		*1 7	-

*1: The basic number of steps changes to eight steps when a constant is used.

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Appendix 12 Safety FB (Function Blocks)

Appendix 12.1 Features

A safety FB (Function block) is an FB provided by the manufacturer that has acquired ISO13849-1 Category 4 and IEC61508 SIL3 authentication.
The features of safety FBs are as follows.

(1) Improved safety program productivity/maintainability
Frequently used functions when creating a safety program are provided as safety FBs. Use of safety FBs simplifies safety programs and improves the productivity/maintainability of safety programs. Safety programs can also be debugged and evaluated more efficiently.

(2) Improved safety by safety FBs that have acquired safety approval
Safety FBs have acquired safety approval, and safety applications can be built up to ISO13849-1 category 4 and IEC61508 SIL3. Highly safe programs can be built by using safety FBs, and the safety authentication of safety programs can be easily acquired.

(3) Improved reliability of safety programs
Safety FBs cannot be altered or modified since users cannot view the inside of safety FBs. The reliability of safety functions can be improved since safety functions are not altered intentionally or due to operating mistakes.
Since safety FBs are FB names that cannot be created or renamed by the user, it can be confirmed that the used FB is an authenticated safety FB merely by looking at its name.

(4) Enhanced error functions
If an error (input variable out of range, fixed at non-detection of rising edge of reset) is detected internally in the safety FB, an error is output. Simultaneously, an error code is output. If an error has not occurred, the status code of the safety FB is output, which allows to understand safety FBs behavior and helps in debugging.

(5) Coexistence with ladder language
Since safety FBs can be embedded in MELSEC ladder language, safety programs that are highly safe and highly flexible can be created by combining safety functions with familiar ladder language

Appendix 12.2 List of Safety FBs

The following describes the provided safety FBs.

Safety FB list

FB name	Function name	Function overview
S+2HAND2	Two-hand switch Type II	Control of type II two-hand operation switches (EN574, Chapter 4)
S+2HAND3	Two hand switch Type III	Control of type III two-hand operation switches (EN574, Chapter 4, dual mismatch time fixed to 500 ms)
S+EDM	External device monitor	Monitoring of safety shut-off device such as actuator, contactor, etc, and control of safety output
S+ENBLSW	Enable switch	Evaluation of input signal from three-position enable switch
S+ESPE	Light curtain (ESPE)	Emergency stop of stop category 0 by light curtain
S+ESTOP	Emergency stop	Emergency stop of stop category 0 by emergency stop switch
S+GLOCK	Guard interlock	Control of entry into a hazardous area by safety guard (4-state interlock) equipped with guard lock function
S+GMON	Guard monitoring	Monitoring of safety guard by two safety switches, monitoring of dual switch mismatch time (MonitoringTime) when guard is closed
S+MODSEL	Mode selection	Selection of operating mode such as manual, semi-automatic, etc.
S+MUTE2	Parallel muting by two sensors	Invalidation (muting) of light curtain safety function by two sensors
S+MUTEP	Parallel muting	Muting of light curtain safety function by four parallel arranged sensors
S+MUTES	Serial muting	Muting of light curtain safety function by four serially arranged sensors
S+OUTC	Output control	Setting of safety output control and startup prohibition by application and general controllers
S+TSSEN	Safety sensor test	Testing function for testable external sensors (light curtain, etc.) (Example: Loss of detection function of sensor module, response time exceeded, single-channel sensor fixed at ON)

For details, refer to the QSCPU Programming Manual (Safety FB).

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Appendix 13 List of Special Relays

Special relays SM are internal relays whose specifications are determined internally by the programmable controller. Therefore, they cannot be used as regular internal relays in sequence programs. However, they can be turned ON/OFF as required for controlling the CPU module.

How to view each item in the list is as follows.

How to view the list of special relays

Item	Item description
Number	• Indicates the number of the special relay.
Name	• Indicates the name of the special relay.
Description	• Indicates the contents of the special relay.
Details	• Describes the details of special relay contents.
Set by (set timing)	• Describes who the special relays are set by and the timing that special relays are set if set by the system. <Set by> S: Set by the system. U: Set by the user (by sequence program or test operation from GX Developer). S/U: Set by both system and user. <Set timing> Indicates the set timing only when set by the system. Individual END: Set at every individual END processing. Initial: Set at initial (Power-on, STOP → RUN etc.) operations only. Change in state: Set only when the state has changed. Error occurrence: Set when an error occurs. Instruction execution: Set when an instruction is executed. When requested: Set only when there is a request from the user (SM, etc.).

For details of following items, refer to the following manual.
• Network related: Manual of each network module

POINT
SM1000 to SM1299 only can be used in the program for implementing safety functions. Special relays other than SM1000 to SM1299 cannot be used in the program for implementing safety functions.

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(1) Diagnostic information

Special relay

No.	Name	Description	Details	Set by (set timing)
SM0	Diagnostic errors	OFF: No error ON: Error	• Turns ON when an error is detected by diagnostics. (including when annunciator is ON.) • The relay is held at ON even after the status returns to normal.	S (error occurrence)
SM1	Self-diagnostic error	OFF: No self-diagnostic error ON: Self-diagnostic error	• Turns ON when an error is detected by self diagnostics. (not including when annunciator is ON.) • The relay is held at ON even after the status returns to normal.	S (error occurrence)
SM5	Common error information	OFF: No common error information ON: Common error information	• Turns ON when SM0 turns ON and there is common error information.	S (error occurrence)
SM16	Error individual information	OFF: No error individual information ON: Error individual information	• Turns ON when SM0 is turns ON and there is error individual information.	S (error occurrence)
SM50	Error clear	OFF → ON: Error clear	• Error clear operation is performed.	U
SM51	Battery low latch	OFF: Normal ON: Battery low	• Turns ON when the battery voltage of the CPU module falls below the specified level. • The relay is held at ON even after the battery voltage becomes normal. • Synchronized with "BAT." LED.	S (error occurrence)
SM52	Battery low	OFF: Normal ON: Battery low	• Though the same as SM51, this relay turns OFF when the battery voltage becomes normal.	S (error occurrence)
SM53	AC DOWN detection	OFF: No AC DOWN ON: AC DOWN	• Turns ON when there is a momentary power failure within 20 ms when the AC power supply module is used. This relay is reset when power is turned OFF then ON.	S (error occurrence)
SM56	Operation error	OFF: Normal ON: Operation error	• Turns ON when an operation error occurs. • The relay is held at ON even after the status returns to normal.	S (error occurrence)
SM61	I/O module Verification error	OFF: Normal ON: Error	• Turns ON if the state differs from the state where the input/output module was registered when the power was turned ON. • The relay is held at ON even after the status returns to normal.	S (error occurrence)
SM62	Annunciator detection	OFF: Not detected ON: Detected	• Turns ON when at least one annunciator F is ON.	S (instruction execution)

(2) System information

Special relay

No.	Name	Description	Details	Set by (set timing)
SM203	STOP contact	STOP state	• Turns ON in the STOP state.	S (status change)
SM210	Clock data set request	OFF: Non-processing ON: Set request	• The clock data stored in SD210 to SD213 is written to the CPU module after execution of the END instruction of the scan in which this relay turned OFF to ON.	U
SM211	Clock data error	OFF: No error ON: Error	• Turns ON if an error occurs in the clock data (SD210 to SD213) value, and OFF if there is no error.	S (when requested)
SM213	Clock data read request	OFF: Non-processing ON: Read request	• Clock data is read as BCD values to SD210 to SD213 when this relay turns ON.	U
SM232	Number of ROM writes	OFF: Within the range of number of writes ON: Number of writes exceeded	• Turns ON when the number of ROM writes exceeds 100,000.	S (error occurrence)

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(3) System clock/counter

Special relay

No.	Name	Description	Details	Set by (set timing)
SM400	Always ON	ON OFF	• Turns ON at all times.	S (individual END)
SM401	Always OFF	ON OFF	• Turns OFF at all times.	S (individual END)
SM402	ON for only one scan after RUN	ON OFF 1 Scan	• Turns ON for only one scan after RUN.	S (individual END)
SM403	OFF for only one scan after RUN	ON OFF 1 Scan	• Turns OFF for only one scan after RUN.	S (individual END)
SM410	0.1 second clock	0.05 second 0.05 second	• This relay repeatedly turns ON/OFF every fixed interval. • Starts from OFF state when the power supply of the programmable controller turns ON or when the CPU module is reset.	S (status change)
SM411	0.2 second clock	0.1 second 0.1 second		
SM412	1 second clock	0.5 second 0.5 second		
SM413	2 second clock	1 second 1 second		
SM414	2n second clock	n second n second	• This relay repeatedly turns ON/OFF at every interval (unit: second) specified in SD414. • Starts from OFF state when the power supply of the programmable controller turns ON or when the CPU module is reset.	S (status change)

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(4) Safety CPU

Special relay

No.	Name	Description	Details	Set by (set timing)
SM560	TEST MODE flag	OFF: Other than TEST MODE ON: TEST MODE	• Turns ON when the controller is running in the TEST MODE. • Turns OFF when the controller is running in a mode other than the TEST MODE (SAFETY MODE, SAFETY MODE (wait-for-restart)).	S (status change)
SM561	TEST MODE continued Allowable RUN time setting	OFF: Within set time ON: Set time exceeded	• Turns ON when the TEST MODE continuous allowable RUN time set in parameters is exceeded.	S (error occurrence)

(5) Boot operation

Special relay

No.	Name	Description	Details	Set by (set timing)
SM660	Boot operation	OFF: Program memory execution ON: Boot operation in progress	<In TEST MODE> • Turns ON when the boot operation from the standard ROM is in progress. • Turns OFF when the boot operation from the standard ROM is not being performed. <IN SAFETY MODE> • Turns ON at all times.	S (initial)

(6) Instruction related

Special relay

No.	Name	Description	Details	Set by (set timing)
SM722	BIN, DBIN instruction error disable flag	OFF: Error detected ON: No error detected	• Turn ON to disable output of "OPERATION ERROR" by the BIN, DBIN instruction.	U

(7) CC-Link Safety

Special relay

No.	Name	Description	Details	Set by (set timing)
SM1004	Safety station refresh communication status (CC	OFF: Normal ON: Communication error station present	Stores the refresh communication status of the safety station. (stores the status of each station in SD1004 to SD1007.)	S (status change)
SM1204	Safety station refresh communication status (CC	OFF: Normal ON: Communication error station present	Stores the refresh communication status of the safety station. (stores the status of each station in SD1204 to SD1207.)	S (status change)

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Appendix 14 List of Special Registers

Special registers SD are internal registers whose specifications are determined internally by the programmable controller. Therefore, they cannot be used as regular internal registers in sequence programs. However, if necessary, the data can be written to control the CPU module and remote I/O module.
Data stored to special registers is stored as BIN values unless specified otherwise.

How to view each item in the list is as follows.

How to view the list of special registers

Item	Item description
Number	• Indicates the number of the special register.
Name	• Indicates the name of the special register.
Description	• Indicates the contents of special register.
Details	• Describes the details of special register contents.
Set by (set timing)	• Describes who the special registers are set by and the timing that special registers are set if set by the system. <Set by> S: Set by the system. U: Set by the user (by sequence program or test operation from GX Developer). S/U: Set by both system and user. <Set timing> Indicates the set timing only when set by the system. Individual END: Set at every individual END processing. Initial: Set at initial (Power-on, STOP → RUN etc.) operations only. Change in state: Set only when the state has changed. Error occurrence: Set when an error occurs. Instruction execution: Set when an instruction is executed. When requested: Set only when there is a request from the user (SM, etc.). When writing to ROM: Set when writing to ROM.

For details of following items, refer to the following manual.
• Network related: Manual of each network module

POINT
SD1000 to SD1299 only can be used in the program for implementing safety functions. Special registers other than SD1000 to SD1299 cannot be used in the program for implementing safety functions.

