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Mitsubishi Electric Programmable Controller
MELSEC iQ-F Series

Quick Start Guide (Safety Extension Module)

MELSEC iQ-F series

INTRODUCTION

Thank you for purchasing the Mitsubishi Electric MELSEC iQ-F series programmable controllers.
This manual describes the handling of MELSEC iQ-F series safety extension module.
Before using this product, please read this manual and relevant manuals carefully and develop familiarity with the specifications to handle the product correctly.
When applying the program and circuit examples provided in this manual to an actual system, ensure the applicability and confirm that it will not cause system control problems.

Conditions of use for the product

- Although Mitsubishi Electric has obtained the certification for product's compliance to the international safety standards IEC 61508 and ISO 13849-1 from TÜV Rheinland, this fact does not guarantee that product will be free from any malfunction or failure. The user of this product shall comply with any and all applicable safety standard, regulation or law and take appropriate safety measures for the system in which the product is installed or used and shall take the second or third safety measures other than the product. Mitsubishi Electric is not liable for damages that could have been prevented by compliance with any applicable safety standard, regulation or law.

Regarding use of this product

- This product has been manufactured as a general-purpose part for general industries, and has not been designed or manufactured to be incorporated in a device or system used in purposes related to human life.
- Before using the product for special purposes such as nuclear power, electric power, aerospace, medicine or passenger movement vehicles, please contact Mitsubishi Electric sales office.
- This product has been manufactured under strict quality control. However when installing the product where major accidents or losses could occur if the product fails, install appropriate backup or failsafe functions into the system.

Note

- If in doubt at any stage during the installation of the product, always consult a professional electrical engineer who is qualified and trained to the local and national standards. If in doubt about the operation or use, please contact your local Mitsubishi Electric representative.
- Mitsubishi Electric will not accept responsibility for actual use of the product based on these illustrative examples. Please use it after confirming the function and safety of the equipment and system.
- The content, specifications etc. of this manual may be changed, for improvement, without notice.
- For the non-Mitsubishi manuals mentioned in this manual, please contact the manufactures of the corresponding products.
- The information in this manual has been carefully checked and is believed to be accurate; however, if you notice a doubtful point, an error, etc., please contact your local Mitsubishi Electric representative. When doing so, please provide the manual number given at the end of this manual.

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RELEVANT MANUALS

The following relevant manuals can be downloaded from the Mitsubishi Electric FA site.
www.mitsubishielectric.com/fa/ref/ref.html?kisyu=plcf&manual=download_all

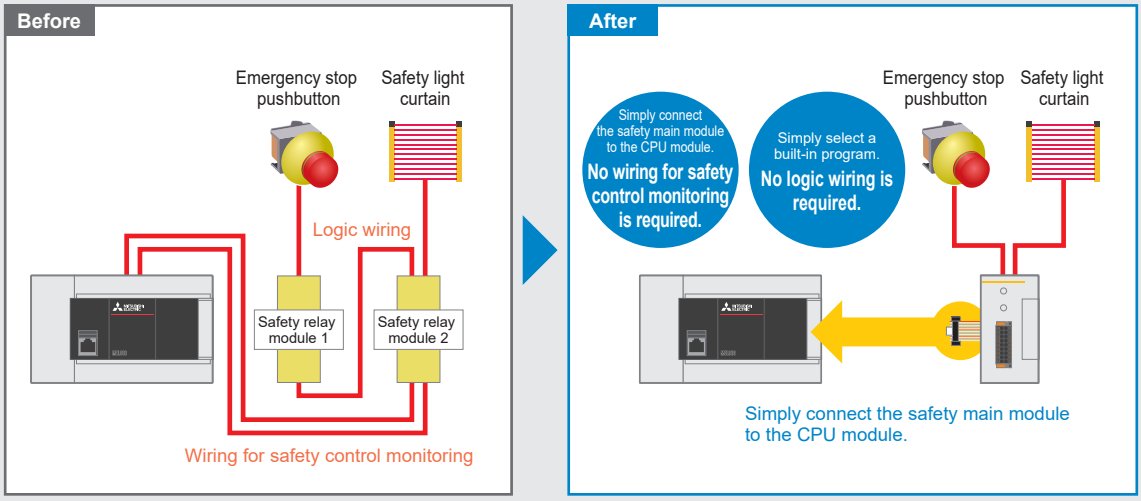
Manual	Manual number
MELSEC iQ-F FX5 User's Manual (Safety Control)	SH(NA)-082078ENG
MELSEC iQ-F FX5S/FX5UJ/FX5U/FX5UC User's Manual (Hardware)	SH(NA)-082452ENG
MELSEC iQ-F FX5 User's Manual (Application)	JY997D55401

RECOMMENDED POINTS

Point 1

Safety control can be introduced with less wiring and space.

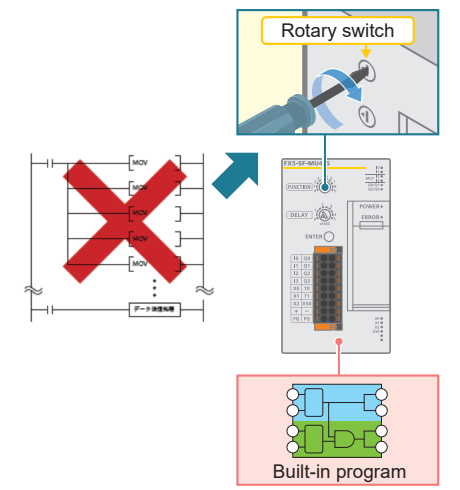
No logic wiring between safety relays and no wiring for safety control monitoring is required.



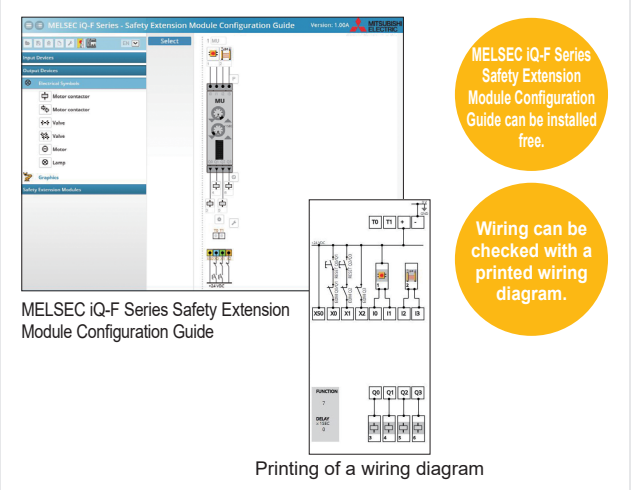
Point 2

No programming is required and simple wiring reduces man-hours.

An applicable safety control circuit can be simply selected from the nine built-in programs using the rotary switch. No sequence programming is required.



Users can print the wiring diagram of the module configuration using MELSEC iQ-F Series Safety Extension Module Configuration Guide* and easily check the wiring of safety sensors and contactors connected.



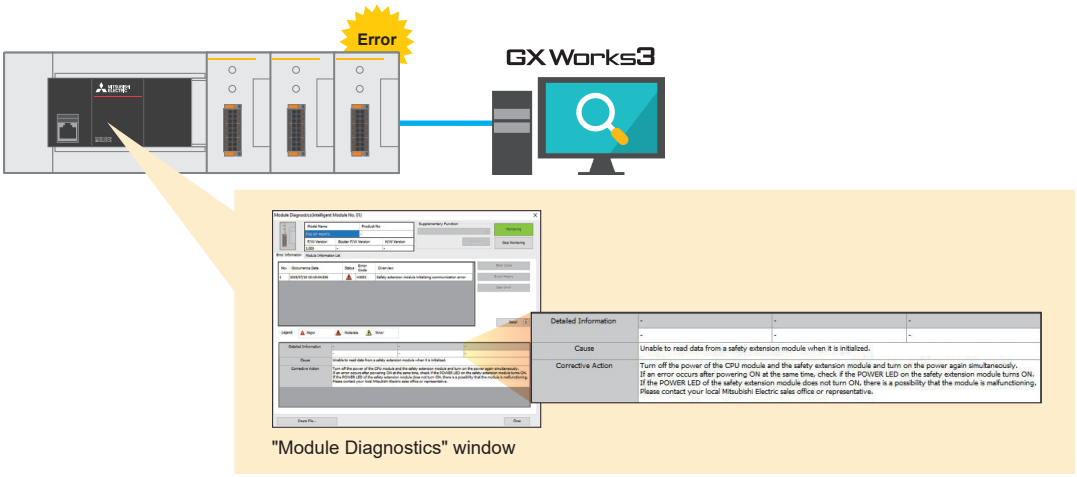
*: MELSEC iQ-F Series Safety Extension Module Configuration Guide can be downloaded from the Mitsubishi Electric FA site.
URL
www.mitsubishielectric.com/fa/ref/ref.html?kisyu=plcf&&software=iqfsafety_cfgguide

RECOMMENDED POINTS

Point 3

Downtime reduction improves operating rate.

Error details and corrective actions of the safety extension module can be checked using the module diagnostic function of GX Works3, helping early recovery from an error.



"Module Diagnostics" window

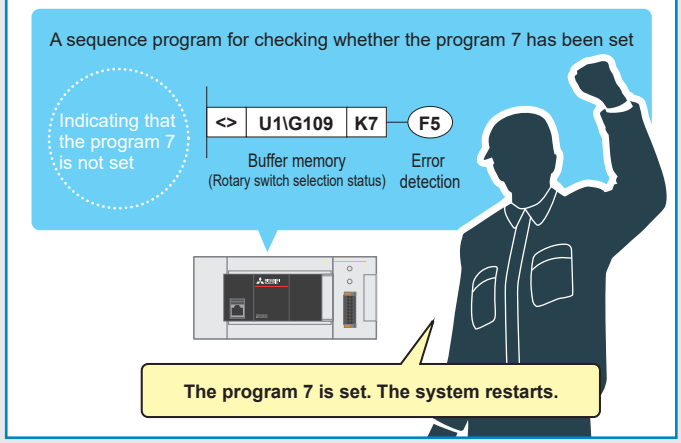
Information such as safety device settings and input/output status can be checked in the buffer memory, reducing the recovery time.

Before

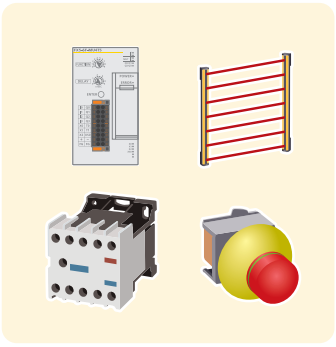
Although the safety main module is replaced with new one after error occurrence, the system does not restart. The error cause cannot be identified.

After

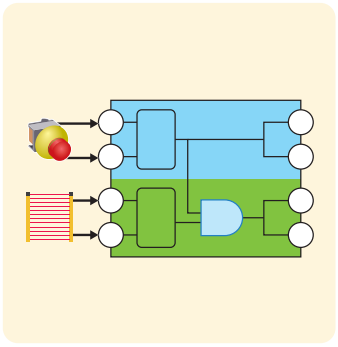
A sequence program for checking the settings can be created using information stored in the buffer memory.



1.1 Before Connecting Safety Devices

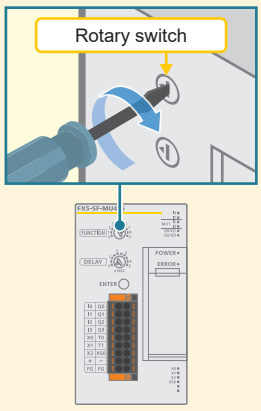


1 Preparing required products

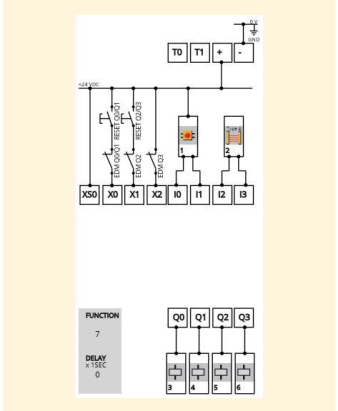


2 Examining safety control circuits

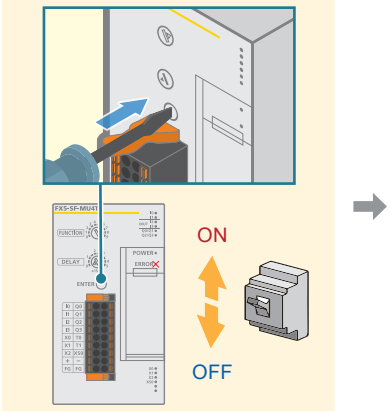
3 Selecting a built-in program



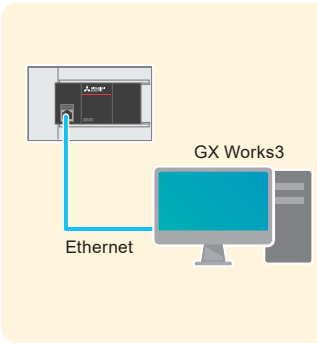
4 Setting the safety main module



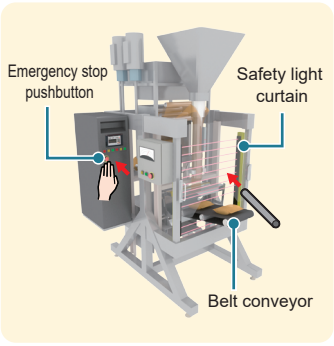
5 Wiring the safety main module



6 Applying the safety main module settings



7 Setting the CPU module



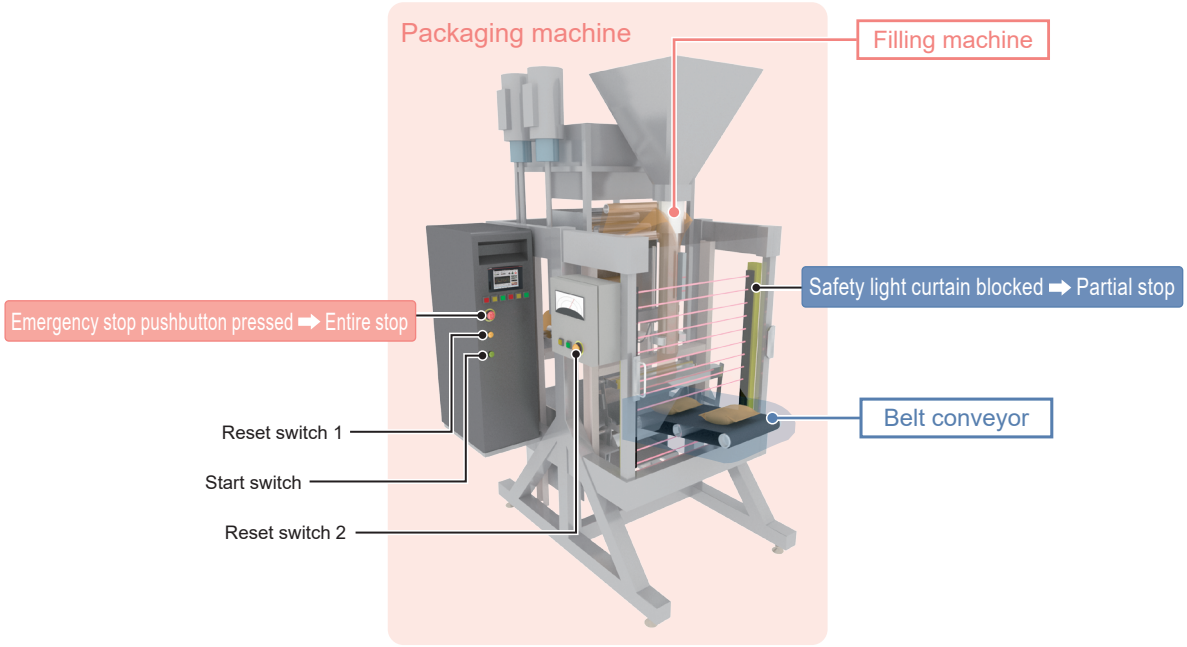
8 Checking operation of the safety control circuits

1.2 Safety Application Example

This manual describes the settings and wiring of the safety main module (FX5-SF-MU4T5), the settings of the FX5U CPU module, and the safety devices, such as emergency stop pushbuttons and safety light curtains, using the following safety application example. To use the safety main module and safety devices correctly, assess risks based on the user module configuration, and implement proper safety measures in accordance with the safety standards.