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(1) Diagnostic information

Special registers

No.	Name	Description	Details	Set by (set timing)
SD0	Diagnostic errors	Diagnostic error code	• The error code when the error is detected by diagnostics is stored in BIN code. • The contents are same as the latest information of the error history.	S (error occurrence)
SD1	Diagnostic errors occurrence time	Diagnostic errors occurrence time	• The year (last two digits of the year) and month when SD0 data was updated are stored in two-digit BCD code. b15 ~ b8 b7 ~ b0 Year (0 to 99) | Month (1 to 12) (Example) September 2006 H0609	S (error occurrence)
SD2			• The day and time when SD0 data was updated are stored in two-digit BCD code. b15 ~ b8 b7 ~ b0 Date (1 to 31) | Hour (0 to 23) (Example) 25th, 10:00 H2510	
SD3			• The minutes and seconds when SD0 data was updated are stored in two-digit BCD code. b15 ~ b8 b7 ~ b0 Minute (0 to 59) | Second (0 to 59) (Example) 35 minutes 48 seconds H3548	
SD4	Error information category	Error information category code	The category code that determines which error information is stored to each of the common information (SD5 to SD15) and the individual information (SD16 to SD26) is stored. b15 ~ b8 b7 ~ b0 Individual information category code | Common information category code • The following codes are stored to the common information category code: 0: None 1: Module No./Base No. 2: File name/drive name 3: Time (setting value) 4: Program error location 9: CC-Link Safety information 10: Module No./Station No. • The following codes are stored to the individual information category code: 0: None 2: File name/drive name 3: Time (actual measurement value) 4: Program error location 5: Parameter number 6: Annunciator (F) number 9: Error information 10: CC-Link Safety information 11: Program abort information 12: File diagnostic information	S (error occurrence)

Special registers

<table>
<tr><th>No.</th><th>Name</th><th>Description</th><th>Details</th><th>Set by
(set timing)</th></tr>
<tr><td>SD5
SD6
SD7
SD8
SD9
SD10
SD11
SD12
SD13
SD14
SD15</td><td>Common error information</td><td>Common error information</td><td>
• The common information corresponding to error code (SD0) is stored.
• The following six types of information are stored.

(1) Module No./Base No.
<table>
<tr><th>No.</th><th>Description</th></tr>
<tr><td>SD5</td><td>Slot No./Base No. ＊1</td></tr>
<tr><td>SD6</td><td>I/O No. ＊2</td></tr>
<tr><td>SD7
SD8
SD9
SD10
SD11
SD12
SD13
SD14
SD15</td><td>(Empty)</td></tr>
</table>
*1: When 255 is stored to SD5 (slot No.), the slot No. of the module specified by the instruction, etc. may not be identifiable.
To store the base No. to SD5, store 0 (main base unit).
*2: When FFFFH is stored to SD6 (I/O No.), the I/O number may not be identifiable due to duplication of the I/O No. in the I/O assignment setting in PLC parameters, or the I/O No. may not be identifiable from the network No. specified by the instruction. For this reason, specify the faulty area in SD5.

(2) File name/drive name
<table>
<tr><th>No.</th><th>Description</th></tr>
<tr><td>SD5</td><td>Drive</td></tr>
<tr><td>SD6
SD7
SD8
SD9</td><td>File name
(ASCII code: eight characters)</td></tr>
<tr><td>SD10</td><td>Extension*3 2EH(.)</td></tr>
<tr><td>SD11</td><td>(ASCII code: three characters)</td></tr>
<tr><td>SD12
SD13
SD14
SD15</td><td>(Empty)</td></tr>
</table>
(Example) File name = MAIN.QPG
<table>
<tr><th>b15～b8</th><th>b7～b0</th></tr>
<tr><td>41H(A)</td><td>4DH(M)</td></tr>
<tr><td>4EH(N)</td><td>43H(I)</td></tr>
<tr><td>20H(SP)</td><td>20H(SP)</td></tr>
<tr><td>20H(SP)</td><td>20H(SP)</td></tr>
<tr><td>51H(Q)</td><td>2EH(.)</td></tr>
<tr><td>47H(G)</td><td>50H(P)</td></tr>
</table>
(3) Time (setting value)
<table>
<tr><th>No.</th><th>Description</th></tr>
<tr><td>SD5</td><td>Time: in microseconds (0～999μs)</td></tr>
<tr><td>SD6</td><td>Time: in milliseconds (0～65535ms)</td></tr>
<tr><td>SD7
SD8
SD9
SD10
SD11
SD12
SD13
SD14
SD15</td><td>(Empty)</td></tr>
</table>
</td><td>S (error occurrence)</td></tr>
</table>

REMARKS

*3: Extension names are shown in the following table.

Extension name

SDn	SDn+1		Extension name	File type
Upper 8 bits	Lower 8 bits	Upper 8 bits		
51H	50H	41H	QPA	Parameter
51H	50H	47H	QPG	Sequence program
51H	50H	44H	QCD	Device comment

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Special registers

<table>
<tr><th>No.</th><th>Name</th><th>Description</th><th>Details</th><th>Set by
(set timing)</th></tr>
<tr><td>SD5
SD6
SD7
SD8
SD9
SD10
SD11
SD12
SD13
SD14
SD15</td><td>Common error information</td><td>Common error information</td><td>(4) Program error location
<table>
<tr><th>No.</th><th>Description</th></tr>
<tr><td>SD5</td><td rowspan="4">File name
(ASCII code: eight characters)</td></tr>
<tr><td>SD6</td></tr>
<tr><td>SD7</td></tr>
<tr><td>SD8</td></tr>
<tr><td>SD9</td><td>Extension ∗3 2EH(.)</td></tr>
<tr><td>SD10</td><td>(ASCII code: three characters)</td></tr>
<tr><td>SD11</td><td>(Empty)</td></tr>
<tr><td>SD12</td><td>Block No.∗4</td></tr>
<tr><td>SD13</td><td>Step No. ∗4</td></tr>
<tr><td>SD14</td><td>Sequence step No. (L)</td></tr>
<tr><td>SD15</td><td>Sequence step No. (H)</td></tr>
</table>
*4: 0 is stored in the block number and step number.

(9) CC-Link Safety information
<table>
<tr><th>No.</th><th>Description</th></tr>
<tr><td>SD5</td><td>Error category∗5</td></tr>
<tr><td>SD6</td><td>Error item∗5</td></tr>
<tr><td>SD7</td><td>Link ID</td></tr>
<tr><td>SD8</td><td>Station number</td></tr>
<tr><td>SD9</td><td>System area 1</td></tr>
<tr><td>SD10</td><td>System area 2</td></tr>
<tr><td>SD11</td><td>System area 3</td></tr>
<tr><td>SD12</td><td>System area 4</td></tr>
<tr><td>SD13</td><td>System area 5</td></tr>
<tr><td>SD14</td><td>System area 6</td></tr>
<tr><td>SD15</td><td>System area 7</td></tr>
</table>
*5: The error category and error item are stored only when the error code is 8300 (CC-LINK REMOTE DETECTION ERROR). 0 is stored for error codes other than 8300.

(10) Unit No./Station No.
<table>
<tr><th>No.</th><th>Description</th></tr>
<tr><td>SD5</td><td>Slot No.</td></tr>
<tr><td>SD6</td><td>I/O No.</td></tr>
<tr><td>SD7</td><td>Station number</td></tr>
<tr><td>SD8
SD9
SD10
SD11
SD12
SD13
SD14
SD15</td><td>(Empty)</td></tr>
</table></td><td>S (error occurrence)</td></tr>
</table>

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Special registers

<table>
<tr><th>No.</th><th>Name</th><th>Description</th><th>Details</th><th>Set by
(set timing)</th></tr>
<tr><td>SD16
SD17
SD18
SD19
SD20
SD21
SD22
SD23
SD24
SD25
SD26</td><td>Error individual information</td><td>Error individual information</td><td>
• The common information corresponding to error code (SD0) is stored.
• The following nine types of information are stored.

(2) File name/drive name
<table>
<tr><th>No.</th><th>Description</th></tr>
<tr><td>SD16</td><td>Drive</td></tr>
<tr><td>SD17
SD18
SD19
SD20</td><td>File name
(ASCII code: eight characters)</td></tr>
<tr><td>SD21</td><td>Extension＊3 2EH(.)</td></tr>
<tr><td>SD22</td><td>(ASCII code: three characters)</td></tr>
<tr><td>SD23
SD24
SD25
SD26</td><td>(Empty)</td></tr>
</table>
(Example) File name = MAIN.QPG
<table>
<tr><th>b15～b8</th><th>b7～b0</th></tr>
<tr><td>41H(A)</td><td>4DH(M)</td></tr>
<tr><td>4EH(N)</td><td>43H(I)</td></tr>
<tr><td>20H(SP)</td><td>20H(SP)</td></tr>
<tr><td>20H(SP)</td><td>20H(SP)</td></tr>
<tr><td>51H(Q)</td><td>2EH(.)</td></tr>
<tr><td>47H(G)</td><td>50H(P)</td></tr>
</table>
(3) Time (actual measurement value)
<table>
<tr><th>No.</th><th>Description</th></tr>
<tr><td>SD16</td><td>Time: in microseconds (0～999μs)</td></tr>
<tr><td>SD17</td><td>Time: in milliseconds (0～65535ms)</td></tr>
<tr><td>SD18
SD19
SD20
SD21
SD22
SD23
SD24
SD25
SD26</td><td>(Empty)</td></tr>
</table>
(4) Program error location
<table>
<tr><th>No.</th><th>Description</th></tr>
<tr><td>SD16
SD17
SD18
SD19</td><td>File name
(ASCII code: eight characters)</td></tr>
<tr><td>SD20</td><td>Extension＊3 2EH(.)</td></tr>
<tr><td>SD21</td><td>(ASCII code: three characters)</td></tr>
<tr><td>SD22</td><td>(Empty)</td></tr>
<tr><td>SD23</td><td>Block No.＊6</td></tr>
<tr><td>SD24</td><td>Step No. ＊6</td></tr>
<tr><td>SD25</td><td>Sequence step No. (L)</td></tr>
<tr><td>SD26</td><td>Sequence step No. (H)</td></tr>
</table>
*6: 0 is stored in the block number and step number.

(5) Parameter No.
<table>
<tr><th>No.</th><th>Description</th></tr>
<tr><td>SD16</td><td>Parameter No.</td></tr>
<tr><td>SD17
SD18
SD19
SD20
SD21
SD22
SD23
SD24
SD25
SD26</td><td>(Empty)</td></tr>
</table>
(6) Annunciator No.
<table>
<tr><th>No.</th><th>Description</th></tr>
<tr><td>SD16</td><td>No.</td></tr>
<tr><td>SD17
SD18
SD19
SD20
SD21
SD22
SD23
SD24
SD25
SD26</td><td>(Empty)</td></tr>
</table>
(9) Error information
<table>
<tr><th>No.</th><th>Description</th></tr>
<tr><td>SD16</td><td>Error information 1</td></tr>
<tr><td>SD17</td><td>Error information 2</td></tr>
<tr><td>SD18</td><td>Error information 3</td></tr>
<tr><td>SD19</td><td>Error information 4</td></tr>
<tr><td>SD20</td><td>Error information 5</td></tr>
<tr><td>SD21</td><td>Error information 6</td></tr>
<tr><td>SD22</td><td>Error information 7</td></tr>
<tr><td>SD23</td><td>Error information 8</td></tr>
<tr><td>SD24</td><td>Error information 9</td></tr>
<tr><td>SD25</td><td>Error information 10</td></tr>
<tr><td>SD26</td><td>Error information 11</td></tr>
</table>
</td><td>S (error occurrence)</td></tr>
</table>

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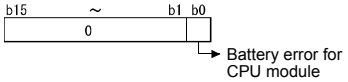
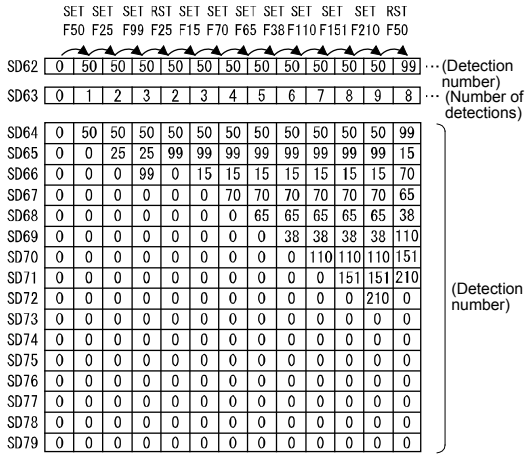
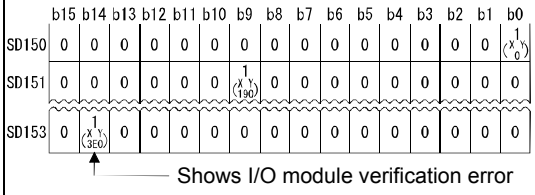
Special registers

<table>
<tr><th>No.</th><th>Name</th><th>Description</th><th>Details</th><th>Set by
(set timing)</th></tr>
<tr><td>SD16
SD17
SD18
SD19
SD20
SD21
SD22
SD23
SD24
SD25
SD26</td><td>Error individual information</td><td>Error individual information</td><td>(10) CC-Link Safety information
<table>
<tr><th>No.</th><th>Description</th></tr>
<tr><td>SD16</td><td>Number of individual information items</td></tr>
<tr><td>SD17</td><td>Individual information 1</td></tr>
<tr><td>SD18</td><td>Individual information 2</td></tr>
<tr><td>SD19</td><td>Individual information 3</td></tr>
<tr><td>SD20</td><td>Individual information 4</td></tr>
<tr><td>SD21</td><td>Individual information 5</td></tr>
<tr><td>SD22</td><td>Individual information 6</td></tr>
<tr><td>SD23</td><td>Individual information 7</td></tr>
<tr><td>SD24</td><td>Individual information 8</td></tr>
<tr><td>SD25</td><td>Individual information 9</td></tr>
<tr><td>SD26</td><td>Individual information 10</td></tr>
</table>
(11) Program abort information
<table>
<tr><th>No.</th><th>Description</th></tr>
<tr><td>SD16</td><td>Abort code *7</td></tr>
<tr><td>SD17
SD18
SD19
SD20
SD21
SD22
SD23
SD24
SD25
SD26</td><td>(Empty)</td></tr>
</table>
*7: The abort code specified by the S.QSABORT instruction is stored.
(12) File diagnostic information
<table>
<tr><th>No.</th><th colspan="2">Description</th></tr>
<tr><td>SD16</td><td>Error information 1</td><td>Drive No.</td></tr>
<tr><td>SD17
SD18
SD19
SD20</td><td colspan="2">File name
(ASCII code: eight characters)</td></tr>
<tr><td>SD21</td><td>Extension*3</td><td>2EH(.)</td></tr>
<tr><td>SD22</td><td colspan="2">(ASCII code: three characters)</td></tr>
<tr><td>SD23
SD24</td><td colspan="2">Error information 2</td></tr>
<tr><td>SD25
SD26</td><td colspan="2">Error information 3</td></tr>
</table>
(Example) File name = MAIN.QPG
<table>
<tr><th>b15～b8</th><th>b7～b0</th></tr>
<tr><td>41H(A)</td><td>4DH(M)</td></tr>
<tr><td>4EH(N)</td><td>43H(I)</td></tr>
<tr><td>20H(SP)</td><td>20H(SP)</td></tr>
<tr><td>20H(SP)</td><td>20H(SP)</td></tr>
<tr><td>51H(Q)</td><td>2EH(.)</td></tr>
<tr><td>47H(G)</td><td>50H(P)</td></tr>
</table></td><td>S (error occurrence)</td></tr>
<tr><td>SD27</td><td>CPU identifier of CPU issuing diagnostic errors</td><td>CPU identifier
(CPU A/CPU B)</td><td>• Stores the identifier of the CPU that issued diagnostic errors of SD0 to SD26.
0001H: CPU A
0002H: CPU B</td><td>S (error occurrence)</td></tr>
<tr><td>SD50</td><td>Error clear</td><td>Clears the error.
Error code</td><td>• Stores the error code to be cleared.</td><td>U</td></tr>
<tr><td>SD51</td><td>Battery low latch</td><td>Bit pattern indicating where battery voltage drop occurred</td><td>• The corresponding bit changes to 1 (ON) when battery voltage drop occurs.
• Then, it is held at 1 even if the battery voltage returns to normal.
 
</td><td>S (error occurrence)</td></tr>
<tr><td>SD52</td><td>Battery low</td><td>Bit pattern indicating where battery voltage drop occurred</td><td>• Same configuration as SD51 above
• Then, it changes to 0 (OFF) when the battery voltage returns to normal.</td><td>S (error occurrence)</td></tr>
<tr><td>SD53</td><td>AC DOWN detection</td><td>Number of AC DOWN detections</td><td>• This is incremented by one every time the input voltage drops to 85% of the rating or below (AC power supply) during operation of CPU module. The value is stored in BIN code.</td><td>S (error occurrence)</td></tr>
</table>

Special registers

<table>
<tr><th>No.</th><th>Name</th><th>Description</th><th>Details</th><th>Set by
(set timing)</th></tr>
<tr><td>SD61</td><td>I/O module
Verification error No.</td><td>I/O module
Verification error module No.</td><td>• The lowest I/O number of the modules causing I/O module verification errors is stored.</td><td>S (error occurrence)</td></tr>
<tr><td>SD62</td><td>Annunciator number</td><td>Annunciator number</td><td>• The number (F number) of earliest detected annunciator is stored.</td><td>S (instruction execution)</td></tr>
<tr><td>SD63</td><td>Annunciator number</td><td>Annunciator number</td><td>• Stores the number of times annunciators were detected.</td><td>S (instruction execution)</td></tr>
<tr><td>SD64
SD65
SD66
SD67
SD68
SD69
SD70
SD71
SD72
SD73
SD74
SD75
SD76
SD77
SD78
SD79</td><td>Annunciator
Detected number table</td><td>Annunciator
Detection number</td><td>• If F is turned ON by OUT F and SET F, the turned ON F numbers are sequentially registered to SD64 to SD79.
• F numbers that have been turned OFF by RST F are erased from SD64 to SD79s and F numbers that were stored onwards from the erased F numbers are packed to the front. If the number of detected annunciators is 16, F numbers are not stored to SD64 to SD79 even if a 17th is detected.
 
</td><td>S (instruction execution)</td></tr>
<tr><td>SD81</td><td>Error cause</td><td>Error cause</td><td>• When a continuation error occurs, all corresponding bits are turned ON.
• After the cause is removed, the bits are turned OFF by clearing the error, starting up the power supply to the programmable controller or resetting the CPU module.
<table>
<tr><th>Bit No.</th><th>Name of cause</th></tr>
<tr><td>0</td><td>Momentary power failure</td></tr>
<tr><td>1</td><td>Battery low</td></tr>
<tr><td>2</td><td>Number of writes to standard ROM exceeded</td></tr>
<tr><td>3</td><td>Test mode continuous RUN permissible time exceeded</td></tr>
<tr><td>4</td><td>Scan time exceeded</td></tr>
<tr><td>5</td><td>Annunciator ON</td></tr>
<tr><td>6</td><td>Safety remote station detection error</td></tr>
<tr><td>7</td><td>Safety remote station product information mismatch</td></tr>
<tr><td>8</td><td>Initial monitoring time-out error
Safety monitoring time-out error
Error monitoring time-out error</td></tr>
<tr><td>9</td><td>Safety remote station command error
Safety remote station data split error
Safety remote station link ID error
Safety remote station running No. error
Safety remote station received data error</td></tr>
<tr><td>10～15</td><td>(Empty)</td></tr>
</table></td><td>S (error occurrence)</td></tr>
<tr><td>SD150
SD151
SD152
SD153</td><td>I/O module
Verification error</td><td>Bit pattern, in units of 16 points, indicating the modules with verification errors
0: No I/O verification error
1: I/O verification error</td><td>• When an I/O module different from the I/O information that was registered at power-on is detected, the number (units of 16 points) of that I/O module is registered.
• (Preset I/O module number when it is set in parameters)
 

• This error is not cleared even if the verification is returned to normal. It is cleared by an error clear.</td><td>S (error occurrence)</td></tr>
</table>

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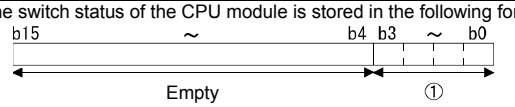
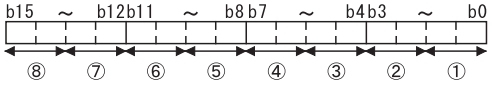
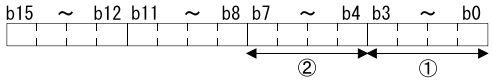
(2) System information

Special registers

No.	Name	Description	Details	Set by (set timing)
SD200	Switch status	CPU switch status	• The switch status of the CPU module is stored in the following format.  ① : CPU switch status 0 : RUN 1 : STOP 2 : RESET	S (individual END)
SD201	LED status	CPU-LED status	• The status of the CPU module LEDs is stored by the following bit patterns. • 0 indicates OFF, 1 indicates ON and 2 indicates flashing.  (1): RUN (5): Empty (2): ERR. (6): Empty (3): USER (7): TEST (4): BAT. (8): Empty	S (status change)
SD203	CPU module operating status	CPU module operating status	• The operating status of the CPU module is stored as shown in the figure below.  ① : CPU module operating status 0 : RUN 2 : STOP ② : STOP cause 0 : RUN/STOP/RESET switch 1 : Remote contact 2 : Remote operation from GX Developer 4 : Error 5 : SAFETY MODE (wait-for-restart) 6 : PLC write executed Note) Causes are stored starting with the smallest number. However, treat 4: Error has the highest priority.	S (individual END)

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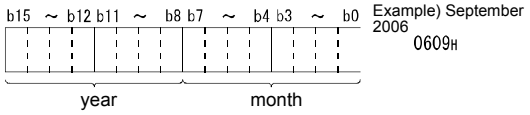
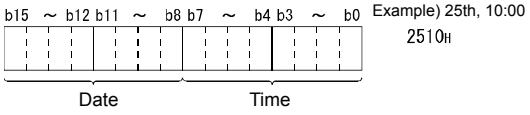
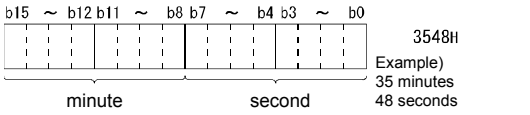
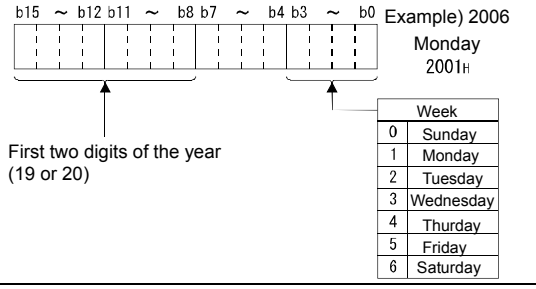
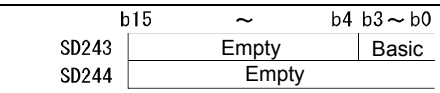
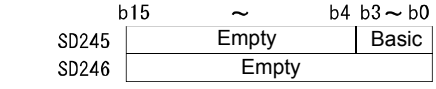
Special registers

<table>
<tr><th>No.</th><th>Name</th><th>Description</th><th>Details</th><th>Set by
(set timing)</th></tr>
<tr><td>SD210</td><td>Clock data</td><td>Clock data
(year, month)</td><td>• The year (last two digits of the year) and month are stored to SD210 in BCD code as shown in the figure below.
 
</td><td rowspan="4">S (when requested)/U</td></tr>
<tr><td>SD211</td><td>Clock data</td><td>Clock data
(date, hour)</td><td>• The day and hour are stored to SD211 in BCD code as shown in the figure below.
 
</td></tr>
<tr><td>SD212</td><td>Clock data</td><td>Clock data
(minutes, seconds)</td><td>• The minutes and seconds are stored to SD212 in BCD code as shown in the figure below.
 
</td></tr>
<tr><td>SD213</td><td>Clock data</td><td>Clock data
(first two digits of the year, day of the week)</td><td>• The year (first two digits of the year) and day of the week are stored to SD213 in BCD code as shown in the figure below.
 
</td></tr>
<tr><td>SD232
SD233</td><td>Number of ROM writes</td><td>Number of writes to ROM up to the present date</td><td>• Stores the number of writes to ROM up to the present date.</td><td>S (when writing to ROM)</td></tr>
<tr><td>SD240</td><td>Base mode</td><td>0: Auto mode</td><td>• The base mode is stored. (Fixed at 0)</td><td>S (initial)</td></tr>
<tr><td>SD241</td><td>Number of extension base units</td><td>0: Base only</td><td>• The maximum number of mounted extension base units is stored. (Fixed at 0)</td><td>S (initial)</td></tr>
<tr><td>SD242</td><td>Q base mounting enabled/disabled</td><td>Base type differentiation
0: Base not mounted
1: QS***B mounted</td><td> 
</td><td>S (initial)</td></tr>
<tr><td>SD243
SD244</td><td>Number of base slots (operating status)</td><td>Number of base slots</td><td> 

• Stores the number of slots of the mounted base module for all above mentioned areas.
(Preset number of slots when it is set in parameters)</td><td>S (initial)</td></tr>
<tr><td>SD245
SD246</td><td>Number of base slots (mounted status)</td><td>Number of base slots</td><td> 

• Stores the number of slots (actual number of slots of mounted base unit) of base unit in mounted status for all above mentioned areas.</td><td>S (initial)</td></tr>
<tr><td>SD250</td><td>Maximum implemented I/O</td><td>Maximum implemented I/O number</td><td>• Stores the first two digits of the number obtained by incrementing the final I/O number of the mounted module by 1 as a BIN value.</td><td>S (initial)</td></tr>
</table>

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Special registers

No.	Name	Description	Details	Set by (set timing)
SD254	CC-Link IE Controller Network, MELSECNET/H information	Number of mountable modules	• Indicates the number of mounted CC-Link IE Controller network modules or MELSECNET/H modules.	S (initial)
SD255		I/O No.	• Indicates the I/O number of mounted CC-Link IE Controller network modules or MELSECNET/H modules.	
SD256		Network No.	• Indicates the network number of mounted CC-Link IE Controller network modules or MELSECNET/H modules.	
SD257		Group number	• Indicates the group number of mounted CC-Link IE Controller network modules or MELSECNET/H modules.	
SD258		Station No.	• Indicates the station number of mounted CC-Link IE Controller network modules or MELSECNET/H modules.	
SD290	Device assignment (same as the parameter contents)	Number of points assigned for X	• Stores the number of points currently set for X devices.	S (initial)
SD291		Number of points assigned for Y	• Stores the number of points currently set for Y devices.	
SD292		Number of points assigned for M	• Stores the number of points currently set for M devices.	
SD294		Number of points assigned for B	• Stores the number of points currently set for B devices.	
SD295		Number of points assigned for F	• Stores the number of points currently set for F devices.	
SD296		Number of points assigned for SB	• Stores the number of points currently set for SB devices.	
SD297		Number of points assigned for V	• Stores the number of points currently set for V devices.	
SD299		Number of points assigned for T	• Stores the number of points currently set for T devices.	
SD300		Number of points assigned for ST	• Stores the number of points currently set for ST devices.	
SD301		Number of points assigned for C	• Stores the number of points currently set for C devices.	
SD302		Number of points assigned for D	• Stores the number of points currently set for D devices.	
SD303		Number of points assigned for W	• Stores the number of points currently set for W devices.	
SD304		Number of points assigned for SW	• Stores the number of points currently set for SW devices.	
SD340	Ethernet information	Number of mountable modules	• Indicates the number of mounted Ethernet modules.	S (initial)
SD341		I/O No.	• Indicates the I/O number of mounted Ethernet modules.	
SD342		Network No.	• Indicates the network number of mounted Ethernet modules.	
SD343		Group number	• Indicates the group number of mounted Ethernet modules.	
SD344		Station No.	• Indicates the station number of mounted Ethernet modules.	