1.2.1 Safety application example described in this manual

The following is the safety application example of a packaging machine configured using the safety main module and safety devices (an emergency stop pushbutton and a safety light curtain).
This safety application controls activation and stopping of a filling machine and belt conveyor by turning ON/OFF the main contact on the safety contactor which opens and closes the power of the filling machine and belt conveyor. When the safety main module detects an error by the self-diagnostics, all outputs of the safety contactor turn OFF regardless of the applied logic, and the filling machine and belt conveyor stop.
Welding of the safety contactor contacts is also monitored. If a contact is welded, the system does not start even when the start switch or the reset switch is pressed.
The following operations are performed by the logic of program 7 (➡ P. 13) in the safety main module.



▶ Operation of the program 7 in the safety main module

1. After safety confirmation (emergency stop pushbutton: OFF, safety light curtain: not blocked), press the reset switches 1 and 2. Then, press the start switch to turn ON the safety contactors of the filling machine and belt conveyor.
2. When the emergency stop pushbutton is pressed and the safety light curtain is blocked, the filling machine and belt conveyor operate as follows:

Emergency stop pushbutton pressed	
Filling machine	Stop
Belt conveyor	Stop

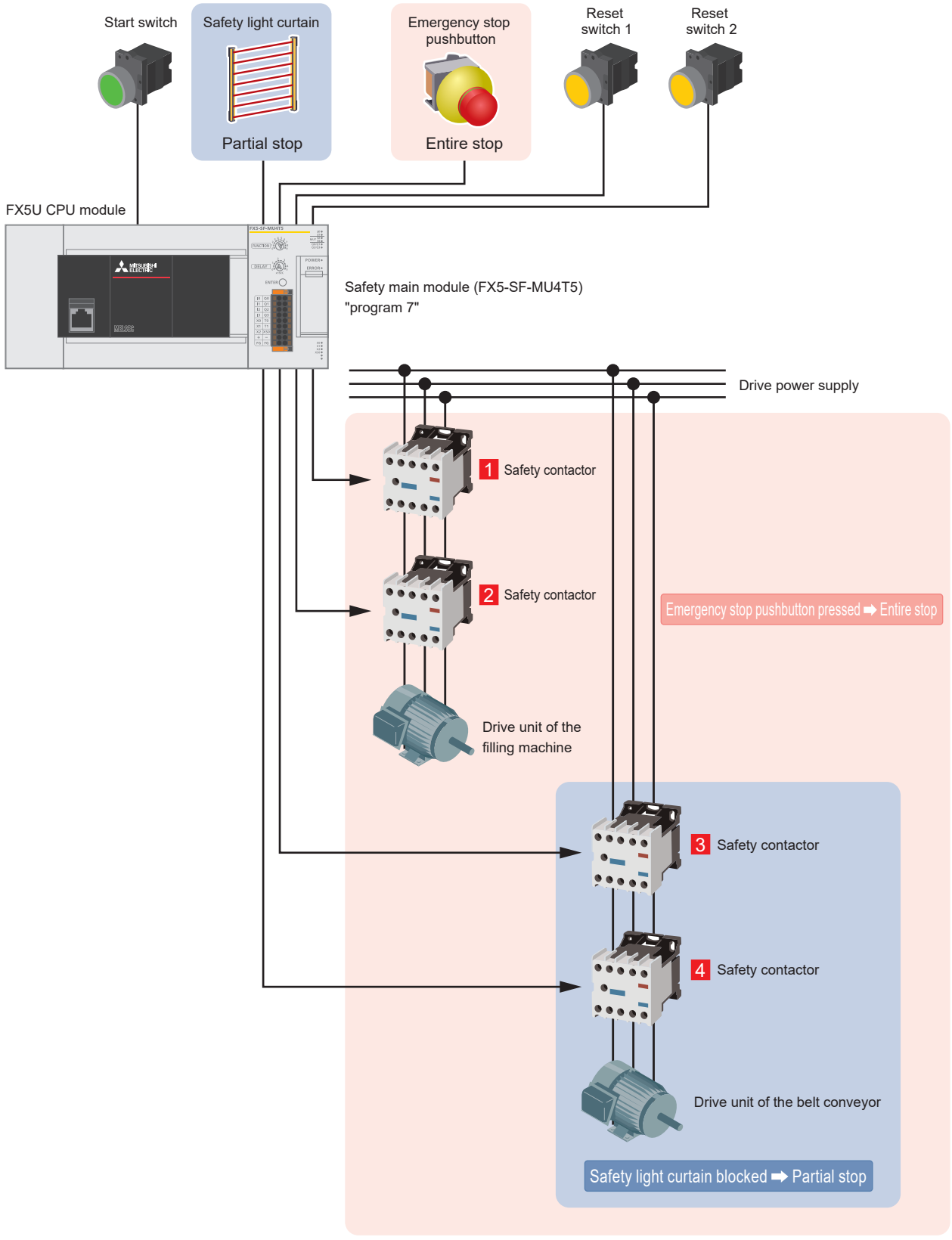
Emergency stop pushbutton pressed ➡ Entire stop

Safety light curtain blocked	
Filling machine	Run
Belt conveyor	Stop

Safety light curtain blocked ➡ Partial stop

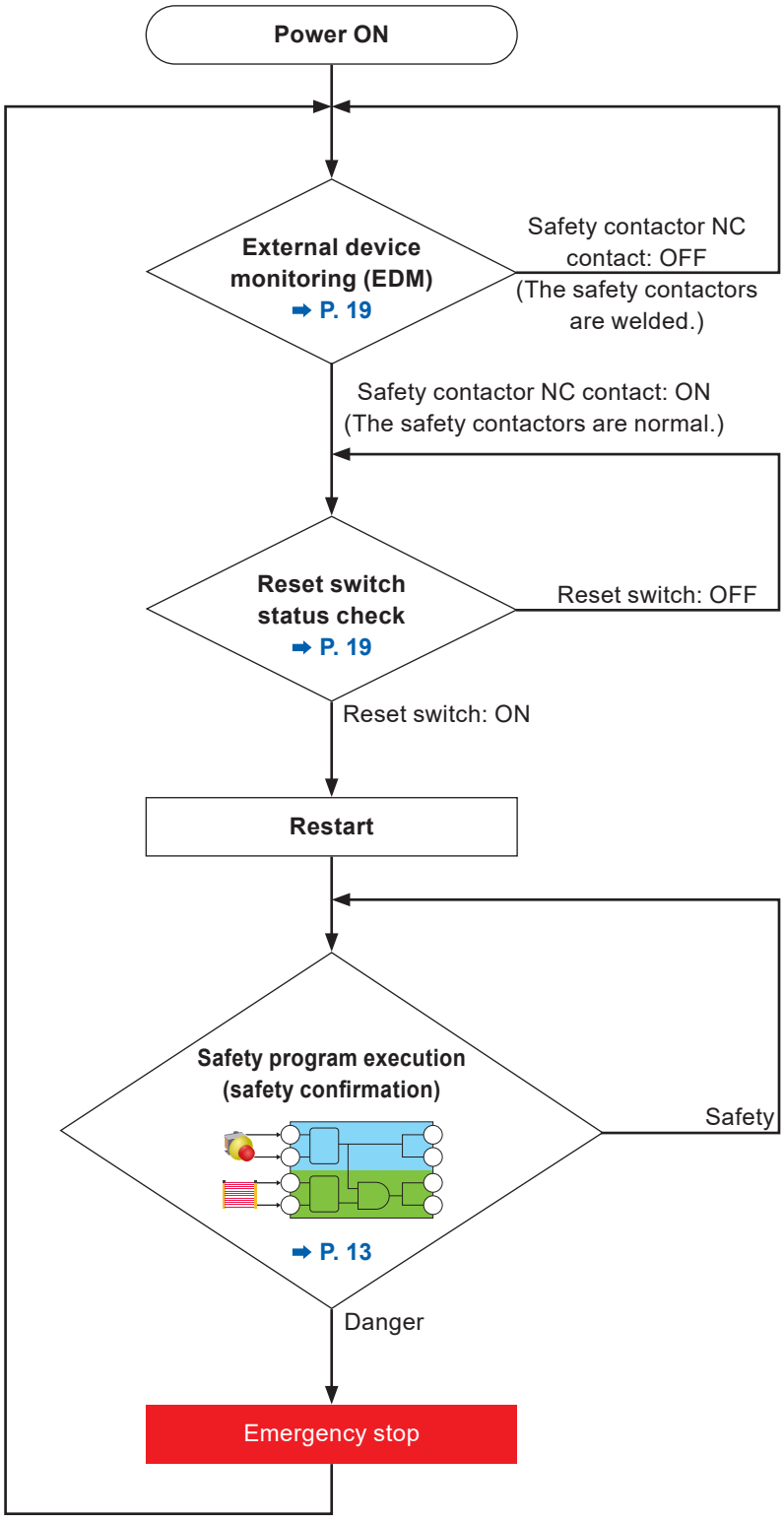
3. Release the restart interlock with the reset switches 1 and 2, and turn ON the start switch.
4. The filling machine and belt conveyor run again.

1.2.2 Connection example of safety devices



1.2.3 Operation flow

The following shows the operation flow of the safety application.



Point

External device monitoring (EDM) Whether the safety contactor is welded or not can be checked before start-up by monitoring NC (normally closed) contacts which correspond to the mirror contact.

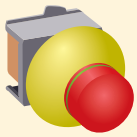
1.3 Required Products

In the safety application example described in this manual, the safety main module (FX5-SF-MU4T5) is connected to the FX5U CPU module, and the following safety devices are connected to the safety main module.

FX5U CPU module*
(1 module)

Safety main module
(FX5-SF-MU4T5)

Emergency stop pushbutton
(ES21-SB10G1 manufactured by SICK AG)



*: Firmware version "1.200" or later and serial number 17X**** or later

Safety light curtain (manufactured by SICK AG)

In addition to the following products, a power supply and terminal block for the safety light curtain may be required.

Sender
(C4P-SA03011C00)

+

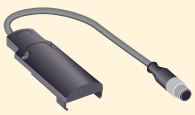
System plug for sender
(2076832)

+

External connection cable
(YF2A15-020UB5XLEAX2)

Receiver
(C4P-EA03011D00)

+



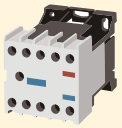
System plug for receiver
(2093097)

+

External connection cable
(YF2A15-020UB5XLEAX2)

Point The sender and receiver of the safety light curtain must be installed and adjusted correctly. For the installation and adjustments, refer to the manual of the manufacturer.

Contactor
(Supporting mirror contact*1)



× 4

(manufactured by Mitsubishi Electric: SD-Q11*2)
This safety device is described as "safety contactor" in this manual.

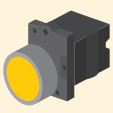
*1: Mirror contact is a mechanism that detects welding of a main contact.
*2: Auxiliary contact is NC contact.

Personal computer

GX Works3*

*: Version 1.060N or later

Pushbutton switch
(automatic return type)



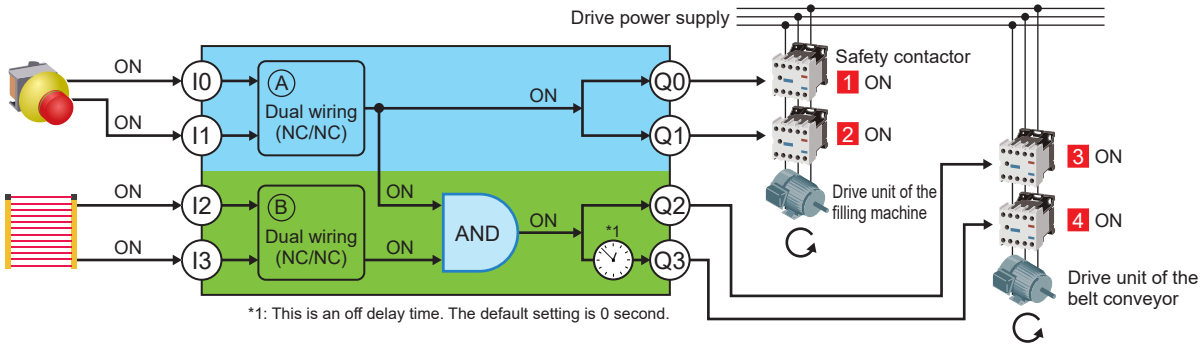
× 2

2 EXAMINATION OF SAFETY CONTROL CIRCUITS

There are nine built-in programs in the safety main module (FX5-SF-MU4T5).
The program 7 is applied to the safety application example (➡ P. 8) described in this manual.
This section describes the operation of the program 7.