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(3) System clock/counter

Special registers

No.	Name	Description	Details	Set by (set timing)
SD412	Second counter	Number of count in units of one second	• Incremented by one every second after CPU module RUN. • The count repeats from 0 to 32767 and then -32767 to 0.	S (status change)
SD414	2n seconds clock setting	2n seconds clock unit	• Stores n of the 2n seconds clock. (default: 30) • Can be set from 1 to 32767.	U
SD420	Scan counter	Number of count per scan	• Incremented by one at each scan after CPU module RUN. • The count repeats from 0 to 32767 and then -32767 to 0.	S (individual END)

(4) Scan information

Special registers

No.	Name	Description	Details	Set by (set timing)
SD520	Current scan time	Current scan time (in milliseconds)	• Stores the current scan time to SD520 and SD521. (Measured in 100 μs increments.) SD520: Stores the millisecond places (Stored range: 0 to 6553) SD521: Stores the microsecond places (Stored range: 0 to 900) (Example) If the current scan time is 23.6 ms, values are stored as follows. SD520 = 23 SD521 = 600 • The accuracy of the scan time is +/-0.1 ms.	S (individual END)
SD521		Current scan time (in microseconds)		S (individual END)
SD524	Minimum scan time	Minimum scan time (in milliseconds)	• Stores the minimum value of the scan time to SD524 and SD525. (Measured in 100 μs increments.) SD524: Stores the millisecond places (Stored range: 0 to 6553) SD525: Stores the microsecond places (Stored range: 0 to 900) • The accuracy of the scan time is +/-0.1 ms.	S (individual END)
SD525		Minimum scan time (in microseconds)		S (individual END)
SD526	Maximum scan time	Maximum scan time (in milliseconds)	• Stores the maximum value of the scan time to SD526 and SD527. (Measured in 100 μs increments.) SD526: Stores the millisecond places (Stored range: 0 to 6553) SD527: Stores the microsecond places (Stored range: 0 to 900) • The accuracy of the scan time is +/-0.1 ms.	S (individual END)
SD527		Maximum scan time (in microseconds)		
SD540	END processing time	END processing time (in milliseconds)	• After the scan program ends, stores the time till start of the next scan to SD540 and SD541. (Measured in 100 μs increments.) SD540: Stores the millisecond places (Stored range: 0 to 6553) SD541: Stores the microsecond places (Stored range: 0 to 900) • The accuracy of the END processing time is +/-0.1 ms.	S (individual END)
SD541		END processing time (in microseconds)		
SD542	Constant scan waiting time	Constant scan waiting time (in milliseconds)	• Stores the waiting time when the constant scan is set to SD542 and SD543. (Measured in 100 μs increments.) SD542: Stores the millisecond places (Stored range: 0 to 6553) SD543: Stores the microsecond places (Stored range: 0 to 900) • The accuracy of the constant scan waiting time is +/-0.1 ms.	S (individual END)
SD543		Constant scan waiting time (in microseconds)		
SD548	Scan program execution time	Scan program execution time (in milliseconds)	• Stores the execution time of the scan program during one scan to SD548 and SD549. (Measured in 100 μs increments.) SD548: Stores the millisecond places (Stored range: 0 to 6553) SD549: Stores the microsecond places (Stored range: 0 to 900) • Stored at each scan. • The accuracy of the scan program execution time is +/-0.1 ms.	S (individual END)
SD549		Scan program execution time (in microseconds)		

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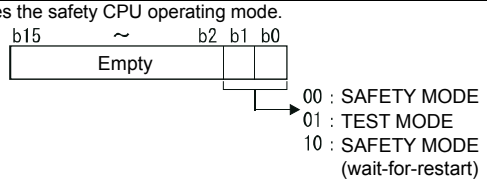
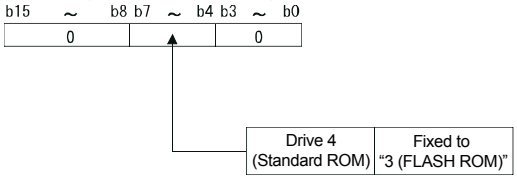
(5) Safety CPU

Special registers

No.	Name	Description	Details	Set by (set timing)
SD560	Safety CPU operating mode	Safety CPU operating mode	Stores the safety CPU operating mode. 	S (status change)
SD561 SD562	TEST MODE continuous RUN time	TEST MODE continuous RUN time (in seconds)	• Stores the continuous RUN time in TEST MODE. (Measured in unit of one second) (RUN time in TEST MODE. Starts measurement when mode changes STOP → RUN. (STOP time is not included.)) • Stores the measurement value within the range 1 to 2147483647.	S (individual END)

(6) Memory

Special registers

No.	Name	Description	Details	Set by (set timing)
SD620	Memory type	Memory type	• Indicates the type of internal memory. 	S (initial)
SD623	Drive 4 (ROM) capacity	Capacity of drive 4	• Stores the capacity of drive 4 in 1 kbyte increments.	S (initial)

(7) CC-Link Safety

Special registers

<table>
<tr><th>No.</th><th>Name</th><th>Description</th><th>Details</th><th>Set by
(set timing)</th></tr>
<tr><td>SD1000
to
SD1003</td><td>Safety remote station specification (First CC-Link Safety master module)</td><td>0: Safety remote station not specified
1: Safety remote station specified</td><td>• Stores the specification status of the safety remote station.
• "0" is stored for a standard remote station.
<table><tr><th></th><th>b15</th><th>b14</th><th>—</th><th>b1</th><th>b0</th></tr><tr><td>SD1000</td><td>16</td><td>15</td><td>~</td><td>2</td><td>1</td></tr><tr><td>SD1001</td><td>32</td><td>31</td><td>~</td><td>18</td><td>17</td></tr><tr><td>SD1002</td><td>48</td><td>47</td><td>~</td><td>34</td><td>33</td></tr><tr><td>SD1003</td><td>64</td><td>63</td><td>~</td><td>50</td><td>49</td></tr></table>In the table, 1 to 64 indicate station numbers.</td><td>S (initial)</td></tr>
<tr><td>SD1004
to
SD1007</td><td>Safety station refresh communication status (First CC-Link Safety master module)</td><td>0: Normal, reserved station specification, unused, standard remote station
1: Safety station communication error</td><td>• Stores the refresh communication status of the safety remote station.
• "0" is stored for a standard remote station.
<table><tr><th></th><th>b15</th><th>b14</th><th>—</th><th>b1</th><th>b0</th></tr><tr><td>SD1004</td><td>16</td><td>15</td><td>~</td><td>2</td><td>1</td></tr><tr><td>SD1005</td><td>32</td><td>31</td><td>~</td><td>18</td><td>17</td></tr><tr><td>SD1006</td><td>48</td><td>47</td><td>~</td><td>34</td><td>33</td></tr><tr><td>SD1007</td><td>64</td><td>63</td><td>~</td><td>50</td><td>49</td></tr></table>In the table, 1 to 64 indicate station numbers.</td><td>S (status change)</td></tr>
<tr><td>SD1008
to
SD1071</td><td>Safety remote station communication status (First CC-Link Safety master module)</td><td>Stores the communication status with the safety remote station.</td><td>• Stores the communication status with each safety remote station.
• SD1008: Station number 1 to SD1071: Station number 64
• (Fixed at "0" for standard remote station, reserved station specification, no connection)
0: Normal communication in progress
10: Initializing
20: Accessing internal information
30: Link error
8300: Safety communication - Safety remote station detection error
8310: Safety communication - Product information mismatch
8320: Safety communication - Initial monitoring time-out
8321: Safety communication - Safety monitoring time-out
8322: Safety communication - Error monitoring time-out
8330: Safety communication - Command error
8331: Safety communication - Data split No. error
8332: Safety communication - Link ID error
8333: Safety communication - Running No. error
8334: Safety communication - Receive data error</td><td>S (status change)</td></tr>
<tr><td>SD1072
to
SD1075</td><td>Safety station interlock status (First CC-Link Safety master module)</td><td>0: Interlock OFF
1: Interlocked</td><td>• Sets the equivalent bit of the corresponding station number to 1 when an error is detected on the master station and the status has changed to interlocked.
<table><tr><th></th><th>b15</th><th>b14</th><th>—</th><th>b1</th><th>b0</th></tr><tr><td>SD1072</td><td>16</td><td>15</td><td>~</td><td>2</td><td>1</td></tr><tr><td>SD1073</td><td>32</td><td>31</td><td>~</td><td>18</td><td>17</td></tr><tr><td>SD1074</td><td>48</td><td>47</td><td>~</td><td>34</td><td>33</td></tr><tr><td>SD1075</td><td>64</td><td>63</td><td>~</td><td>50</td><td>49</td></tr></table>In the table, 1 to 64 indicate station numbers.</td><td>S (status change)</td></tr>
<tr><td>SD1076
to
SD1079</td><td>Safety station interlock clear request (First CC-Link Safety master module)</td><td>0: Do not clear the safety station input/output interlock
1: Clear the safety station input/output interlock</td><td>• The input/output interlock of the safety station is cleared by changing the bit of this register from 0 to 1.
<table><tr><th></th><th>b15</th><th>b14</th><th>—</th><th>b1</th><th>b0</th></tr><tr><td>SD1076</td><td>16</td><td>15</td><td>~</td><td>2</td><td>1</td></tr><tr><td>SD1077</td><td>32</td><td>31</td><td>~</td><td>18</td><td>17</td></tr><tr><td>SD1078</td><td>48</td><td>47</td><td>~</td><td>34</td><td>33</td></tr><tr><td>SD1079</td><td>64</td><td>63</td><td>~</td><td>50</td><td>49</td></tr></table>In the table, 1 to 64 indicate station numbers.</td><td>U (when requested)</td></tr>
</table>