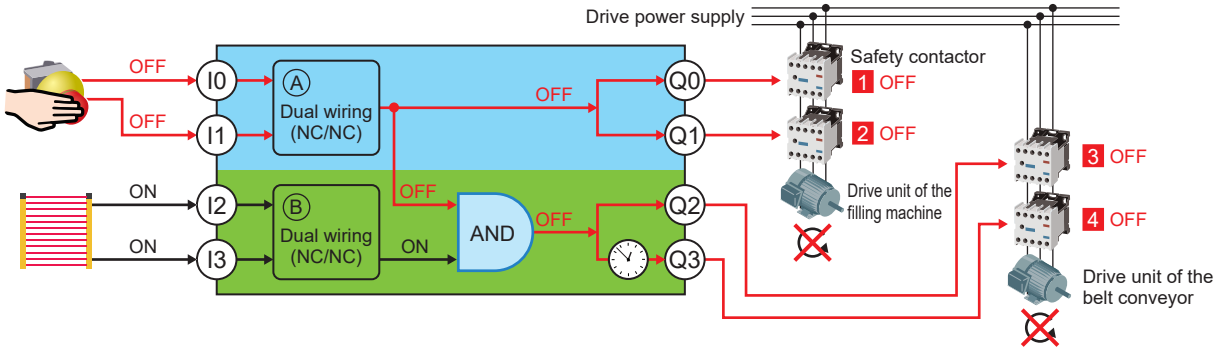
2.1 Operation of Program 7

Normal operation



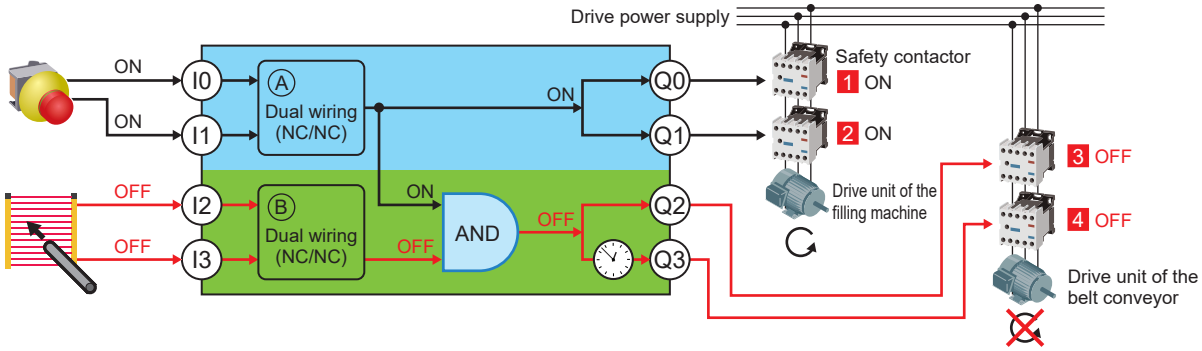
Operation when the emergency stop pushbutton is pressed (entire stop)

The following shows the operation when the emergency stop pushbutton is pressed.
All the outputs (Q0 to Q3) turn OFF and all the drive motors stop running.

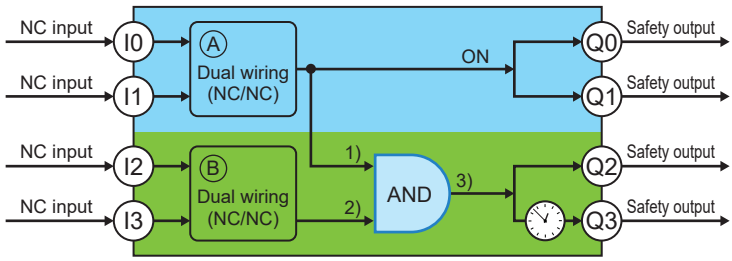


Operation when the safety light curtain detects a person (partial stop)

The following shows the operation when the safety light curtain detects a person.
The outputs (Q2 and Q3) turn OFF and only the drive motor of the belt conveyor stops running.



2.2 Logic Diagram of Program 7



NC input and NO input operations

The operations of NC input and NO input differ as follows. The program 7 supports only the NC input.

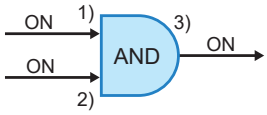
	Normal operation	Danger detected
NC (normally closed)	ON	OFF
NO (normally open)	OFF	ON

Point

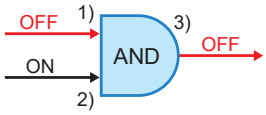
When the program 7 is selected, connect NC inputs to the input terminals (I0 to I3).
If NO inputs are connected, safety control circuits cannot be configured properly.

Operation of AND control

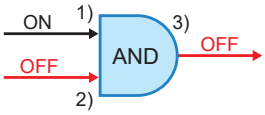
The operation of AND control will be as follows.



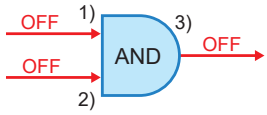
Signal	Status
1)	ON
2)	ON
3)	ON



Signal	Status
1)	OFF
2)	ON
3)	OFF



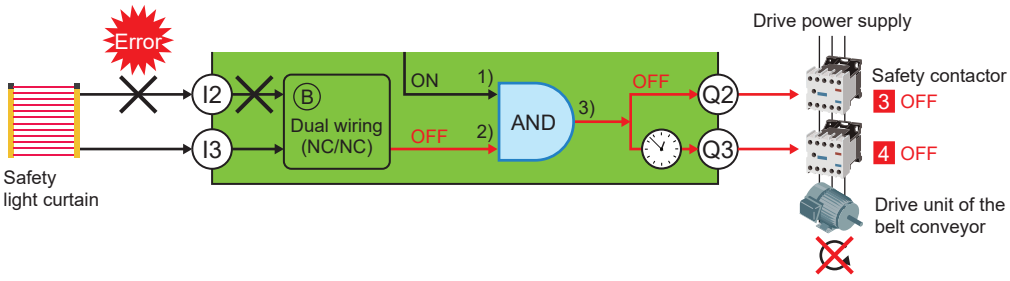
Signal	Status
1)	ON
2)	OFF
3)	OFF



Signal	Status
1)	OFF
2)	OFF
3)	OFF

Operation when input terminals are wired redundantly

A safety device can be wired redundantly (using two input terminals) to the safety main module. The signals input to the safety main module are verified internally. When the safety device is wired redundantly, if a “mismatch” is detected by verifying input signals, the safety outputs can be turned OFF although an input signal from either one of the input terminals is error. Also, the safety main module can turn OFF the safety contactors to stop the drive motor at the time of an input wiring disconnection or a safety device failure.



For the overview of other built-in programs (1 to 6, 8, and 9), refer to ➡ P. 39 .
For details on the built-in programs, refer to ➡ Section 4.2 Built-In Program Selection Function in the MELSEC iQ-F FX5 User’s Manual (Safety Control).

3 SELECTION OF A BUILT-IN PROGRAM

This section describes how to install a safety main module safely, setting the module, and checking the electric wiring of the module.

3.1 Installation

Operating environment

The recommended browsers are as follows:
• Internet Explorer®11
• Google Chrome™

How to use MELSEC iQ-F Series Safety Extension Module Configuration Guide

Step 1. Download

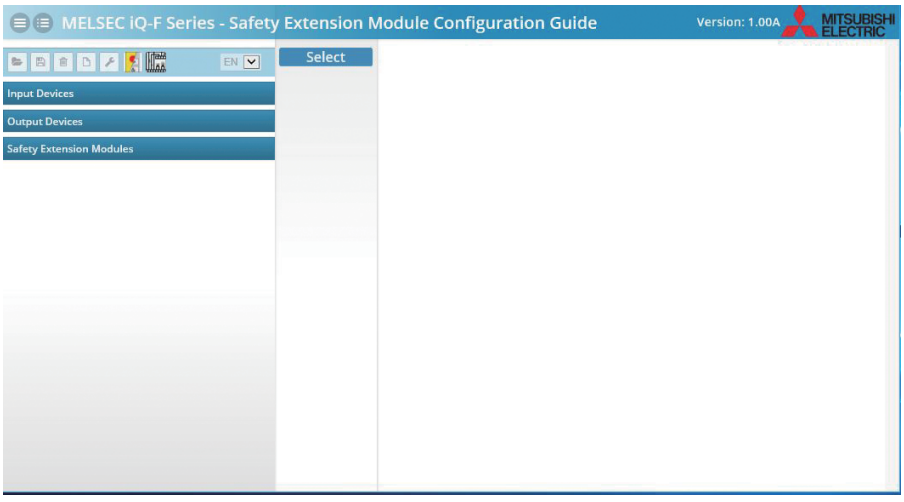
MELSEC iQ-F Series Safety Extension Module Configuration Guide can be downloaded from the following URL.
www.mitsubishielectric.com/fa/ref/ref.html?kisyu=plcf&&software=iqfsafety_cfgguide

Step 2. Installation

Extract the downloaded MELSEC iQ-F Series Safety Extension Module Configuration Guide, and store it to a local folder.
(Save destination example: C:\)

Step 3. Start-up

Double-click the "START.html" file in the "iqfsafety_cfgguide" folder.



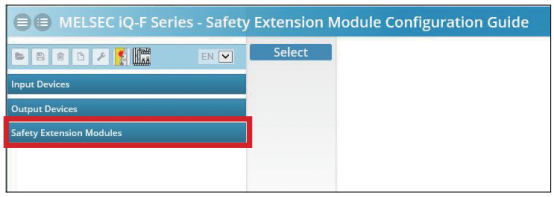
*: When MELSEC iQ-F Series Safety Extension Module Configuration Guide does not start normally, refer to ➡ P. 49 .

For details, refer to the following.
➡Appendix 6 How to Use MELSEC iQ-F Series Safety Extension Module Configuration Guide in the MELSEC iQ-F MELSEC iQ-F FX5 User's Manual (Safety Control).

3.2 Module Selection

Select a safety main module (FX5-SF-MU4T5) and a program.
In this manual, select the program 7 (➡ P. 12).

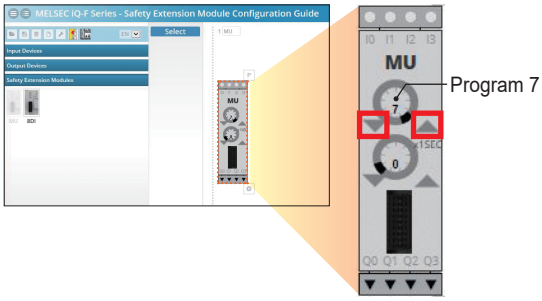
1 Click **Safety Extension Modules**.



2 Click  "MU".

3 The safety main module (FX5-SF-MU4T5) is selected.

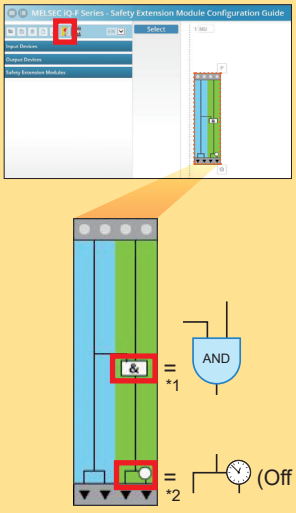
4 Select a program by using ▲ and ▼.
Select the program 7.



Point

To display a logic circuit of the program 7, click  (Logic) on the toolbar.

A logic diagram is displayed as below.



*1: "&" means the same as "AND".
In this manual, "AND" or "AND" is used.
*2: "◯" means the same as "◷".
In this manual, "◷" is used.

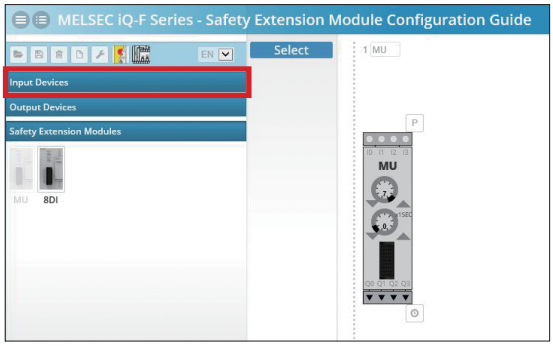
For details on the window configuration, refer to the following.
➡Appendix 6 How to Use MELSEC iQ-F Series Safety Extension Module Configuration Guide in the MELSEC iQ-F MELSEC iQ-F FX5 User's Manual (Safety Control).

3.3 Input Device Selection

After selecting the safety main module (➡ P. 15), select input devices.
For the selectable input devices, refer to ➡ Connectable devices and ladder symbols in the MELSEC iQ-F FX5 User's Manual (Safety Control).
In this manual, select an emergency stop pushbutton and a safety light curtain.

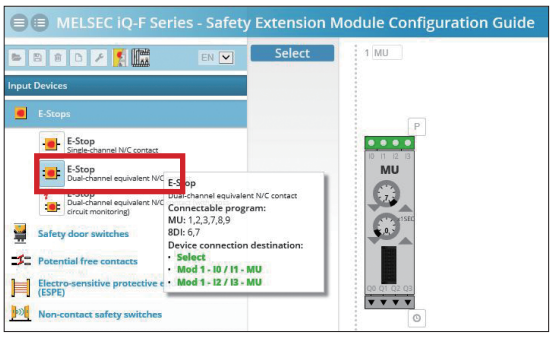
Selecting an emergency stop pushbutton

1 Click **Input Devices**.

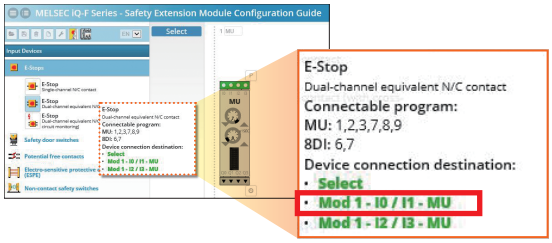


2 Click "E-Stops".

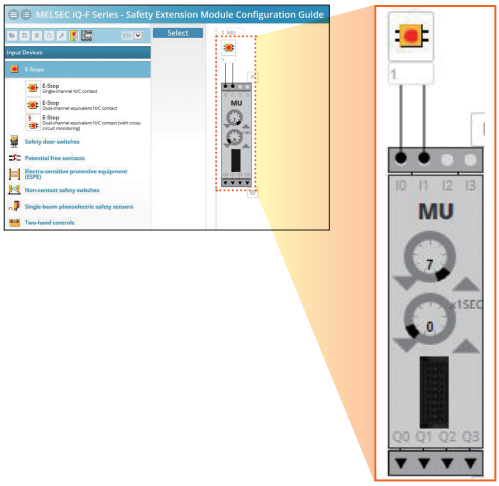
3 Click "E-Stop".



4 Click **Mod 1 - I0 / I1 - MU**.



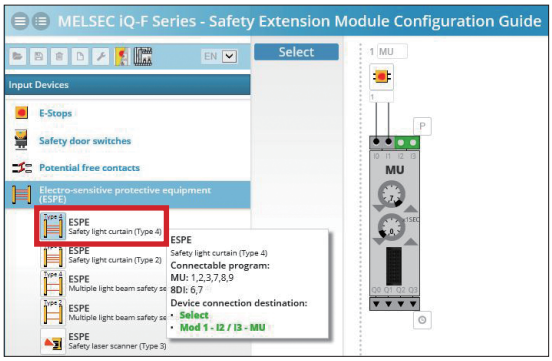
5 The connection configuration of the emergency stop pushbutton to the safety main module is displayed.