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Special registers

<table>
<tr><th>No.</th><th>Name</th><th>Description</th><th>Details</th><th>Set by
(set timing)</th></tr>
<tr><td>SD1200
to
SD1203</td><td>Safety remote station specification (Second CC-Link Safety master module)</td><td>0: Safety remote station not specified
1: Safety remote station specified</td><td>• Stores the specification status of the safety remote station.
• "0" is stored for a standard remote station.<table><tr><td></td><td>b15</td><td>b14</td><td>—</td><td>b1</td><td>b0</td></tr><tr><td>SD1200</td><td>16</td><td>15</td><td>~</td><td>2</td><td>1</td></tr><tr><td>SD1201</td><td>32</td><td>31</td><td>~</td><td>18</td><td>17</td></tr><tr><td>SD1202</td><td>48</td><td>47</td><td>~</td><td>34</td><td>33</td></tr><tr><td>SD1203</td><td>64</td><td>63</td><td>~</td><td>50</td><td>49</td></tr></table>In the table, 1 to 64 indicate station numbers.</td><td>S (initial)</td></tr>
<tr><td>SD1204
to
SD1207</td><td>Safety station refresh communication status (Second CC-Link Safety master module)</td><td>0: Normal, reserved station specification, unused, standard remote station
1: Safety station communication error</td><td>• Stores the refresh communication status of the safety station.
• "0" is stored for a standard remote station.<table><tr><td></td><td>b15</td><td>b14</td><td>—</td><td>b1</td><td>b0</td></tr><tr><td>SD1204</td><td>16</td><td>15</td><td>~</td><td>2</td><td>1</td></tr><tr><td>SD1205</td><td>32</td><td>31</td><td>~</td><td>18</td><td>17</td></tr><tr><td>SD1206</td><td>48</td><td>47</td><td>~</td><td>34</td><td>33</td></tr><tr><td>SD1207</td><td>64</td><td>63</td><td>~</td><td>50</td><td>49</td></tr></table>In the table, 1 to 64 indicate station numbers.</td><td>S (status change)</td></tr>
<tr><td>SD1208
to
SD1271</td><td>Safety remote station communication status (Second CC-Link Safety master module)</td><td>Stores the communication status with each safety remote station.</td><td>• Stores the communication status with each safety remote station.
SD1208: Station number 1 to SD1271: Station number 64
(Fixed at "0" for standard remote station, reserved station specification, no connection)
0: Normal communication in progress
10: Initializing
20: Accessing internal information
30: Link error
8300: Safety communication - Safety remote station detection error
8310: Safety communication - Product information mismatch
8320: Safety communication - Initial monitoring time-out
8321: Safety communication - Safety monitoring time-out
8322: Safety communication - Error monitoring time-out
8330: Safety communication - Command error
8331: Safety communication - Data split No. error
8332: Safety communication - Link ID error
8333: Safety communication - Running No. error
8334: Safety communication - Receive data error</td><td>S (status change)</td></tr>
<tr><td>SD1272
to
SD1275</td><td>Safety station interlock status (Second CC-Link Safety master module)</td><td>0: Interlock OFF
1: Interlocked</td><td>• Sets the equivalent bit of the corresponding station number to 1 when an error is detected on the master station and the status has changed to interlocked.<table><tr><td></td><td>b15</td><td>b14</td><td>—</td><td>b1</td><td>b0</td></tr><tr><td>SD1272</td><td>16</td><td>15</td><td>~</td><td>2</td><td>1</td></tr><tr><td>SD1273</td><td>32</td><td>31</td><td>~</td><td>18</td><td>17</td></tr><tr><td>SD1274</td><td>48</td><td>47</td><td>~</td><td>34</td><td>33</td></tr><tr><td>SD1275</td><td>64</td><td>63</td><td>~</td><td>50</td><td>49</td></tr></table>In the table, 1 to 64 indicate station numbers.</td><td>S (status change)</td></tr>
<tr><td>SD1276
to
SD1279</td><td>Safety station interlock clear request (Second CC-Link Safety master module)</td><td>0: Do not clear the safety station input/output interlock
1: Clear the safety station input/output interlock</td><td>• The input/output interlock of the safety station is cleared by changing the bit of this register from 0 to 1.<table><tr><td></td><td>b15</td><td>b14</td><td>—</td><td>b1</td><td>b0</td></tr><tr><td>SD1276</td><td>16</td><td>15</td><td>~</td><td>2</td><td>1</td></tr><tr><td>SD1277</td><td>32</td><td>31</td><td>~</td><td>18</td><td>17</td></tr><tr><td>SD1278</td><td>48</td><td>47</td><td>~</td><td>34</td><td>33</td></tr><tr><td>SD1279</td><td>64</td><td>63</td><td>~</td><td>50</td><td>49</td></tr></table>In the table, 1 to 64 indicate station numbers.</td><td>U (when requested)</td></tr>
</table>

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Appendix 15 List of Error Codes (Safety Programmable Controller)

If an abnormality occurs when the programmable controller power supply is turned ON, at a reset when programmable controller operation is started or while it is operating, the CPU module indicates an error on the LED display by the self-diagnostics function, and stores the error information to special relays SM and special registers SD. Moreover, if an error occurs when there is a communication request from GX Developer to the CPU module, an error code (4000H to 4FFFH) is returned to request source.
The following describes the content of errors generated in the CPU module and the corrective actions to be taken for each error.

Appendix 15.1 Types of Error Codes

Errors include those detected by the self-diagnostics function of the CPU module and those detected during communication with the CPU module.
The error detection type, error detection location and relation between error codes are shown in the table below.

Error detection type	Error detection location	Error code	Reference for error descriptions
Detection by self-diagnostics function of CPU module	CPU module	1000 to 9000	Appendix 12.3
Detection during communication with CPU module	CPU module	4000H to 4FFFH	QCPU User's Manual (Hardware Design, Maintenance and Inspection)
	CC-Link Safety master module	B000H to BFFFH	CC-Link Safety System Master Module User's Manual
	Ethernet module	C000H to CFFFH	Ethernet Interface Module User's Manual
	CC-Link IE Controller network module	E000H to EFFFH	CC-Link IE Controller Network Reference Manual
	MELSECNET/H module	E000H to EFFFH	MELSECNET/H Network System Reference Manual

Appendix 15.2 How to Read Error Codes

If an error occurs, the error code, error message etc., for performing troubleshooting can be read using GX Developer.
The following shows the procedure for reading error codes by GX Developer.

(1) Start up GX Developer.
(2) Connect the CPU module to the personal computer on which GX Developer is running.
(3) Select the [Online] → [PLC read] menu on GX Developer, and read the project from the CPU module.
(4) Select the [Diagnostics] → [PLC diagnostics] menu.
(5) Click the [Current error] button in the PLC diagnostics dialog box. The error code and error message are displayed.
(6) Select the [Help] → [CPU fault] menu, and confirm the content of the corresponding error code.

For details of operation methods on GX Developer, refer to the manual below.
GX Developer Operating Manual

Appendix 15.3 List of Error Codes (1000 to 9000)

The following describes the definitions and causes of error codes, and corrective action to be taken for each error code.

Error codes

Error code	Error definition and cause	Corrective action
1000	Main CPU runs away or malfunctions. • Malfunction due to noise, etc. • Hardware failure	• Take measures against noise. • Reset and operate (RUN) the CPU module again. If the same error is displayed again, there is a hardware failure on the CPU module. (Contact your nearest system service, distributor, or branch office and explain the symptoms.)
1001		
1002		
1003		
1004		
1006		
1009	Failure of the power supply module, CPU module or base unit was detected.	Reset and operate (RUN) the CPU module again. If the same error is detected again, a probable cause is failure of the power supply module, CPU module or base unit. (Contact your nearest system service, distributor, or branch office and explain the symptoms.)
1010	The entire program within the program capacity was executed but the END instruction was not executed. • At execution of the END instruction, noise, etc. caused this instruction to be read by a different instruction code. • The END instruction changed to a different instruction code for some reason.	• Take measures against noise. • Reset and operate (RUN) the CPU module again. If the same error is displayed again, there is a hardware failure on the CPU module. (Contact your nearest system service, distributor, or branch office and explain the symptoms.)
1030	Main CPU runs away or malfunctions. • Malfunction due to noise etc • Hardware failure	• Take measures against noise. • Reset and operate (RUN) the CPU module again. If the same error is displayed again, there is a hardware failure on the CPU module. (Contact your nearest system service, distributor, or branch office and explain the symptoms.)
1031		
1131	An error in CPU module internal memory was detected.	Hardware failure of the CPU module (Contact your nearest system service, distributor, or branch office and explain the symptoms.)
1132		
1133		
1136		
1137		
1141		
1142		
1143		
1146		
1210	The operation circuit that performs sequence processing in the CPU module is not functioning normally.	Hardware failure of the CPU module (Contact your nearest system service, distributor, or branch office and explain the symptoms.)
1311	An interrupt request was detected from a module where the interrupt pointer setting parameter is not set.	Hardware failure of the CPU module or base unit (Contact your nearest system service, distributor, or branch office and explain the symptoms.)
1401	• No reply is returned from the intelligent function module at initial processing. • There is a fault in the buffer memory size of the intelligent function module.	Hardware failure of intelligent function module, CPU module or base unit (Contact your nearest system service, distributor, or branch office and explain the symptoms.)

Error codes (continued)

Error code	Error definition and cause	Corrective action
1403	• The hardware test of the module mounted at the slot position indicated by the module No. was completed. • No reply is returned from the intelligent function module at END instruction execution. • An error on the intelligent function module was detected. • The intelligent function module being accessed is malfunctioning.	• Confirm whether the module mounted at the slot position indicated by the module No. is set to execute the hardware test or not. • A hardware failure occurred on the intelligent function module at the access destination. (Contact your nearest system service, distributor, or branch office and explain the symptoms.)
1404	A data error was detected in the response from the intelligent function module.	Reset and operate (RUN) the CPU module again. If the same error is displayed again, there is an error on the intelligent function module, CPU module or base unit. (Contact your nearest system service, distributor, or branch office and explain the symptoms.)
1411	If I/O assignments have been set in the PLC parameters, the intelligent function module cannot be accessed at initial communications. (When an error occurs, the start I/O number of the intelligent function module that is targeted for common information is stored.)	Reset and operate (RUN) the CPU module again. If the same error is displayed again, there is an error in the intelligent function module, CPU module or base unit. (Contact your nearest system service, distributor, or branch office and explain the symptoms.)
1413	An error was detected on the system bus.	Intelligent function module, CPU module or base unit failure (Contact your nearest system service, distributor, or branch office and explain the symptoms.)
1414	An error was detected on the system bus.	Intelligent function module, CPU module or base unit failure (Contact your nearest system service, distributor, or branch office and explain the symptoms.)
1415	An error was detected on the main base unit.	Intelligent function module, CPU module or base unit failure (Contact your nearest system service, distributor, or branch office and explain the symptoms.)
1500	• There was a momentary power failure in the supply power. • The supply power was turned OFF.	Check the supply power.
1600	• The battery voltage of the CPU module main unit dropped to the specified value or below. • The lead connector of the CPU module main unit battery is not mounted.	• Replace the battery. • Mount the lead connector on the battery.
1610	Number of write to standard ROM exceeded 100,000 times. (Number of writes > 100,000 times.)	Replace the CPU module.
2000	• The intelligent function module information differs from the information that was registered when the power was turned ON. • Was the intelligent function module connection loose or was it disconnected during operation? Or, was it mounted?	Read the error common information using GX Developer, and check and replace the module corresponding to that numerical value (module No.). Or, monitor special registers SD150 to SD153 using GX Developer, and check and replace the module at the location where the bit of the corresponding data is "1".
2100	• An intelligent function module has been assigned where it should be an I/O module in the I/O assignment settings in PLC parameters. • Set a value smaller than the number of points of the connected module as the number of assigned points for the intelligent function module in the I/O assignment settings in PLC parameters.	Reset the I/O assignment settings in PLC parameters to match the mounted status of the intelligent function module.
2106	• Three or more CC-Link Safety master modules are mounted. • Two or more CC-Link IE Controller Network modules are mounted. • Two or more MELSECNET/H modules are mounted. • Two or more Ethernet modules are mounted. • Modules that cannot be recognized are mounted on the CPU module.	• Set the number of CC-Link Safety master modules to two or less. • Set to either one CC-Link IE Controller Network module or one MELSECNET/H module. • Set to one Ethernet module. • Mount modules that can be used on the CPU module.

Error codes (continued)

Error code	Error definition and cause	Corrective action
2107	The same start X/Y set in the I/O assignment settings in PLC parameters is also set to the start X/Y of other modules.	Reset the I/O assignment settings in PLC parameters to match the mounted status of the intelligent function module.
2112	• The intelligent function module is not at the location specified by the intelligent function module dedicated instruction. Or, it is not the corresponding intelligent function module. • The network No. specified by the network dedicated instruction does not exist. Or, the relay destination network does not exist.	Read the error individual information on a peripheral device, and check and correct the intelligent function module dedicated instruction corresponding to that numerical value (program error location).
2124	• A module was mounted onwards from the actual number of I/O points. • A module was mounted across the boundary of the actual I/O number of points.	• Unmount the module mounted onwards from the actual number of I/O points. • Reset the I/O assignment settings in PLC parameter so that the actual number of I/O points is not exceeded.
2125	• Modules that cannot be recognized are mounted on the CPU module. • No reply is returned from the intelligent function module.	• Mount modules that can be used on the CPU module. • Hardware failure of the intelligent function module (Contact your nearest system service, distributor, or branch office and explain the symptoms.)
2200	There is no parameter file in program memory.	Set a parameter file to program memory.
2210	The contents of the boot file are strange.	Review the boot settings.
2500	There is a program file that uses devices outside the device assignment range set in the device settings in PLC parameters.	Read the error common error information using GX Developer, and check and correct the device assignments of the program file corresponding to that numerical value (file name) and the device assignments in the device settings in PLC parameters.
2501	• There are two or more program files on one drive. • Program name and program content differ.	• Delete the unnecessary program file(s). • Match program name and program content.
2502	The program file is not correct. Or, file content is not a sequence program.	Check whether the program file type is QP and whether the file content is a sequence program.
2503	Not even one program file exists. (Only the drive number is displayed in the common information.)	• Check the program configuration. • Check the parameters and program configuration.
3000	Each of the PLC parameter settings, such as timer limit setting, RUN-PAUSE contacts and empty slot number of points, is not set within the usable range of the CPU module.	Read the error detailed information using GX Developer, and check and correct the parameter items corresponding to that numerical value (parameter number).
3001	Parameter content is corrupted.	
3003	The number of device points set in the device settings in PLC parameters is not set within the usable range of the CPU module.	Read the error detailed information using GX Developer, and check and correct the parameter items corresponding to that numerical value (parameter number).
3004	Parameter file is not correct. Or, the content of the file is not parameters.	Check whether the parameter file type is ***.QPA and whether the file content is parameters.
3008	The system power supply was not turned ON again or the CPU module was not reset after writing parameters to the CPU module. (This error is generated when the CC-Link Safety remote I/O station is returned while the system power supply was turned ON or while the CPU module was being reset after writing of PLC parameters to the CPU module.)	Turn the system power supply ON or reset the CPU module.

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Error codes (continued)

error code	Error definition and cause	Corrective action
3100	• The number of modules in the network parameters for the CC-Link IE Controller Network differs from the number of mounted modules. • The start I/O number in the network parameters for the CC-Link IE Controller Network differs from the mounted I/O number. • Some data cannot be handled in parameters. • The station type of the CC-Link IE Controller Network was rewritten while the power was ON. (RESET → RUN is required to change the station type.)	• Confirm the network parameters and mounted status. If they differ, match the network parameters to the mounted status. When network parameters are corrected, write the new network parameters to the CPU module. • If an error occurs even after correction, this is because of a hardware failure. (Contact your nearest system service, distributor, or branch office and explain the symptoms.)
	• The number of modules in the network parameters on MELSECNET/H differs from the number of mounted modules. • The start I/O number of the network parameters on MELSECNET/H differs from the mounted I/O number. • Some data cannot be handled in parameters. • The station type of MELSECNET/H was rewritten while the power was ON. (RESET → RUN is required to change the station type.) • The mode switch of the MELSECNET/H module*1 is out of range.	• Confirm the network parameters and mounted status. If they differ, match the network parameters to the mounted status. When network parameters are corrected, write the new network parameters to the CPU module. • If an error occurs even after correction, this is because of a hardware failure. (Contact your nearest system service, distributor, or branch office and explain the symptoms.) • Set the mode switch of the MELSECNET/H module*1 to within range.
3101	The refresh parameters of the CC-Link IE Controller Network are out of range.	Confirm the network parameters and mounted status. If they differ, match the network parameters to the mounted status. When network parameters are corrected, write the new network parameters to the CPU module.
	• The start I/O number specified in the network parameters differs from that mounted. • The refresh parameters of MELSECNET/H are out of range.	
3102	• The network module detected an error in the network parameters. • The content of parameters specific to MELSECNET/H is not normal.	• Correct and write the new network parameters to the CPU module. • If an error occurs even after correction, this is because of a hardware failure. (Contact your nearest system service, distributor, or branch office and explain the symptoms.)
3103	• The number of modules in the network parameters for Ethernet differs from the number of mounted modules. • The start I/O number of the network parameters for Ethernet differs from the mounted I/O number.	• Confirm the network parameters and mounted status. If they differ, match the network parameters to the mounted status. When network parameters are corrected, write the new network parameters to the CPU module. • If an error occurs even after correction, this is because of a hardware failure. (Contact your nearest system service, distributor, or branch office and explain the symptoms.)
3104	• The same network No. is used in Ethernet, CC-Link IE Controller Network and MELSECNET/H. • The network No., station number and group number set in the network parameters are out of range. • The input/output specification is out of the range of the currently used CPU module. • The content of parameters specific to Ethernet is not normal.	• Correct and write the new network parameters to the CPU module. • If an error occurs even after correction, this is because of a hardware failure. (Contact your nearest system service, distributor, or branch office and explain the symptoms.)
3105	• The mounted number of modules is 0 even though the number of modules in CC-Link's number of modules setting parameter is set to 1 or more. • The start I/O number of common parameters differs from the mounted I/O number. • There is a mismatch in the station type in CC-Link's number of modules setting parameter.	• Correct and write the new network parameters to the CPU module. • If an error occurs even after correction, this is because of a hardware failure. (Contact your nearest system service, distributor, or branch office and explain the symptoms.)

*1: MELSECNET/H modules with a serial number whose first 5 digits are "08102" onwards are targeted.

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Error codes (continued)

Error code	Error definition and cause	Corrective action
3106	• The refresh parameters of the CC-Link network are out of range. • The safety data monitoring time is set although the safety remote station set in the network parameters does not support the safety data monitoring time.	• Review the parameter settings. • Either review the model and module technical version in the safety remote station settings, or delete the safety data monitoring time setting.
	The safety data monitoring time is set.	Delete the safety data monitoring time setting.
3107	The content of parameters specific to CC-Link is not normal.	Review the parameter settings.
3400	The start I/O number of the module targeted by the remote password is set to other than 0H to 3E0H.	Change the start I/O number of the module targeted by the remote password to within the range 0H to 3E0H.
3401	An Ethernet module function version B onwards is not mounted in the slot specified by the start I/O number of the remote password.	Set the position specified by the start I/O number of the module targeted by the remote password to an Ethernet module function version B onwards.
4000	• An instruction code that cannot be deciphered by the CPU module is included in program. • An unusable instruction is included in the program.	Read the error common information using GX Developer, and check and correct the error steps corresponding to that numerical value (program error location).
4002	• There is a mistake in the instruction name of the dedicated instruction specified in the program. • The dedicated instruction specified in the program cannot be executed on the specified module. • Unsupported instructions exist.	
4003	There is a mistake in the number of devices in the dedicated instruction specified in the program.	
4004	Devices that cannot be used by the dedicated instruction specified in the program are specified.	
4010	The END instruction is not programmed in the program.	
4100	Data that cannot be handled by instructions is included.	Read the error common information using GX Developer, and check and correct the error steps corresponding to that numerical value (program error location).
4101	• The number of data used in the instruction is set to exceed the available range. • The storage data and constants of the device specified by the instruction exceeds the usable range.	
4102	• There is a mistake in the network No. and station number specified by the dedicated instruction. • The module No., network No. and number of character strings specified by the dedicated instruction exceed the specifiable range.	Read the error common information using GX Developer, and check and correct the error steps corresponding to that numerical value (program error location).
4700	The S.QSABORT instruction was executed to forcefully stop the program.	Remove the cause of executing the S.QSABORT instruction.
5001	• The program scan time exceeds the WDT setting value set in the PLC RAS setting in PLC parameters.	Read the error individual information using GX Developer, check that numerical value (time), and shorten the scan time.
5010	The program scan time exceeds the constant scan setting time set in the PLC RAS setting in PLC parameters.	Review the constant scan time in PLC parameters so that sufficient remaining time for the constant scan can be ensured.
8000	An error was detected in internal register diagnostics incorporated on the CPU module.	Hardware failure of the CPU module (Contact your nearest system service, distributor, or branch office and explain the symptoms.)
8010	An error was detected on the internal bus of the CPU module.	Hardware failure of the CPU module (Contact your nearest system service, distributor, or branch office and explain the symptoms.)
8020	An incompatibility occurred in the execution states of CPUs A and B.	• Take measures against noise. • Reset and operate (RUN) the CPU module again. If the same error is displayed again, there is a hardware failure on the CPU module. (Contact your nearest system service, distributor, or branch office and explain the symptoms.)
8021	A mismatch in the number of program executions was detected between CPU A and CPU B.	

Error codes (continued)

error code	Error definition and cause	Corrective action
8031	An error was detected in the program memory or the file stored in standard ROM.	Write the file indicated in SD17 to SD22 of the individual information to the drive indicated in SD16 of the individual information, and turn the CPU module power supply OFF then ON, or reset the CPU module and clear the reset. If the same error is displayed again, there is a hardware failure on the CPU module. (Contact your nearest system service, distributor, or branch office and explain the symptoms.)
8032		
8050	A mismatch was detected on verifying the safety output between CPUs A and CPU in the CPU module.	• Check that the program that outputs safety output is correct. • Take measures against noise. • Reset and operate (RUN) the CPU module again. If the same error is displayed again, there is a hardware failure on the CPU module. (Contact your nearest system service, distributor, or branch office and explain the symptoms.)
8060	A system program error was detected.	• Take measures against noise. • Reset and operate (RUN) the CPU module again. If the same error is displayed again, there is a hardware failure on the CPU module. (Contact your nearest system service, distributor, or branch office and explain the symptoms.)
8070	Initial communication between CPUs A and B failed.	• Take measures against noise. • Reset and operate (RUN) the CPU module again. If the same error is displayed again, there is a hardware failure on the CPU module. (Contact your nearest system service, distributor, or branch office and explain the symptoms.)
8071	Data transmission to the peer CPU in communication between CPUs A and B failed.	
8072	Data reception from the peer CPU in communication between CPUs A and B failed.	
8073	Data transmission to the peer CPU in communication between CPUs A and B failed.	
8074	Data reception from the peer CPU in communication between CPUs A and B failed.	
8080	A power supply voltage error was detected internally on the CPU module.	• Take measures against noise. • Reset and operate (RUN) the CPU module again. If the same error is displayed again, there is a hardware failure on the CPU module. (Contact your nearest system service, distributor, or branch office and explain the symptoms.)
8090	An error was detected in the power supply voltage monitoring circuit.	• Take measures against noise. • Reset and operate (RUN) the CPU module again. If the same error is displayed again, there is a hardware failure on the CPU module. (Contact your nearest system service, distributor, or branch office and explain the symptoms.)
8100	The continuous operation time in TEST MODE exceeds the TEST MODE continuous allowable RUN time set in parameters.	Confirm that the safety CPU operating mode is in a state where it can be switched to SAFETY MODE, and operate after switching from TEST MODE to SAFETY MODE.
8120	Clock stop of WDT was detected.	• Take measures against noise. • Reset and operate (RUN) the CPU module again. If the same error is displayed again, there is a hardware failure on the CPU module. (Contact your nearest system service, distributor, or branch office and explain the symptoms.)
8300	Error information was received from the CC-Link Safety remote station.	Check the error code of the corresponding CC-Link Safety remote station. (For the confirmation method, refer to the manual of CC-Link Safety remote module.)

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Error codes (continued)

error code	Error definition and cause	Corrective action
8310	Mounted products differ from the product information specified in the network parameters.	• Confirm whether the model, module technical version or production information of the CC-Link Safety remote station set in the network parameters matches the product information of the corresponding CC-Link Safety remote station. (For the confirmation method, refer to the manual for the CC-Link Safety remote module.)
8320	Response data was no longer received during initial processing of the CC-Link Safety remote station.	• Confirm whether the operations mentioned below were performed. (1) Operation mode switching (2) Copying of program memory data to ROM (3) Registration/change of CPU access password (4) PLC memory initialization (If the above-mentioned operations were performed, the said error may occur since the CC-Link Safety send/receive interval becomes longer.) • If there is a momentary power failure in the supply power, change the mode to asynchronous mode or set a slower transmission speed. • Perform a line test to confirm the integrity of the transmission path. • Check whether the transmission speed setting is suitable. • Confirm that the safety refresh monitoring timer is set to a suitable value. • Confirm that the safety data monitoring timer is set to a suitable value.
8321	Response data was no longer received during normal communication with the CC-Link Safety remote station.	
8322	Response data was no longer received during error information processing from the CC-Link Safety remote station.	
8330	The received command differs from the expected value.	• Confirm the cable state visually or by the line test. • Hardware failure of the CC-Link Safety master module or the corresponding CC-Link Safety remote module. (Contact your nearest system service, distributor, or branch office and explain the symptoms.)
8331	There was data missing in the split received data.	
8332	The link ID in the received data differs from the expected value.	• Confirm that the link ID setting on the corresponding remote station is the same as the link ID set in the network parameters. • Hardware failure of the CC-Link Safety master module or the corresponding CC-Link Safety remote module. (Contact your nearest system service, distributor, or branch office and explain the symptoms.)
8333	The running No. in the received data differs from the expected value.	• Confirm that the safety refresh monitoring timer is set to a suitable value. • Hardware failure of the CC-Link Safety master module or the corresponding CC-Link Safety remote module. (Contact your nearest system service, distributor, or branch office and explain the symptoms.)
8334	The received data could not be recognized on the CC-Link Safety master station.	• Confirm the cable state visually or by the line test. • Hardware failure of the CC-Link Safety master module or the corresponding CC-Link Safety remote module. (Contact your nearest system service, distributor, or branch office and explain the symptoms.)
9000	Annunciator(F) was ON. (**** in the error message is the detected annunciator number.)	Read the error individual information using GX Developer, and check the program of that numerical value (annunciator No.).