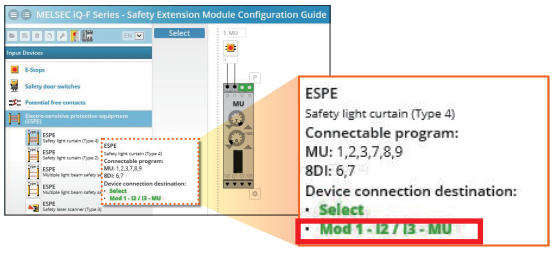
Selecting a safety light curtain

1 Select "Electro-sensitive protective equipment (ESPE)".

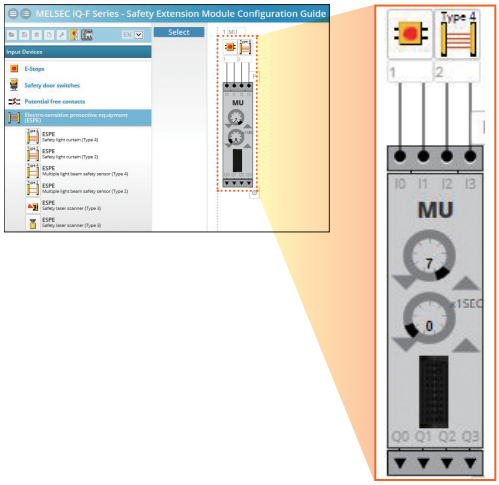
2 Select "ESPE Safety light curtain (Type 4)".



3 Click **Mod 1 - I2 / I3 - MU**.



4 The connection configuration of the emergency stop pushbutton and safety light curtain to the safety main module is displayed.

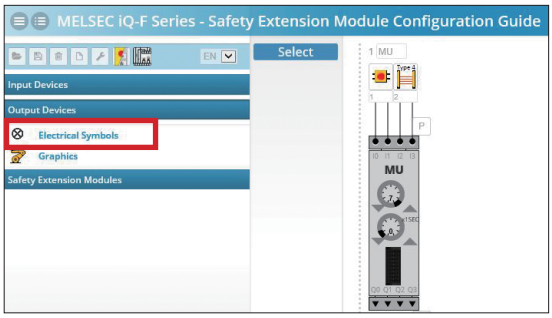


3.4 Output Device Selection

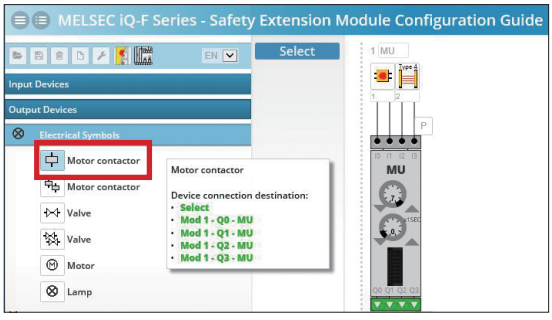
Select output devices.

1 Click **Output Devices**.

2 Click ⊗ "Electrical Symbols".

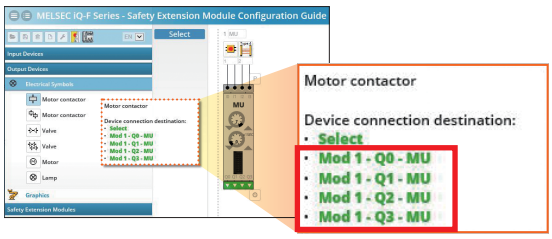


3 Click ⊣⊢ "Motor contactor".

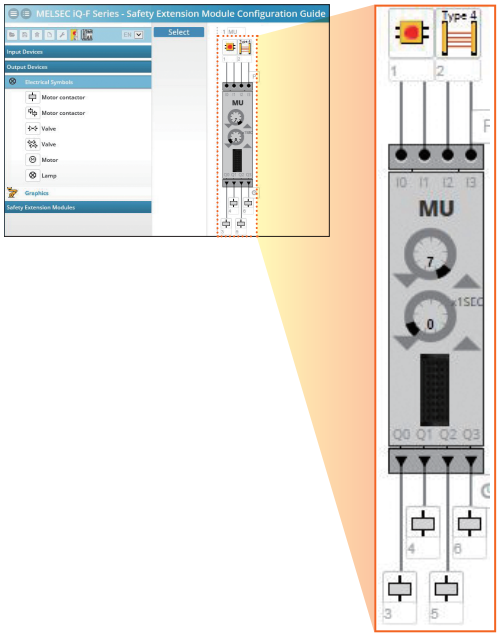


4 Select the following in sequence.

- Mod 1 - Q0 - MU
- Mod 1 - Q1 - MU
- Mod 1 - Q2 - MU
- Mod 1 - Q3 - MU



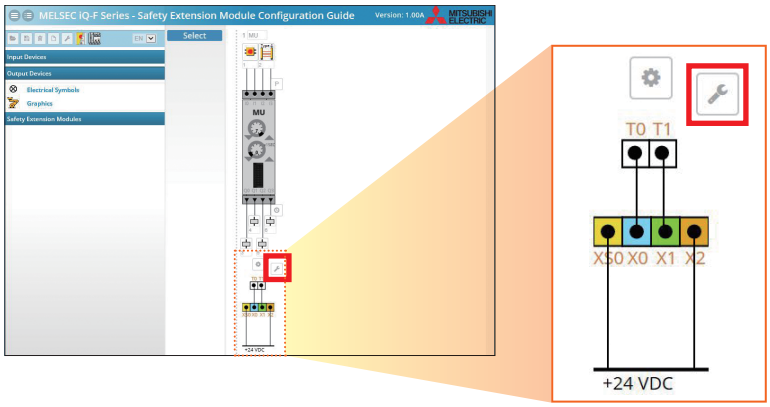
5 The connection configuration of the emergency stop pushbutton, safety light curtain, and safety contactors to the safety main module is displayed.



3.5 General Input Settings

Set the following to execute the external device monitoring (EDM) and the reset switch status check in the operation flow (➡ P. 10).

1 Click (General input settings) on the toolbar.



2 Select the following checkboxes.

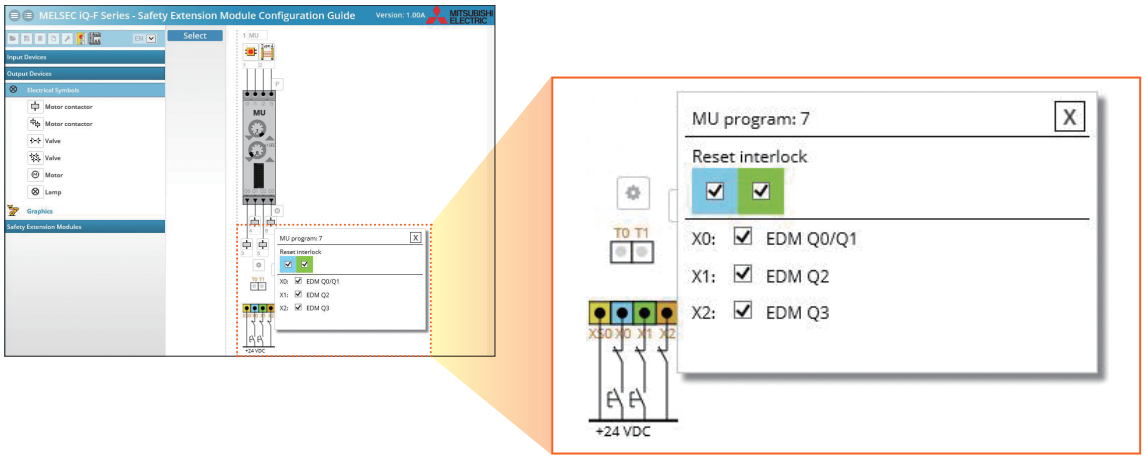
▶ External device monitoring (EDM)

"EDM Q0/Q1", "EDM Q2", "EDM Q3"

▶ Reset switch status check

"Reset interlock"

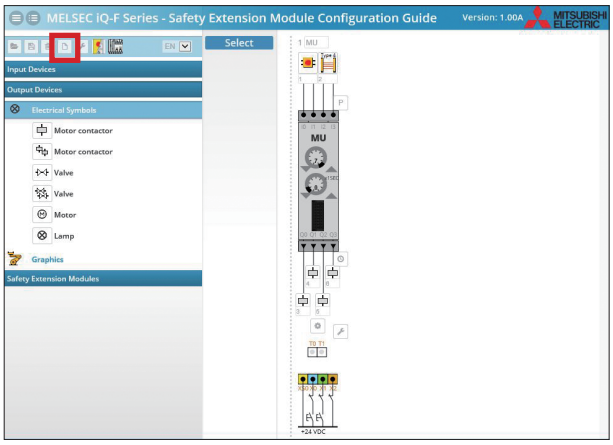
(pushbutton switch) and (auxiliary NC contact of the contactor) are placed between the terminals XS0, X0, X1, X2 and the +24 VDC.



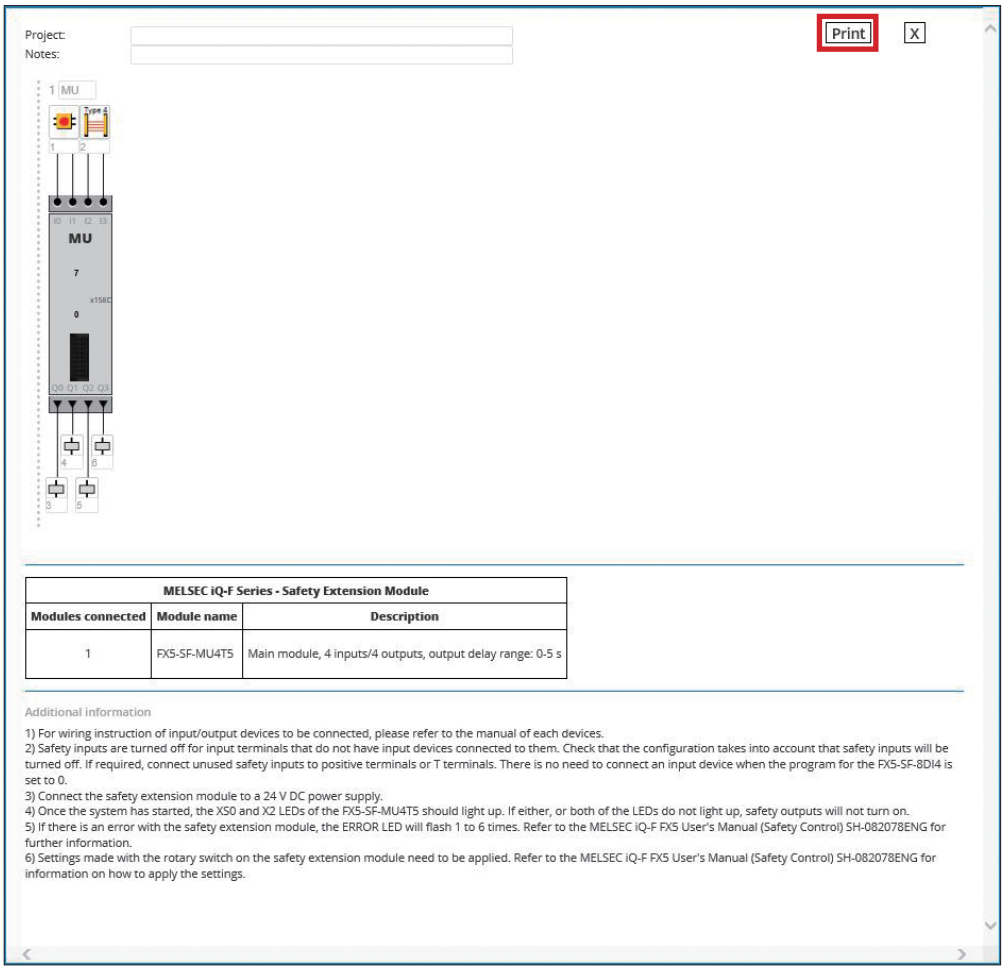
3.6 Printing of Module Configuration

Display the module configuration of the selected safety main module, input devices, and output devices on the configuration window, and print it.

1 Click (Configuration) on the toolbar.



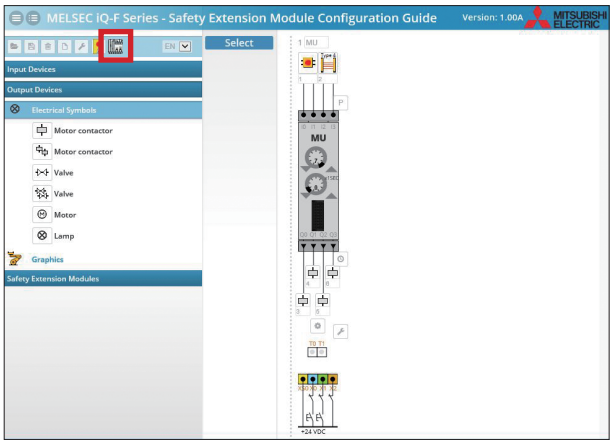
2 Click the Print button.