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Appendix 16 List of Error Codes (CC-Link Safety System Remote I/O Module)

If a moderate error occurs during a power-on or during operation, the safety remote I/O module sends error information to the safety CPU module via the safety master module.
Error codes sent by the safety remote I/O module are as shown below.

Error codes

Error classification	Error item	Name	Error description	Corrective action
302	0000	CC-Link Safety protocol (received command out of range)	Unexpected protocol was generated.	Contact your nearest system service, distributor, or branch office and explain the symptoms.
304	0000	Error in CC-Link Safety protocol division number (product information)	The continuity of the division number was broken in send/receive processing of the product information.	
	0001	Error in CC-Link Safety protocol division number (safety slave station parameter)	The continuity of the division number was broken in send/receive processing of parameters for the safety slave station.	
	0002	Error in CC-Link Safety protocol division number (error information)	The continuity of the division number was broken in send/receive processing of the error information.	
	0003	Error in CC-Link Safety protocol division number (safety slave station internal information)	The continuity of the division number was broken when processing accessing of safety slave station internal information.	
305	0000	CC-Link Safety protocol product mismatch (link ID mismatch)	The link ID of the own station differs from the link ID received from the safety master station.	(1) Review the link ID. (2) Review the parameter settings. (This error code may not be output for the error check of the master station.)
	0001	CC-Link Safety protocol product mismatch (manufacturer code mismatch)	There was a mismatch in the manufacturer code received from the safety master station and the manufacturer code of the station in product information verification processing.	(1) Review the parameter settings. (This error code may not be output for the error check of the master station.)
	0002	CC-Link Safety protocol product mismatch (module-specific code mismatch)	There was a mismatch in the specific code received from the safety master station and the specific code of the own station in product information verification processing.	
	0003	CC-Link Safety protocol product mismatch (module technical version mismatch)	There was a mismatch in the specific code received from the safety master station and the module technical version of the own station in product information verification processing.	
	0004	CC-Link Safety protocol product mismatch (production information mismatch)	There was a mismatch in the specific code received from the safety master station and the production information of the own station in product information verification processing. Own station information 1,2: Lower 16 bits of production information to Own station information 7,8: Upper 16 bits of production information	(1) Review the production information set in parameters. (This error code may not be output for the error check of the master station.)
	0005	CC-Link Safety protocol product mismatch (model information mismatch)	There was a mismatch in the model information received from the safety master station and the model information of the host station in product information verification processing. Details 1 to 9 Detail item 1: 'QS' Detail item 2: '0J' Detail item 3: '65' Detail item 4: 'BT' Detail item 5: 'B2' Detail item 6: '-1' Detail item 7: '2D' Detail item 8: 'T' Detail item 9: 0x0020	(1) Review the parameter settings. (This error code may not be output for the error check of the master station.)

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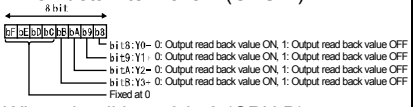
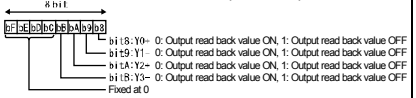
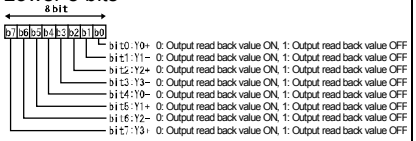
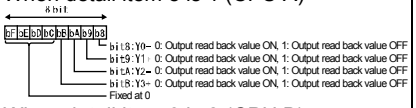
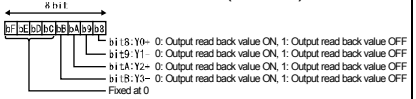
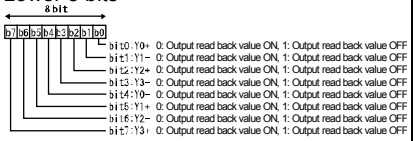
Error classification	Error item	Name	Error description	Corrective action
306	0001	Parameter error for the CC-Link Safety protocol safety slave station (verification request cannot be received)	Although the request to verify the parameters for the safety slave station was received from the safety master station, the own station does not support the request.	(Contact your nearest system service, distributor, or branch office and explain the symptoms.)
	0002	Parameter for safety slave station - Parameter out of range	The parameter number of the parameter for the safety slave station is out of range.	
	0003	Parameter for safety slave station - Same parameter number settings	The same parameter number was set for the parameter for the safety slave station.	
	0004	Parameter for safety slave station - Setting out of range	The setting of the parameter for the safety slave station is out of range.	
	0005	Parameter error for CC-Link Safety protocol safety slave station (CRC32 mismatch)	In the parameters for the safety slave station received from the safety master station, there is a mismatch between the CRC32 calculated from all parameters and the received CRC32.	
307	0000	Protocol version notification error	There is no protocol version notification from the safety master station. Or, there is an error in the protocol version notification from the safety master station.	
	0001	Safety data monitoring timer notification error	There is no safety data monitoring timer notification from the safety master.	
	0002	Safety refresh response processing time request error	There is no safety refresh response processing time request from the safety master station.	
	0015	Unsupported function notification	An unsupported function was sent from the safety master station.	
350	0719	Error in number of parameters for CC-Link Safety protocol safety slave station	The received number of parameters for the safety slave station was out of range.	Confirm whether the CSP file is damaged or whether the latest CSP file is registered, and set the parameters of the safety remote I/O module again.
	0917	Incompatibility in parameters for safety slave station	Incompatibility in parameters for safety slave station <Detail item 2> 201: Time of noise removal filter incompatibility (The input dark test pulse OFF time is greater than the "Time of noise removal filter X0,1" setting.) 601: Output wiring method Incompatibility (When the output wiring method is "source + source", the output wiring method setting for paired wiring is not the same.) 701: Output dark test execution selection incompatibility (When the output wiring method is "source + source", the dark test execution selection is not the same.)	• Judge incompatibility from content of detail item 2 mentioned on the left, and correct the parameters. • * Confirm whether the CSP file is damaged or whether the latest CSP file is registered, and set the parameters of the safety remote I/O module again.
450	0102	Dual input mismatch detection error	A mismatch was detected after the dual input mismatch detection time was exceeded on an input pair (X0 and X1, X2 and X3...). <Detail item 2> bit0: 1: X0 ON 0: X0 OFF bit1: 1: X1 ON 0: X1 OFF to bitE: 1: XE ON 0: XE OFF bitF: 1: XF ON 0: XF OFF	Review connected devices and wiring.

Error classification	Error item	Name	Error description	Corrective action
450	0203	Output overload error (at diagnosis before SafetyLED turns on)	Overcurrent protection or overheat protection was actuated by transistor on output circuit.	(1) Review connected devices and wiring. (2) Replace the safety remote I/O module.
	0204	Output read back error (at diagnosis before Safety LED turns on)	Read back value and output value do not match. <Detail item 2> Upper 8 bits When detail item 8 is 1 (CPU A)  When detail item 8 is 2 (CPU B)  Lower 8 bits  Due to hardware restrictions, sink side (-) output read back is read as ON irrespective of ON/OFF of output.	
	0209	Output overload error (at diagnosis while Safety LED on)	Overcurrent protection or overheat protection was actuated by transistor on output circuit.	
	0210	Output read back error (at diagnosis while Safety LED on)	Read back value and output value do not match. <Detail item 2> Upper 8 bits When detail item 8 is 1 (CPU A)  When detail item 8 is 2 (CPU B)  Lower 8 bits  Due to hardware restrictions, sink side (-) output read back is read as ON irrespective of ON/OFF of output.	(1) Review connected devices and wiring. (2) Replace the safety remote I/O module.

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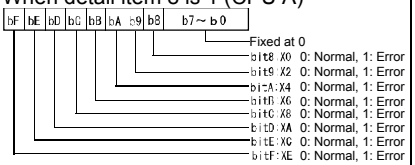
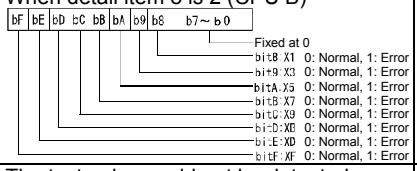
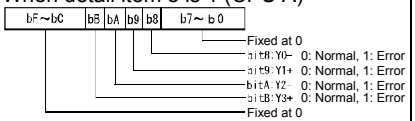
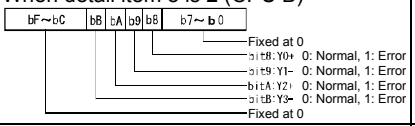
Error classification	Error item	Name	Error description	Corrective action
450	0304	Input data test error	The test pulse could not be detected during execution of the input dark test. <Detail item 6> When detail item 8 is 1 (CPU A)  When detail item 8 is 2 (CPU B)  	(1) Review connected devices and wiring. (2) Replace the safety remote I/O module.
	0305	Output dark test error	The test pulse could not be detected during execution of the output dark test. <Detail item 6> When detail item 8 is 1 (CPU A)  When detail item 8 is 2 (CPU B)  	(1) Review connected devices and wiring. (2) Replace the safety remote I/O module.
	0402	External power supply voltage error	Voltage error of external power supply or hardware failure	(1) Review connected devices, wiring and voltage. (2) Match the timing of external power supply ON with the timing of module power-on. (3) Replace the safety remote I/O module.
	0404	External power supply error	Voltage error of external power supply or hardware failure	
	0427	Output drive power supply status error	The output drive power supply is in an illegal shut-off/supply status.	(1) Review connected devices and wiring. (2) Match the timing of the external power supply ON with the timing of module power-on.
	0735	Technical version combination not allowed	The combination of the technical version set in parameters and the module technical version was not allowed.	(1) Set parameters to original technical version.
	0908	Read state recording of error history	Record read state of error history. The error history was read when there was no error history. If new error code is stored, this error code can no longer be read from history. There are two error histories, for CPU A and for CPU B, and this error is output when there is no history in either one of them. Or, two errors are output if there is no history in both of them.	Module is normal. Use as is.

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Error classification	Error item	Name	Error description	Corrective action
450	0911	Module forced stop control	Operation of the safety remote I/O module was stopped on receiving the forced stop command from the master. Module forced stop control. Note, however, that this excludes commands received after sending an error or when the error history is read.	Refer to the error history of the safety CPU module/safety master module.
	1011	External power supply voltage drop	A voltage drop occurred.	(1) Review connected devices and wiring. (2) Match the timing of the external power supply ON with the timing of module power-on. (3) Replace the safety remote I/O module.
	1213	Setting registration switch state error at power-on	Turning ON of the setting registration switch was detected at power-on.	(1) Do not perform a power-on and reset operation with the setting registration switch held down. (2) If this error occurs at power-on and reset operation while the setting registration switch is not pressed, this is because of failure of the setting registration switch. Replace the module.

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Appendix 17 Restrictions When Using CC-Link IE Controller Network Module with Safety CPU Module

(1) Network parameters that can be set with safety CPU module
The table below shows the network parameters of the CC-Link IE Controller network that can be set using GX Developer when a CC-Link IE Controller network module is used with the safety CPU module.

List of network parameters that can be set using GX Developer

Setting item		Settability
Network type	CC IE Control (control station)	×
	CC IE Control (normal station)	○
Start I/O No.		○
Network No.		○
Total (slave) stations		×
Group number		○
Station number		○
Mode		○
Network range assignment (common parameters)		×
Refresh parameters		○
Interrupt setting		×
Interlink transmission		×
Routing parameters		○
Valid module during other station access		×
Station number setting method		×

○: Can be set, ×: Cannot be set

REMARKS

For details of the CC-Link IE Controller Network, refer to the manual mentioned below.
* CC-Link IE Controller Network Reference Manual

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(2) Functions of CC-Link IE Controller Network that can be used with safety CPU module
The functions of CC-Link IE Controller Network and functions that can be used with the safety CPU module are shown in the table below.

List of functions of CC-Link IE Controller Network and functions that can be used with the safety CPU module

Function			Usability
Cyclic transmission functions	Communication using LB/LW		○
	Communication using LX/LY		○
	Link refresh		○
	Direct access to link devices		×
	Assurance of cyclic data integrity		○
	Cyclic transmission punctuality assurance		○
	Constant link scan		○
	Reserved station specification		○
	Interlink transmission function		×
	Stop/restart of cyclic transmission		○
Transient transmission functions	Read/write of other station word devices (READ/SREAD/WRITE/SWRITE)		○*1
	Transient request to other station (REQ)	Read/write of clock data	○*1
		Remote RUN/STOP	×*1
	Data send/receive (SEND/RECV)		×
	Receive other station data (for interrupt program)(RECVS)		×
	Read/write of other station word devices (ZNRD/ZNWR)		×
	Remote RUN/Remote STOP(RRUN/RSTOP)		×
	Read/write clock data of other station CPU modules (RTMRD/RTMWR)		○*1
	Other station access using GX Developer		○
	Changing the number of transient transmissions		×
	Group function		○
	Routing function		○
	Clock setting from GX Developer		○
RAS functions	Control station switching function		×
	Loopback function (optical loop system)		○
	Automatic return function		○
	Cable fault detection function		○
	Cable insertion error detection function		○
	Detection of duplicated control station or station No		○
	Checking transient transmission abnormal detection time		○
	Transient transmission enable even during CPU error		○
Diagnostic functions	Hardware test		○
	Self-loopback test		○
	Loop test/line test		○
	Station-to-station test		○
	Network test		○
	Communication test		○
Interrupt request to CPU module			×
Station number setting by sequence program			×

○: Can be set, ×: Cannot be set

*1: Other stations cannot write to safety CPU module.

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Appendix 18 Restrictions When Using MELSECNET/H Module with Safety CPU Module

(1) Network parameters that can be set with safety CPU module
The table below shows the network parameters of MELSECNET/H that can be set using GX Developer when a MELSECNET/H module is used with the safety CPU module.

List of network parameters that can be set using GX Developer

Setting item		Settability
Network type	MNET/H mode (control station), MNET/H expanded mode (control station)	×
	MNET/H mode (normal station), MNET/H expanded mode (normal station)	○
	MNET/10 mode (control station)	×
	MNET/10 mode (normal station)	○
	MNET/H standby station	×
	MNET/H (remote master station)	×
Start I/O No.		○
Network No.		○
Total (slave) stations		×
Group number		○
Mode		○
Network range assignment (common parameters)		×
Station-specific parameters		×
Refresh parameters		○
Interrupt setting		×
Control station return settings		×
Module corresponding to standby station		×
Redundant settings		×
Interlink transmission		×
Routing parameters		○
Valid module during other station access		×

○: Can be set, ×: Cannot be set

REMARKS

For details of MELSECNET/H, refer to the manual below.
- Q-compatible MELSECNET/H Network System Reference Manual (PLC to PLC Network)

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(2) MELSECNET/H functions that can be used with the safety CPU module
The functions of MELSECNET/H and functions that can be used with the safety CPU module are shown in the table below.

List of functions of MELSECNET/H and functions that can be used with the safety CPU module

Function			Usability
Cyclic transmission functions	Communication using LB/LW		○
	Communication using LX/LY		○
	MELSECNET/H extended mode		○
	Refresh parameters		○
	Common parameters		○
	Station-specific parameters		×
	Interlink transmission function		×
	Reserved station specification		○
	Low-speed cyclic transmission function		○
	Redundant system function		×
Transient transmission functions	Communication function		○
	Routing function		○
	Group function		○
	Message transmission function using logical channel numbers		×
	Data send/receive (SEND/RECV)		×
	Receive other station data (for interrupt program)(RECVS)		×
	Read/write of other station word devices (READ/SREAD/WRITE/SWRITE)		○*1
	Transient request to other station (REQ)	Read/write of clock data	○*1
		Remote RUN/STOP	×*1
	Read/write of other station word devices (ZNRD/ZNWR)		×
	Remote RUN/Remote STOP(RRUN/RSTOP)		×
	Read/write clock data of other station CPU modules (RTMRD/RTMWR)		○*1
RAS functions	Automatic return function		○
	Control station switching function		×
	Control station return control function		×
	Loopback function (optical loop system)		○
	Prevention of station failure using external power supply (optical loop system)		○
	Station detach function (coaxial bus system)		○
	Transient transmission enable even during CPU error		○
	Checking transient transmission abnormal detection time		○
	Diagnostic functions		○
Direct access to link devices			×
Start of interrupt sequence program			×
Multiplex transmission function (optical loop system)			○
Simple dual-structured network			×
Stopping/restarting cyclic transmission, link refresh stop (network test)			○
Increasing number of send points by installing multiple modules with the same network number			×
Multiple CPU system compatibility			×
Remote I/O system			×
Redundant system compatibility			×
Network diagnostics (network monitor)			○

○: Can be set, ×: Cannot be set

*1: Other stations cannot write to safety CPU module.

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Appendix 19 Restrictions When Using Ethernet Module with Safety CPU Module

(1) Network parameters that can be set with safety CPU module
The table below shows the network parameters of Ethernet that can be set using GX Developer when an Ethernet module is used with the safety CPU module.

List of network parameters that can be set using GX Developer

Setting item		Settability
Network type	Ethernet	○
Start I/O No.		○
Network No.		○
Group number		○
Station number		○
Mode		○
Operation setting		○
Initial settings		○
Open setting		○
Router relay parameters		○
Station number <-> IP related information		○
FTP parameters		×
E-mail settings		×
Interrupt setting		×
Redundant settings		×
Valid modules during other station access		×
Routing parameters		○

○: Can be set, ×: Cannot be set

REMARKS

For details of Ethernet, refer to the manuals below.
- Q-compatible Ethernet Interface Module User's Manual (Basic)
- Q-compatible Ethernet Interface Module User's Manual (Application)

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(2) Ethernet functions that can be used with the safety CPU module
The functions of Ethernet and functions that can be used with the safety CPU module are shown in the table below.

List of functions of Ethernet and functions that can be used with the safety CPU module

Function			Usability
Communication using the MC protocol	4E frame		○*1
	QnA-compatible 3E frame		○
	A-compatible 1E frame		○
Communication by fixed buffer (procedure exist)			○
Communication by fixed buffer (no procedure)			○
Communication using the random access buffer			×
E-mail function			×
Communication by dedicated instruction	Establish/disconnect connection with external devices for data communication (OPEN/CLOSE)		○
	Read received data/write send data using fixed buffer communication (BUFRCV/BUFSND)		○*2
	Read received data using fixed buffer communication (for interrupt program)(BUFRCVS)		×
	Clear/read error information of Ethernet module (ERRCLR/ERRRD)		○
	Re-initialization of Ethernet module (UINI)		○
	Read e-mails from other stations/send e-mails to other stations (MRECV/MSEND)		×
	Read/write of other station word devices (READ/SREAD/WRITE/SWRITE)		○*2
	Read/write of other station word devices (ZNRD/ZNWR)		×
	Data send/receive (SEND/RECV)		×
	Receive other station data (for interrupt program)(RECVS)		×
	Transient request to other station (REQ)	Read/write of clock data	○*2
		Remote RUN/STOP	×*1
File transfer (FTP server function)			×
Communication by Web function			×
CC-Link IE Controller Network, MELSECNET/H, MELSECNET/10 relay communication			×
Router relay communication (router relay function)			○
Connected device alive check function			○
Communication by pairing open			○
Remote password check			○
Broadcast function			○
Communication with MELSOFT products by exclusive connection	TCP/IP		○
	UDP/IP		○
Hardware test			○
Self-loopback test			○
Storage of communication error			○
Ethernet diagnostic function by GX Developer			○

○: Can be set, ×: Cannot be set

*1: Only Ethernet module whose first five digits of serial number are "07082" onwards can be used.
*2: Other stations cannot write to safety CPU module.

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(3) MC protocol that can be used with the safety CPU module
MC protocol that can be used with the safety CPU module is shown in the table below.

(a) 4E frame, QnA-compatible 3E frame

List of MC protocols (4E frame, QnA-compatible 3E frame) that can be used

Function		Type	Command (subcommand)	Usability
Device memory	Batch read	Bit	0401(00*1)	○
		Word	0401(00*0)	○
	Batch write	Bit	1401(00*1)	×
		Word	1401(00*0)	×
	Random read	Word	0403(00*0)	○
	Test (random write)	Bit	1402(00*1)	×
		Word	1402(00*0)	×
	Monitor data registration	Word	0801(00*0)	×
	Monitor	Word	0802 (0000)	×*1*2
	Batch read of multiple blocks	Word	0406(00*0)	○
	Batch write of multiple blocks	Word	1406(00*0)	×
Buffer memory	Batch read	-	0613 (0000)	○*1
	Batch write	-	1613 (0000)	○*1
Intelligent function module	Batch read	-	0601 (0000)	○
	Batch write	-	1601 (0000)	×
Programmable controller CPU	Remote RUN	-	1001 (0000)	×
	Remote STOP	-	1002 (0000)	×
	Remote PAUSE	-	1003 (0000)	×
	Remote latch clear	-	1005 (0000)	×
	Remote RESET	-	1006 (0000)	×
	CPU model name read	-	0101 (0000)	○
Drive memory	Memory usage status read	-	0205 (0000)	×
	Memory defragmentation	-	1207 (0000)	×
File	File information table read	No header statement	0201 (0000)	×
		Header statement	0202 (0000)	×
		File No. usage status	0204 (0000)	×
	File information modification	Modification of time and data of last update	1204 (0000)	×
		File name, file size modification	1204 (0001)	×
		Batch modification	1204 (0002)	×
	File search	-	0203 (0000)	×
	File contents read	-	0206 (0000)	×
	New registration (file name registration)	-	1202 (0000)	×
	File contents write	Arbitrary data	1203 (0000)	×
		Identical data	1203 (0001)	×
	File lock register/cancel	-	0808(000*)	×
	File copy	-	1206 (0000)	×
	File delete	-	1205 (0000)	×
	Directory file information read	-	1810 (0000)	○
	Directory file information search	-	1811 (0000)	○

(Continued on the next page)

List of MC protocols (4E frame, QnA-compatible 3E frame) that can be used (continued from previous page)

Function		Type	Command (subcommand)	Usability
File	New file creation	-	1820 (0000)	×
	File delete	-	1822 (0000)	×
	File copy	-	1824 (0000)	×
	File attribute modification	-	1825 (0000)	×
	File creation date modification	-	1826 (0000)	×
	File open	-	1827 (0000)	○
	Read file	-	1828 (0000)	○
	Write file	-	1829 (0000)	×
	File close	-	182A (0000)	○
LED off, error code initialization		-	1617 (000*)	○*1
Loopback test		-	0619 (0000)	○*1
Programmable controller CPU monitoring	Registration	-	0630 (0000)	○
	Cancel	-	0631 (0000)	○
Remote password	Unlock	-	1630 (0000)	○*1
	Lock	-	1631 (0000)	○*1

○: Can be set, ×: Cannot be set

*1: Functions compatible on the Ethernet module side

*2: Since the safety CPU module cannot use monitor data registration, data is not updated even in case of normal response.

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(b) A-compatible 1E frame

List of MC protocols (A-compatible 1E frame) that can be used

Function		Type	Command	Usability
Device memory	Batch read	Bit	00H	○
		Word	01H	○
	Batch write	Bit	02H	×
		Word	03H	×
	Test (random write)	Bit	04H	×
		Word	05H	×
	Monitor data registration	Bit	06H	×*1
		Word	07H	×*1
	Monitor	Bit	08H	×
		Word	09H	×

○: Can be set, ×: Cannot be set

*1: Since this function is compatible on the Ethernet module side, an error response is not returned if the specified device is normal.

REMARKS

For details of MC protocols, refer to the manuals below.

- Q-compatible MELSEC Communication Protocol Reference Manual
- Q-compatible Ethernet Interface Module User's Manual (Basic)
- Q-compatible Ethernet Interface Module User's Manual (Application)

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Appendix 20 ASCII Codes

LSD \ MSD		0	1	2	3	4	5	6	7
		000	001	010	011	100	101	110	111
0	0000	NUL	DLE	(SP)	0	@	P	`	p
1	0001	SOH	DC1	!	1	A	Q	a	q
2	0010	STX	DC2	"	2	B	R	b	r
3	0011	ETX	DC3	#	3	C	S	c	s
4	0100	EOT	DC4	$	4	D	T	d	t
5	0101	ENQ	NAK	%	5	E	U	e	u
6	0110	ACK	SYN	&	6	F	V	f	v
7	0111	BEL	ETB	'	7	G	W	g	w
8	1000	BS	CAN	(	8	H	X	h	x
9	1001	HT	EM	)	9	I	Y	I	y
A	1010	LF	SUB	*	:	J	Z	j	z
B	1011	VT	ESC	+	;	K	[	k	{
C	1100	FF	FS	,	<	L	\	l	|
D	1101	CR	GS	-	=	M	]	m	}
E	1110	SO	RS	.	>	N	^	n	~
F	1111	SI	US	/	?	O	_	o	DEL

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Memo

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Mitsubishi Programmable Controllers Training Manual
Safety Programmable Controller Operating (MELSEC-QS)

MODEL	
MODEL CODE	
SH-081377ENG-A (1403) MEE	

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