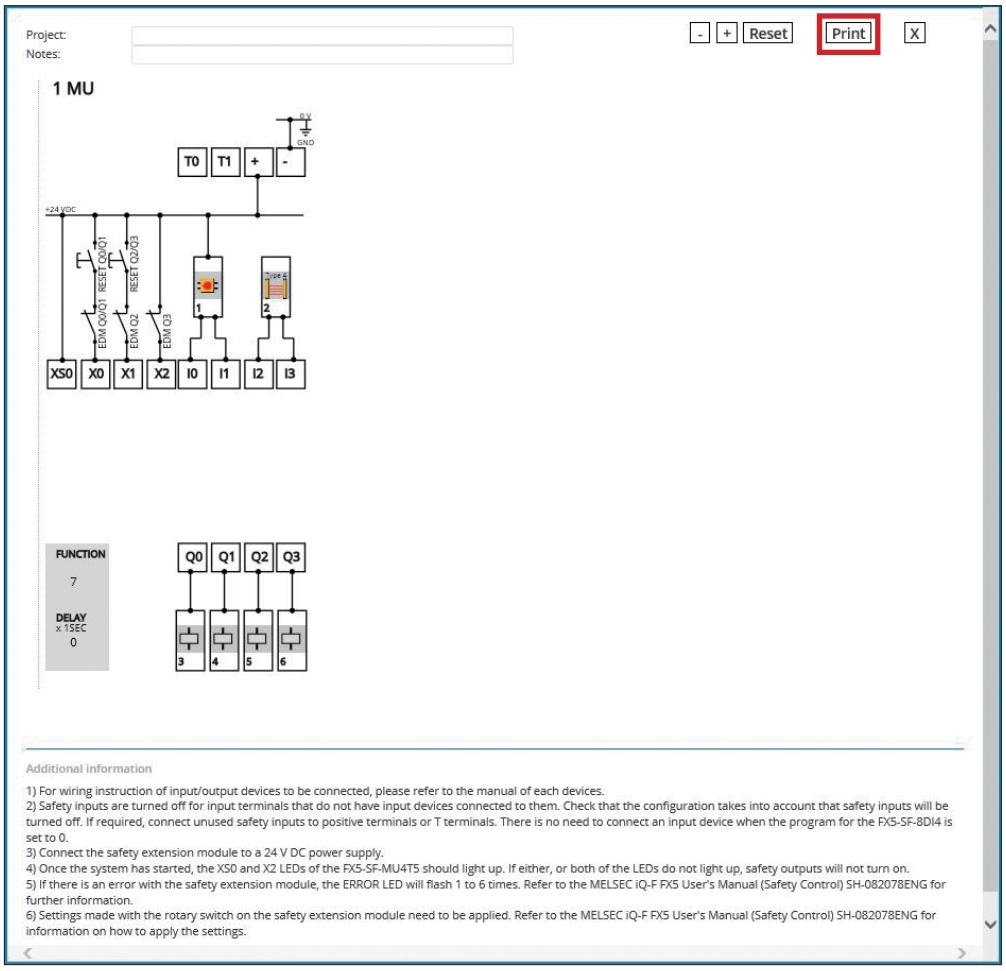
3.7 Printing of Wiring Diagram

Display the wiring diagram of the selected safety main module, input devices, output devices, and general input settings on the wiring window, and print them.

1 Click (Wiring) on the toolbar.



2 Click the Print button.

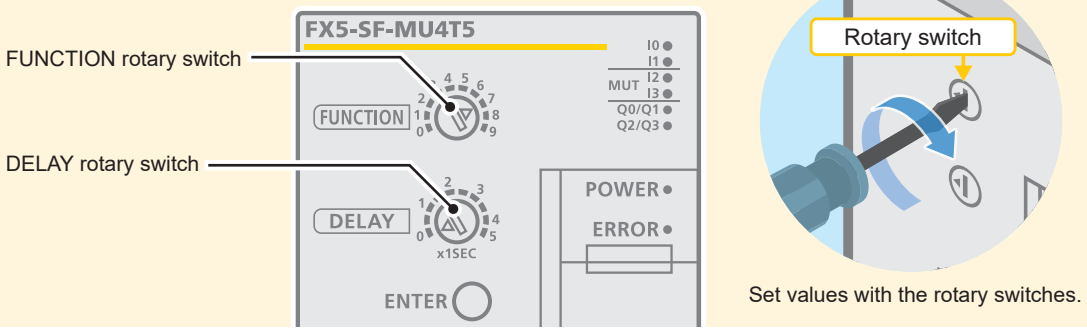


4 SAFETY MAIN MODULE SETTINGS

Part Names

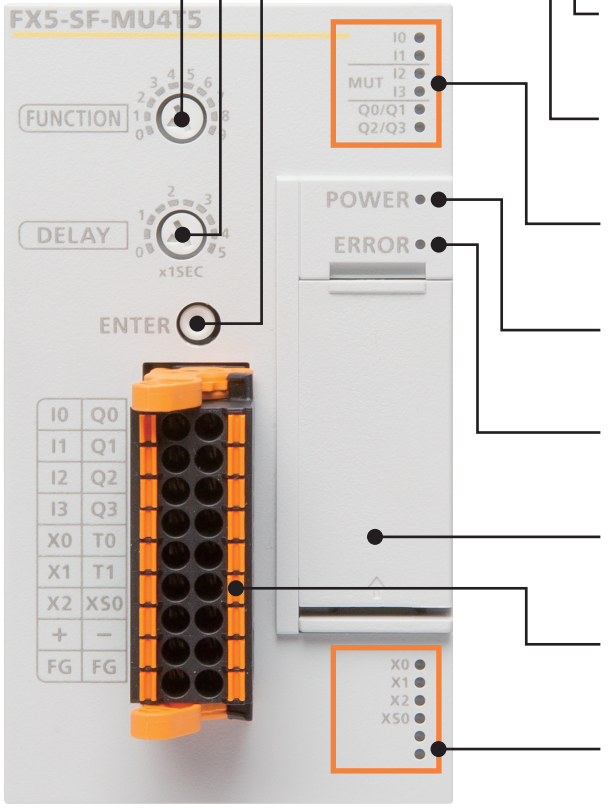
Set the following for the safety application example (➡ P.8) in this manual.

Rotary switch	Initial value	Setting range	Setting value
FUNCTION	0	0 to 9	7
DELAY	0.0 s	0.0 s, 0.5 s, 1.0 s, 1.5 s, 2.0 s, 2.5 s, 3.0 s, 3.5 s, 4.0 s, 5.0 s	0.0 s



Set values with the rotary switches.

4.1 Part Names of the Safety Main Module (FX5-SF-MU4T5)



FUNCTION rotary switch
Sets a built-in program of the safety main module.

DELAY rotary switch
Sets an off delay time for the safety control output.

ENTER button
Runs a set program on the safety main module.

Safety control I/O LEDs
Indicate the ON/OFF status of the safety control input and output.

POWER LED
Indicates the power supply status.

ERROR LED
Indicates the error status of the safety main module.

Extension connector cover
Protects a connector for connecting an extension module.

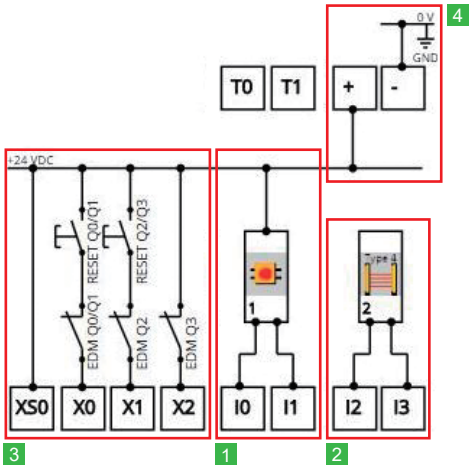
Terminal block (spring clamp terminal block)
Connects safety devices and general control devices.

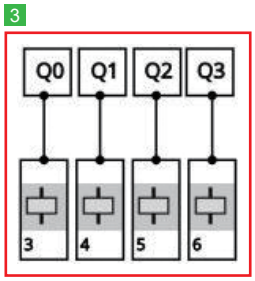
General control input LEDs
Indicate the ON/OFF status of the general control input.

For details on the part names, refer to ➡ Section 2.6 Parts Names in the MELSEC iQ-F FX5 User's Manual (Safety Control).

5 SAFETY MAIN MODULE WIRING

Wire the safety main module and the safety devices based on the wiring diagram created using MELSEC iQ-F Series Safety Extension Module Configuration Guide.
The following shows the wiring diagram of 1 to 4.





1 Input wiring (Emergency stop pushbutton)

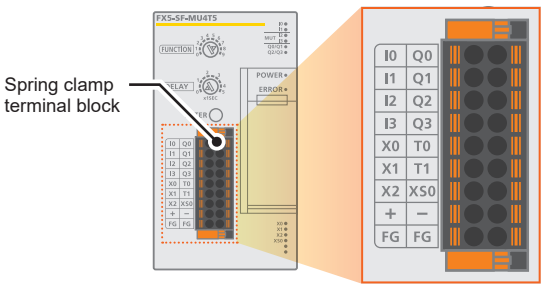
2 Input wiring (Safety light curtain)

3 Safety contactor wiring

4 Power supply wiring

5.1 Terminal Arrangement

The following shows the terminal arrangement of the safety main module (FX-SF-MU4TS).
The terminal numbers on the terminal arrangement below correspond to the terminal numbers written on the wiring diagram.

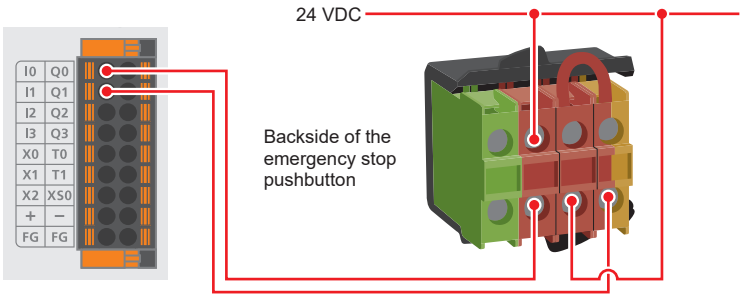


Left side		Right side	
Name	Description	Name	Description
I0	Safety input 0	Q0	Safety output 0
I1	Safety input 1	Q1	Safety output 1
I2	Safety input 2	Q2	Safety output 2
I3	Safety input 3	Q3	Safety output 3
X0	General input 0	T0	Test output 0
X1	General input 1	T1	Test output 1
X2	General input 2	XS0	ENABLE input
+	External 24 V +24 V terminal	-	External 24 V Ground terminal
FG	Frame ground	FG	Frame ground

5.2 Input Wiring

1 Wiring between the emergency stop pushbutton (ES21-SB10G1) and the safety main module

The following shows the wiring between the emergency stop pushbutton and the safety main module.



2 Wiring between the safety light curtain (receiver) and the safety main module

The safety light curtain (receiver) is connected to the safety main module by wiring an external connection cable to the safety main module.
For the wiring of the products manufactured by SICK AG, refer to the following.
➡ deTec4 Safety light curtain OPERATING INSTRUCTIONS

External connection cable
(YF2A15-020UB5XLEAX2)

System plug for receiver
(2093097)

Receiver
(C4P-EA03011D00)

■ Power supply wiring of the safety light curtain (sender)

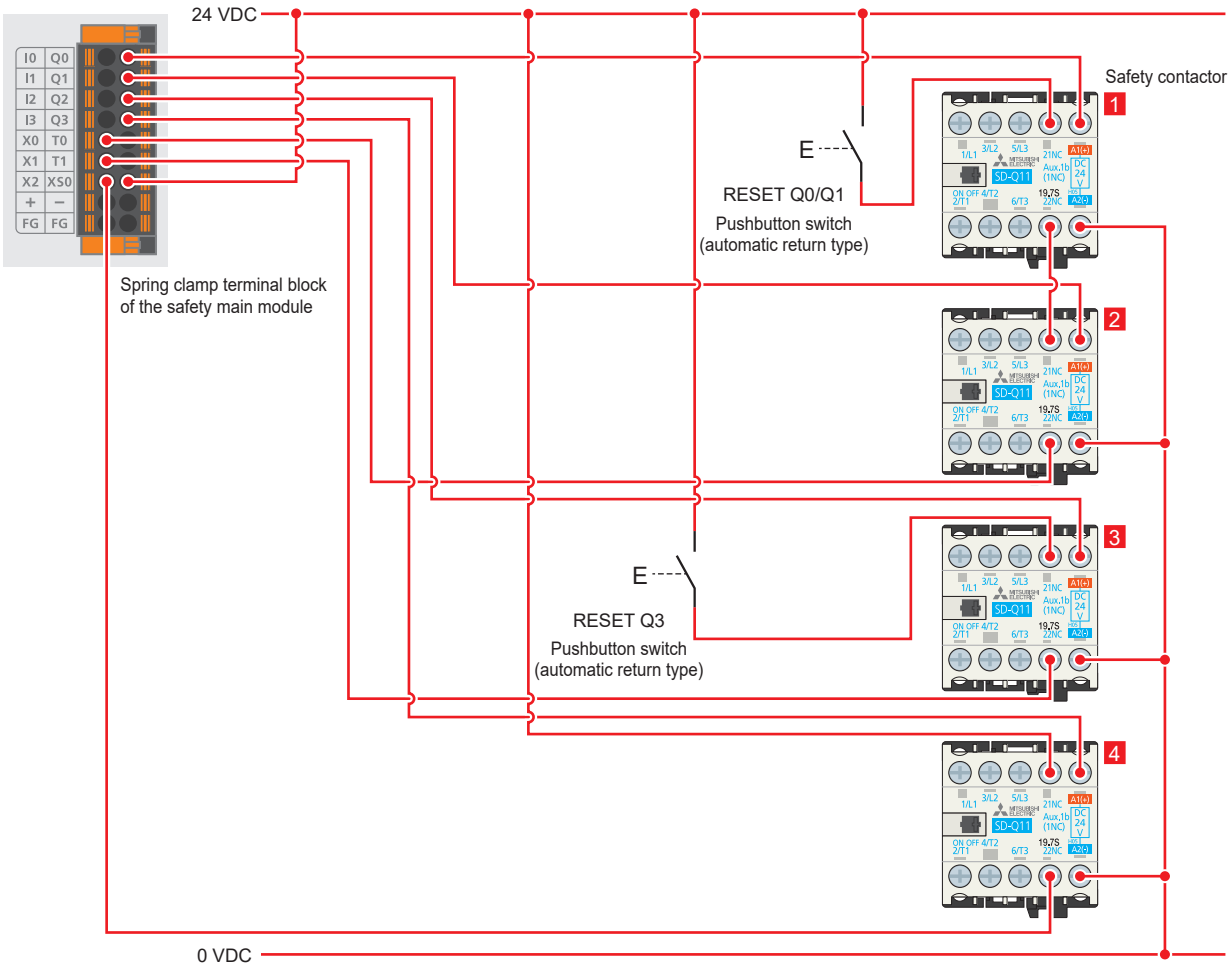
External connection cable
(YF2A15-020UB5XLEAX2)

System plug for sender
(2076832)

Sender
(C4P-SA03011C00)

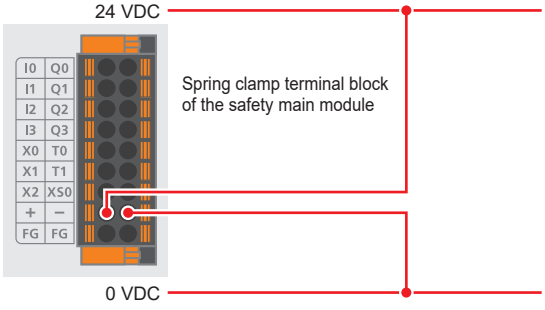
5.3 Safety Contactor Wiring

3 Wiring of safety contactors, restart interlocks, and EDM



5.4 Power Supply Wiring

4 Wiring between an external power supply (24 VDC) and the safety main module



6 APPLICATION OF SAFETY MAIN MODULE SETTINGS

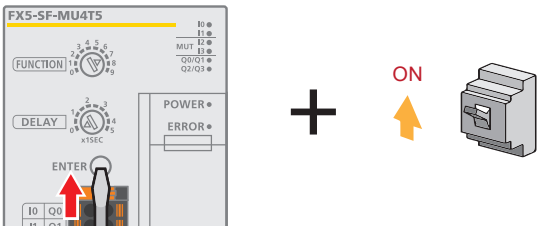
This section describes how to apply the settings of the FUNCTION and DELAY rotary switches (➡ P. 22) to the safety main module (FX-SF-MU4T5).

Point Wire safety devices to the safety main module before applying the settings. (➡ P. 23)

Step 1. Powering ON

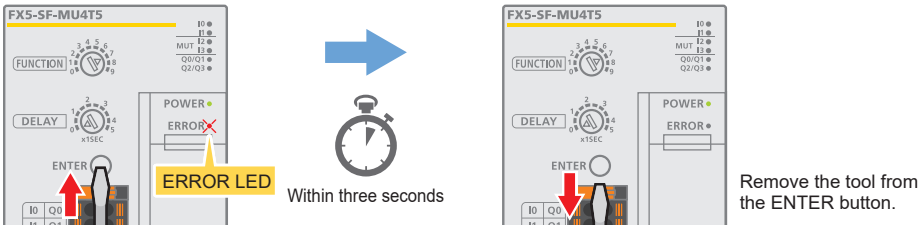
Hold down the ENTER button of the safety main module using a tool, and power ON the FX5U CPU module and the safety main module simultaneously (within two seconds).

Hold down the ENTER button using the tool.



Step 2. Removing the tool from the ENTER button

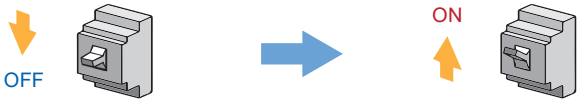
Remove the tool from the ENTER button immediately after the ERROR LED of the main safety module starts flashing.



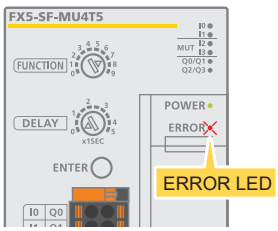
*: Remove the tool from the ENTER button within three seconds after the ERROR LED starts flashing. Holding down the ENTER button for longer than three seconds causes an error of the entire safety main module.
Do not press the reset button connected to any of the terminals X0, X1, or X2 while applying the settings.

Step 3. Powering ON again

Power OFF the FX5U CPU module and the safety main module, and then power them ON simultaneously (within two seconds).



Check that the ERROR LED is not flashing. If an error occurs, the ERROR LED flashes.
When the ERROR LED flashes, refer to ➡ P. 34 .



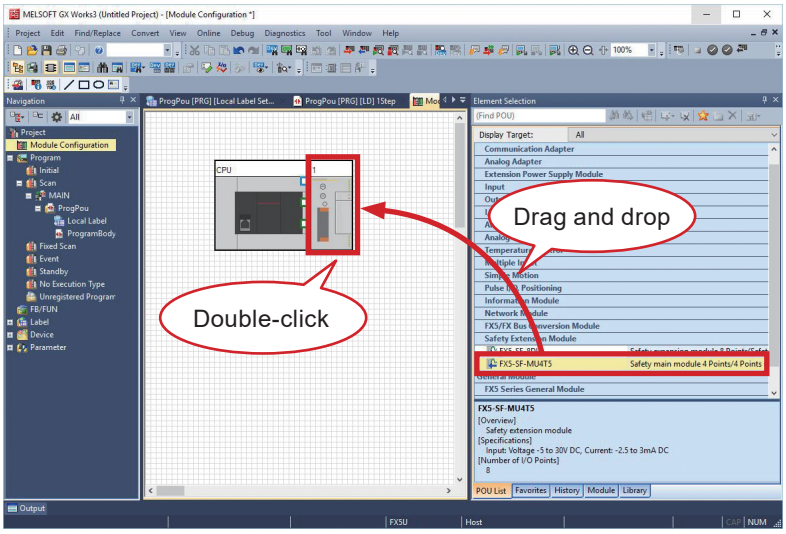
*: An error will occur if the wiring of the terminals X0, X1, and X2 is changed after the settings are applied.

Point An error will occur if only the FX5U CPU module is reset or either one of the FX5U CPU module or the safety extension module is powered OFF and ON.
Make sure to power ON the FX5U CPU module and the safety main module simultaneously (within two seconds).

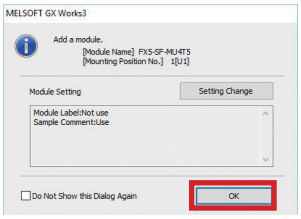
This section describes how to add a safety extension module to the module configuration using GX Works3.

7.1 Parameter Settings Using GX Works3 (Required Settings)

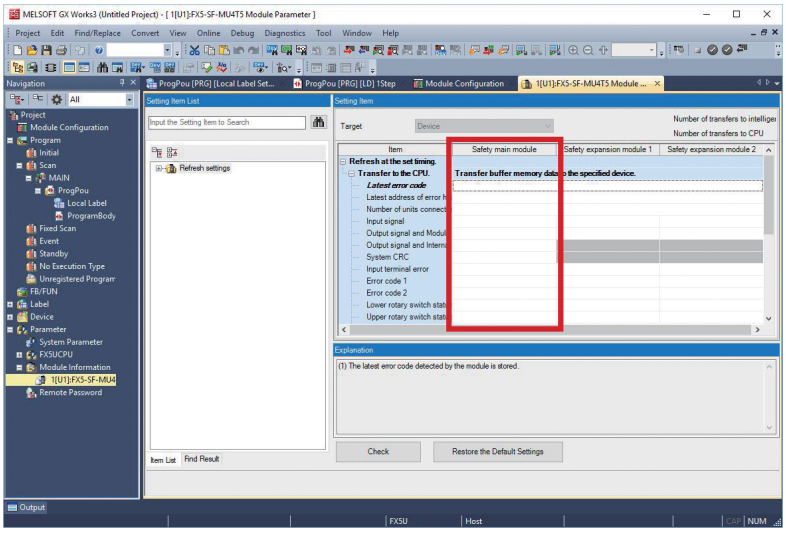
1 Drag and drop a safety main module (FX5-SF-MU4T5), and double-click the added FX5-SF-MU4T5.



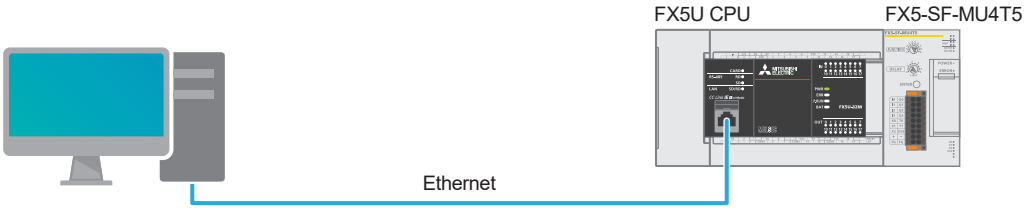
2 Click the [OK] button.



3 Set refresh parameters for input/output signals and error information as necessary.

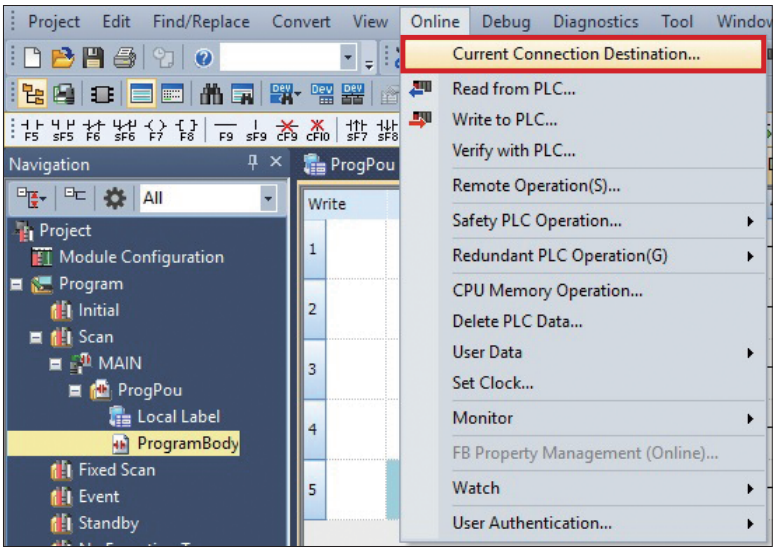


Directly connect the Ethernet ports with a cable as shown below.
Perform a communication test before writing data to the programmable controller.

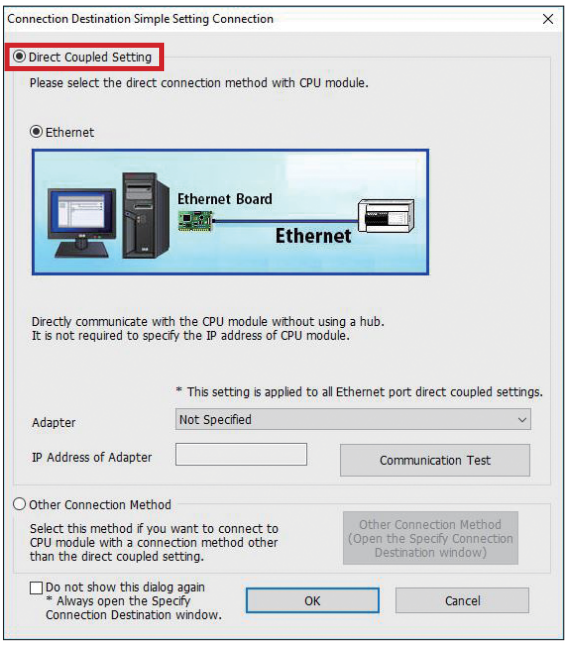


7.2 Communication Settings Using GX Works3

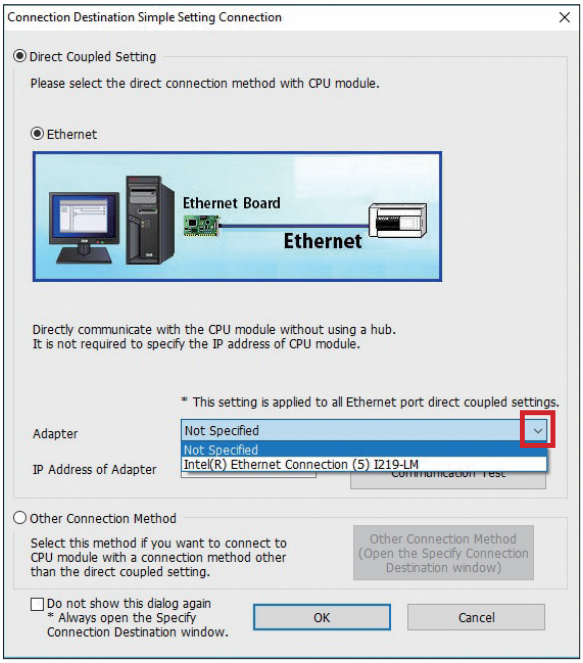
1 Select [Online] ➡ [Current Connection Destination].



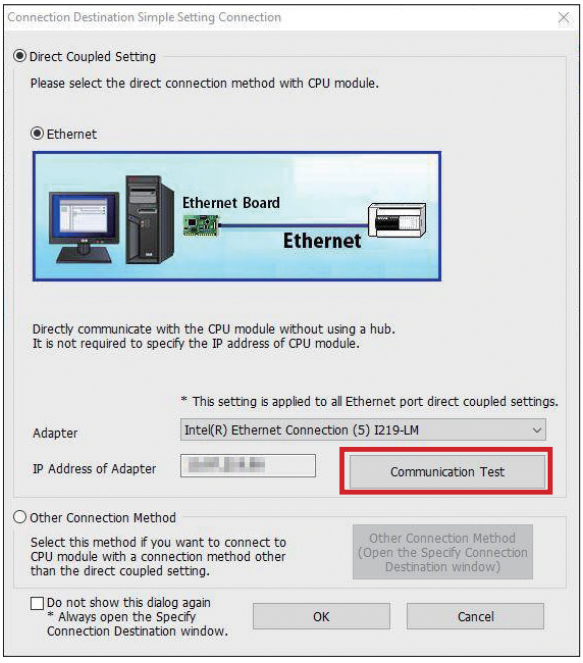
2 Select "Direct Coupled Setting".



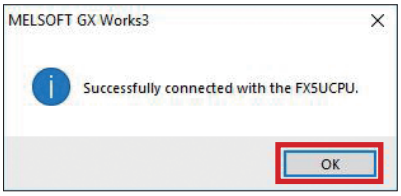
3 Specify the Ethernet adapter of the personal computer that is directly connected to the CPU module. When "Not Specified" is set, select an adapter to be used from the drop-down list.



4 After the adapter is selected, click the Communication Test button.



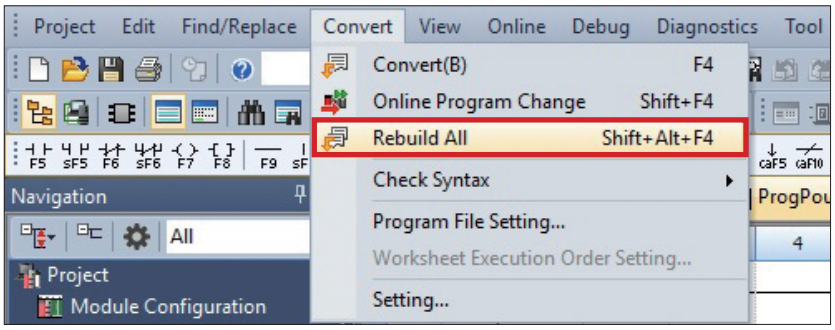
5 When the message "Successfully connected with the FX5UCPU." appears, click the OK button.



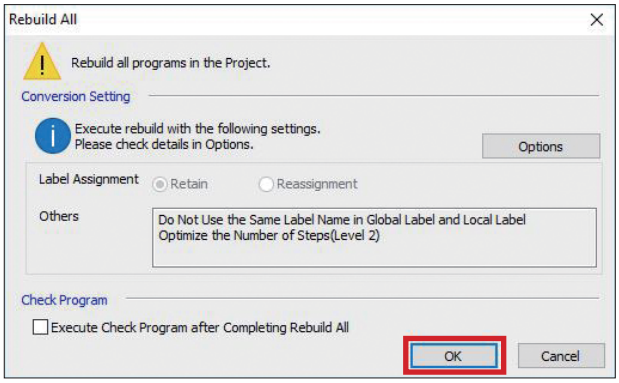
7.3 Writing Data to the Programmable Controller

Convert the program and write data to the programmable controller.

1 Select [Convert] ➡ [Rebuild All].

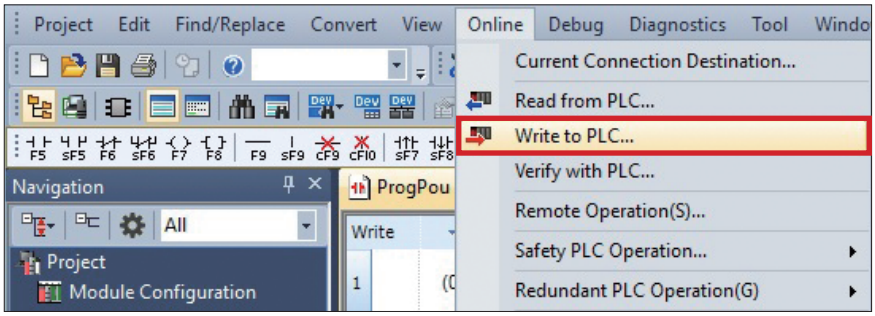


2 Click the OK button.

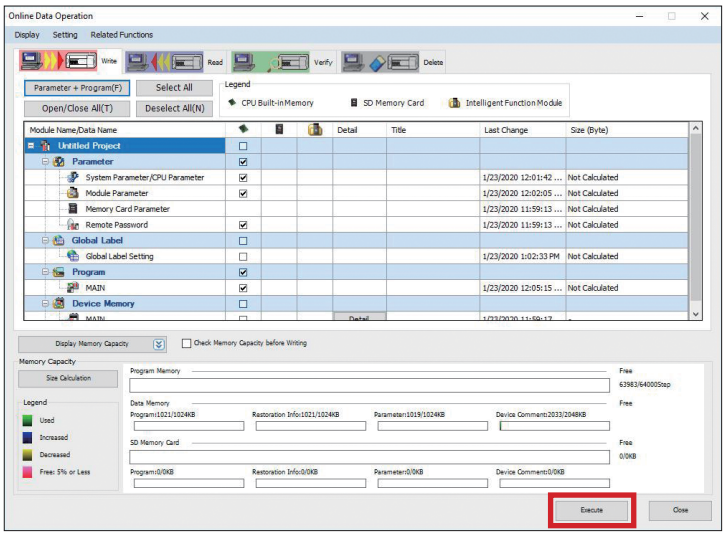


The program is transferred to the programmable controller.

3 Select [Online] ➡ [Write to PLC].

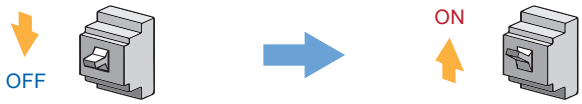


4 Click the [Parameter + Program] button, and click the Execute button.



5 Click the OK button.

6 When the data is written to the programmable controller, power OFF the FX5U CPU module and the safety main module, and then power them ON simultaneously (within two seconds).



Point

An error will occur if only the FX5U CPU module is reset or either one of the FX5U CPU module or the safety extension module is powered OFF and ON.
Make sure to power ON the FX5U CPU module and the safety main module simultaneously (within two seconds).

8.1 Installation of Safety Light Curtain

Install the safety light curtain. For details, refer to the following.
➡ deTec4 Safety light curtain OPERATING INSTRUCTIONS

8.2 Operation Check

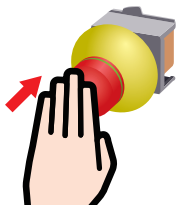
Check the following operations after the packaging machine in the connection example of the safety devices (➡ P. 9) starts running.
• Entire stop • Partial stop • Reset interlock

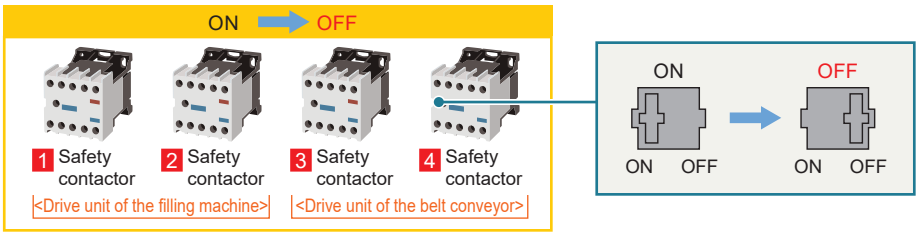
▶ Entire stop

Check that all the safety contactors turn OFF when the emergency stop pushbutton is pressed.

Step 1. Pressing the emergency stop pushbutton

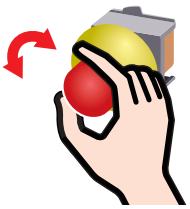
Press the emergency stop pushbutton. Check that all the safety contactors turn OFF and the entire packaging machine stops. Check the ON/OFF status of the safety contactors with the contact carriers.

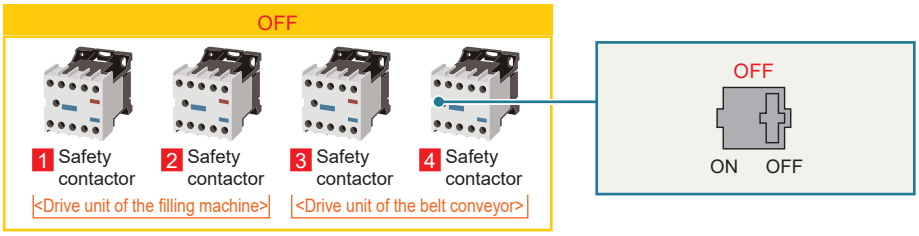




Step 2. Resetting the emergency stop pushbutton

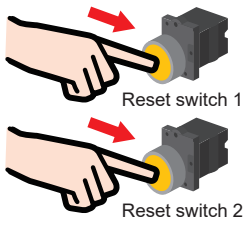
Reset the emergency stop pushbutton. The safety contactors remain OFF, indicating that the restart interlock circuit is functioning.

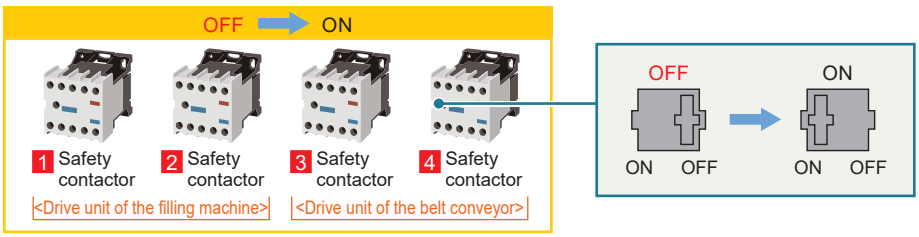




Step 3. Pressing the reset switches 1 and 2

After the entire packaging machine stops, press the reset switches 1 and 2 to turn ON the safety contactors 1 to 4. Check that the restart interlock is released using the reset switches 1 and 2 and the packaging machine starts running again.





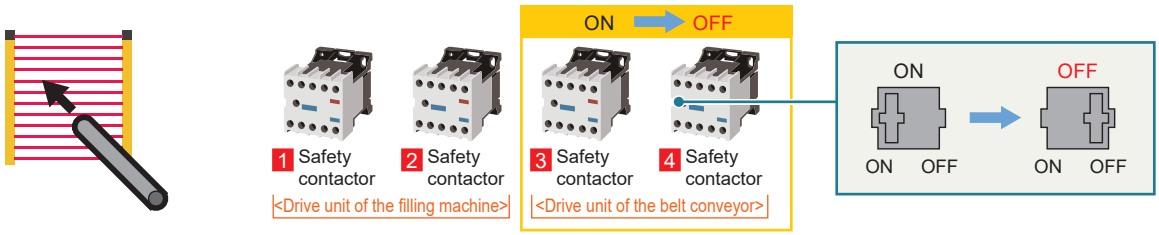
8 OPERATION CHECK OF SAFETY CIRCUITS

Partial stop

Check that some safety contactors turn OFF when the safety light curtain detects a person.

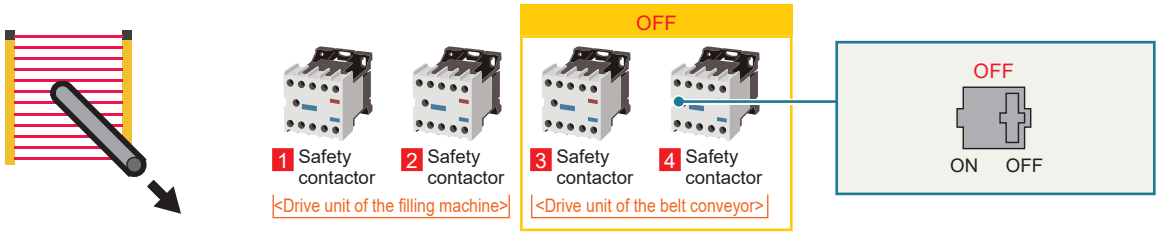
Step 1. Inserting a test rod into the safety light curtain

Insert the test rod into the safety light curtain. Check that only the safety contactors 3 and 4 turn OFF. Check the ON/OFF status of the safety contactors with the contact carriers.



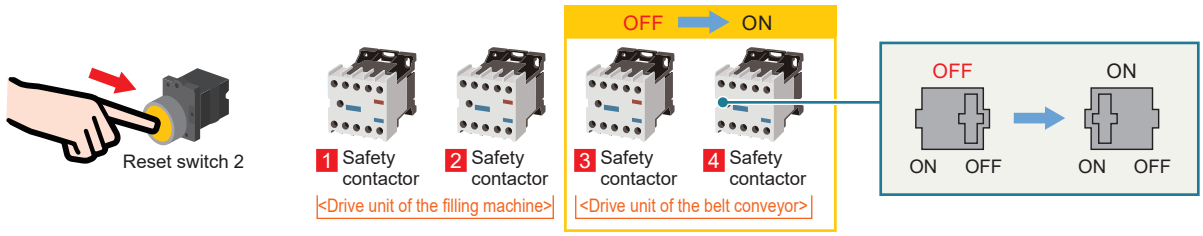
Step 2. Pulling out the test rod

Pull out the test rod from the safety light curtain. The safety contactors 3 and 4 remain OFF, indicating that the restart interlock circuit is functioning.



Step 3. Pressing the reset switch 2

After a part of the packaging machine stops, press the reset switch 2 to turn ON the safety contactors 3 and 4. Check that the restart interlock is released and the entire packaging machine starts running again.



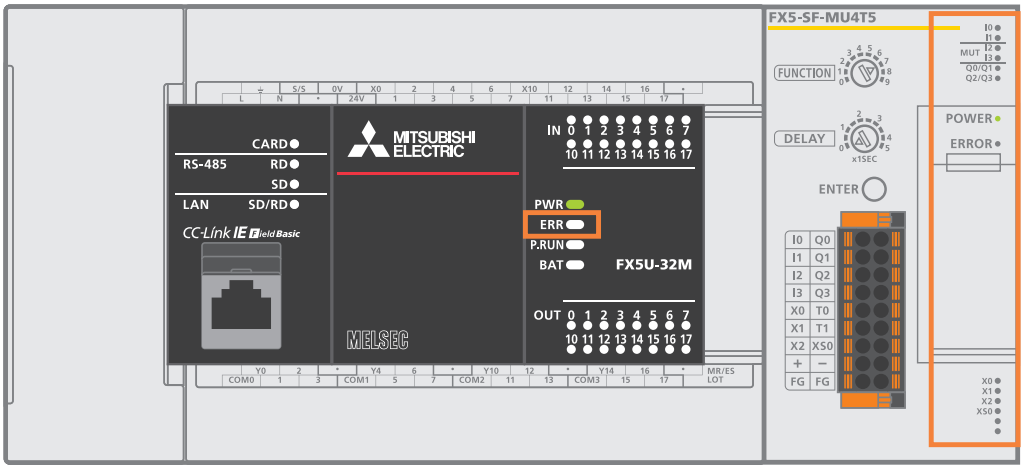
9.1 Checking Procedure

1 Checking the LED status ➡ P. 35

Check the error details with LEDs of the safety main module (FX5-SF-MU4T5) and the FX5U CPU module.

Point

The ERR LED of the FX5U CPU module may flash even when the ERROR LED of the safety main module does not turn ON. In this case, check the error code stored in the buffer memory area of the safety main module. ➡ P. 51



2 Error details (error code) ➡ P. 36 to P. 37

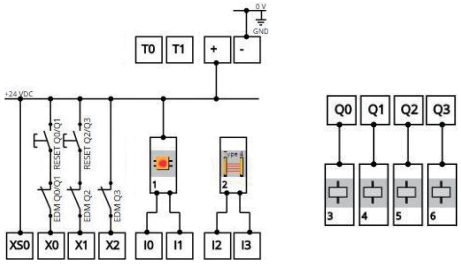
Check the error details with LEDs of the safety main module (FX5-SF-MU4T5).

Safety main module settings ➡ P. 22

- Is the FUNCTION rotary switch set to '7'?

Safety main module wiring ➡ P. 23 and P. 25

- Is the wiring correct?



Application of the safety main module settings ➡ P. 26

- Was the safety main module powered ON while the ENTER button was being held down?
- Were the FX5U CPU module and the safety main module powered ON simultaneously (within two seconds)?

9.2 Checking the LED Status

Checking the LED status is the primary diagnostics without using GX Works3. It narrows down a cause of an error. The following table lists the LEDs of the safety main module (FX5-SF-MU4T5) and the descriptions of each status. For the corrective actions, refer to ➡ Section 10.4 List of Error Codes in the MELSEC iQ-F FX5 User's Manual (Safety Control).

Safety main module (FX5-SF-MU4T5)

LED	LED color (during normal operation)	LED status	Description
POWER LED	Green	ON	Normal operation
		Flashing	The rotary switch setting was changed during operation.
		OFF	Powered OFF
ERROR LED	Red	ON	An error occurred in any one of the safety extension modules.
		Flashing (two times)	Failed to apply the settings to the safety extension module.
		Flashing (three times)	The rotary switch setting was changed during operation.
		Flashing (four times)	Any of the following errors occurred. • The input status of any one of or all of X0 to X2 is incorrect. • The module was powered ON after the rotary switch setting has been changed in the power OFF state. • The ENTER button is pressed for three seconds or longer. • A setting was not applied after changing the position of a module.
		Flashing (five times)	A power supply error occurred
		Flashing (six times)	A self-monitoring error or an internal error occurred
		OFF	No error
I0 LED	Green	ON	Input ON
		Flashing	A process error or synchronization time/concurrence error
		Flashing (I0 and I1 flash in phase)	A cross-circuit occurred between I0 and I1
		OFF	Input OFF
I1 LED	Green	ON	Input ON
		Flashing	A process error or synchronization time/concurrence error
		Flashing (I0 and I1 flash in phase)	A cross-circuit occurred between I0 and I1
		OFF	Input OFF
I2 LED	Green	ON	Input ON
		Flashing	A process error or synchronization time/concurrence error
		Flashing (I2 and I3 flash in phase)	A cross-circuit occurred between I2 and I3
		OFF	Input OFF
I3 LED	Green	ON	Input ON
		Flashing	A process error or synchronization time/concurrence error
		Flashing (I2 and I3 flash in phase)	A cross-circuit occurred between I2 and I3
		OFF	Input OFF
X0 LED	Green	ON	Input ON
		Flashing	Input OFF (by restart interlock or EDM)
		OFF	Input OFF
X1 LED	Green	ON	Input ON
		Flashing	Input OFF (by restart interlock or EDM)
		OFF	Input OFF
X2 LED	Green	ON	Input ON
		Flashing	Input OFF (by restart interlock or EDM)
		OFF	Input OFF

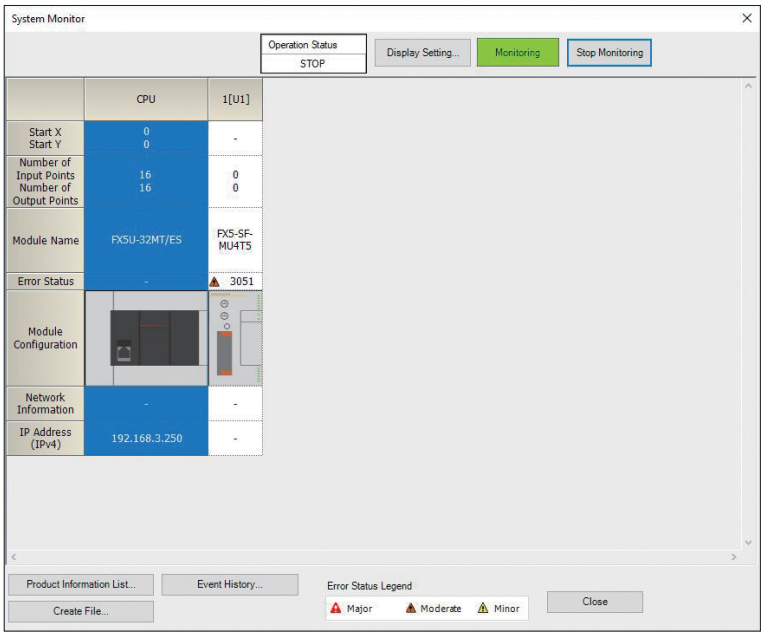
For details on the LED status, refer to ➡ Section 10.1 Checking Errors with LEDs in the MELSEC iQ-F FX5 User's Manual (Safety Control).

9.3 Checking the Error Code

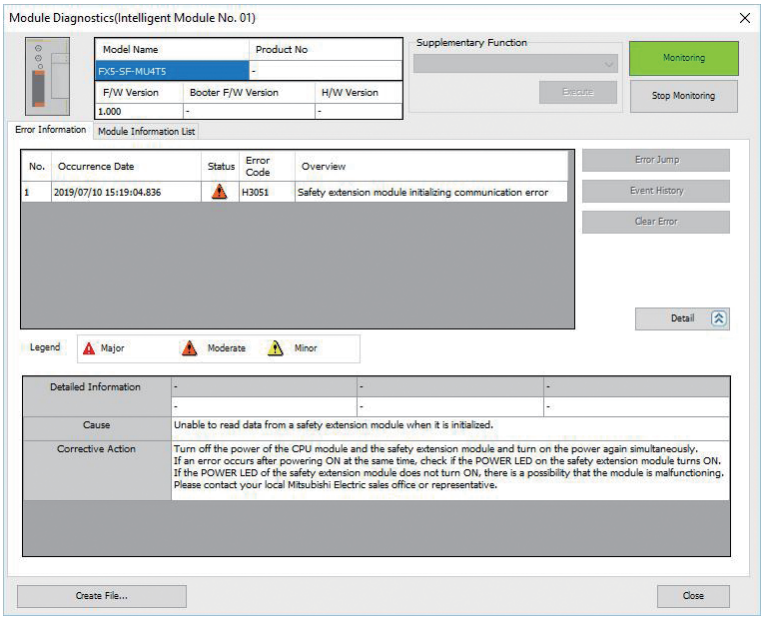
9.3.1 Module diagnostics

Check an error occurred in the module and error history, and identify a cause using GX Works3.
The detailed information, such as error causes and corrective actions, obtained from GX Works3 is more helpful than those obtained from LEDs.
To execute the module diagnostics, connect a personal computer to the programmable controller. ➡ P. 28

1 Select [Diagnostics] ➡ [System Monitor], and double-click "FX5-SF-MU4T5".



2 The module information of the FX5-SF-MU4T5 can be checked.
For the error codes, refer to ➡ P. 37 .



For details on the error codes, refer to ➡ Section 10.4 List of Error Codes in the MELSEC iQ-F FX5 User's Manual (Safety Control).

9.3.2 Lists of error codes

Safety main module (FX5-SF-MU4T5)

The following table lists the error codes stored in the buffer memory (buffer memory 0 in the first module).

Error code	Error	Description	Cause	Corrective action
3051H	Safety extension module initializing communication error	Unable to read data from a safety extension module when it is initialized.	The CPU module and the safety extension module are not powered ON simultaneously.	Turn OFF the power of the CPU module and the safety extension module and turn ON the power again simultaneously. ➡ P. 26 If an error occurs after powering ON at the same time, check if the POWER LED of the safety extension module turns ON. If the POWER LED of the safety extension module does not turn ON, there is a possibility that the module is malfunctioning. Please contact your local Mitsubishi Electric sales office or representative.
3052H	Safety extension module communication error	Unable to read data in the safety extension module.	The CPU module and the safety extension module are not powered ON simultaneously.	Turn OFF the power of the CPU module and the safety extension module and turn ON the power again simultaneously. ➡ P. 26 If an error occurs during operation, check if the POWER LED of the safety extension module turns ON. If the LED does not turn ON, reset the power of the whole system. If the POWER LED of the safety extension module does not turn ON, there is a possibility that the module is malfunctioning. Please contact your local Mitsubishi Electric sales office or representative.
3053H	Number of connectable safety extension modules excess error	The number of connected safety extension modules exceeds the maximum number of connectable modules.	More than the maximum number of connectable modules are connected.	Connect the safety extension modules within the connectable limit. If this error occurs even when the number of connected modules are below the limit, check the parameter and the actual connected module. If they are different, adjust the parameter and the module configuration.
3902H	Configuration change detected	A configuration change is detected.	The ENTER button was not pressed at power-on.	Review the configuration of the safety extension module. If the configuration has not been applied (press the ENTER button) after changing the configuration, apply the configuration. ➡ P. 26
391AH	ENTER button holding down period excess error	When applying a setting, the duration for holding down the ENTER button was too long.	The ENTER button was held down too long at power-on.	Apply the configuration again. Note that, release the ENTER button within three seconds after the ERROR LED flashes. ➡ P. 26
3986H	Configuration error	The configuration of the module is incorrect.	There is inconsistency in a set program and wiring.	Check the setting of the rotary switch and wiring. For the safety application configuration example in this manual, check the following. ➡ P. 22 ➡ P. 23

For details on the error codes of the safety main module, refer to
➡ Section 10.4 List of Error Codes in the MELSEC iQ-F FX5 User's Manual (Safety Control).

PU module

The following table lists the CPU module error codes when an error occurs in the safety main module.

CPU module					Safety main module	
Error code	Error	Description and cause	Corrective action		Error code ➡ P. 37	Corrective action
1200H	Module moderate error detected	Detected a notice of moderate error occurrence from intelligent function module.	Confirm detailed information (system configuration information) from module diagnosis of the engineering tool and remove the error of the abnormal module.	←	3052H or another error code	For corrective actions of each error code, refer to the list of the error codes for the safety main module.
2042H	CPU module configuration error	The number of intelligent function modules connected exceeds the limit of available connection.	Connect each intelligent function modules within the connectable limit.	←	3053H	
3050H	System bus error	Communication with the module failed due to power discontinuity or the like.	Verify that the connected module is powered on.	←	3051H or 3052H	

For details on the error codes of the CPU module, refer to ➡ List of error codes in the FX5 User's Manual (Application).

1 Safety Application Examples of Built-In Programs

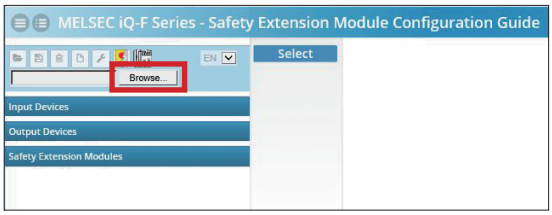
1.1 Template Files in MELSEC iQ-F Series Safety Extension Module Configuration Guide

Template files which correspond to the programs 1 to 9 of the safety main module is included in MELSEC iQ-F Series Safety Extension Module Configuration Guide. The logics of the programs and typical examples of the connectable safety sensors can be checked using the template files.

This section describes how to display the template file for the program 1 as an example.

1 Click .

2 Click the Browse button.

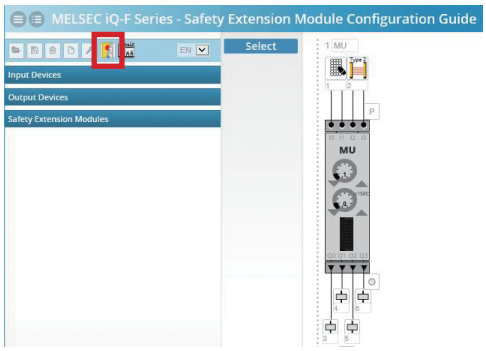


3 Open the "C:\iqfsafety_cfgguide\template" folder.
(Save destination example: C:\)
Double-click 01_SafetyMat_LightCurtain.IQFcfg.

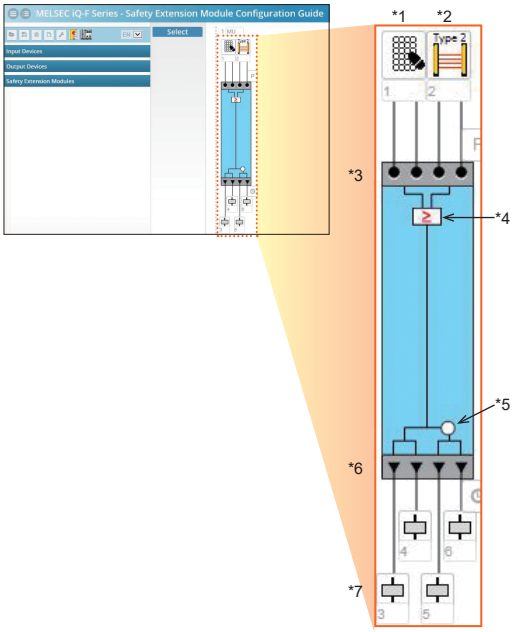
01_SafetyMat_LightCurtain.IQFcfg
02_NoncontactSafetySwitch_LightCurtain.IQFcfg
03_LightCurtain_MutingSensor.IQFcfg
04_TwoHandControl(IIIC).IQFcfg
05_SafetyDoorSwitch_TwoHandControl(IIIC).IQFcfg
06_EStop_SafetyDoorSwitch.IQFcfg
07_EStop_LightCurtain.IQFcfg
08_LightCurtain_LightCurtain.IQFcfg
09_SafetyDoorSwitch_LightCurtain.IQFcfg

4 The configuration of the program 1 is displayed.

Click (Logic) on the toolbar.



5 The logic circuit of the program 1 is displayed.

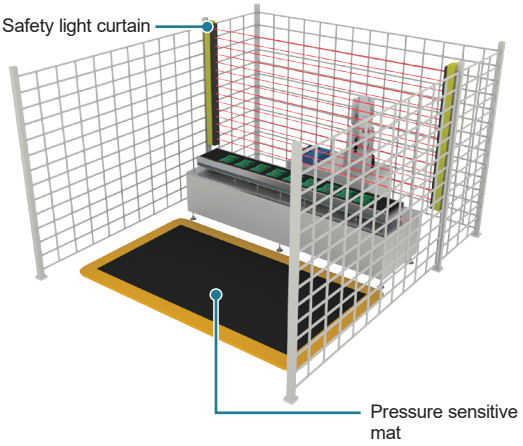


*1: Pressure sensitive mat
*2: Safety light curtain
*3: Inputs
I0 to I3
*4: OR circuit
*5: Off delay
*6: Outputs
Q0 to Q3
*7: Safety contactor

1.2 Safety Application Example

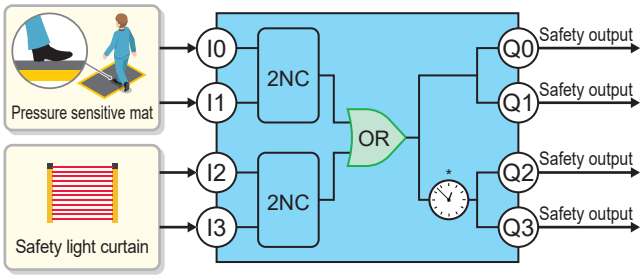
This section describes the safety application examples of the nine different template files in MELSEC iQ-F Series Safety Extension Module Configuration Guide.

Case example

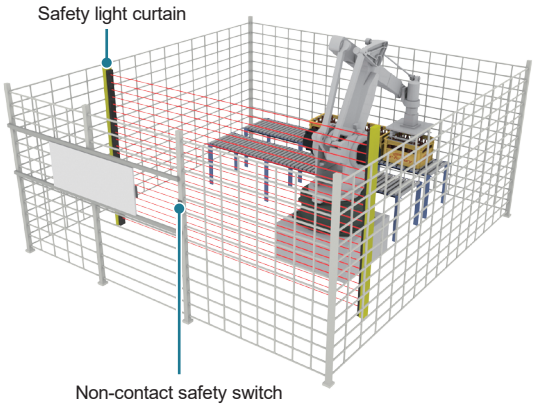


Program 1: OR control (1)

When both the pressure sensitive mat and safety light curtain are turned OFF, all the safety outputs turn OFF.

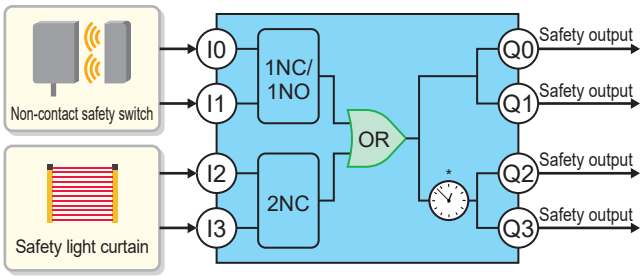


Case example



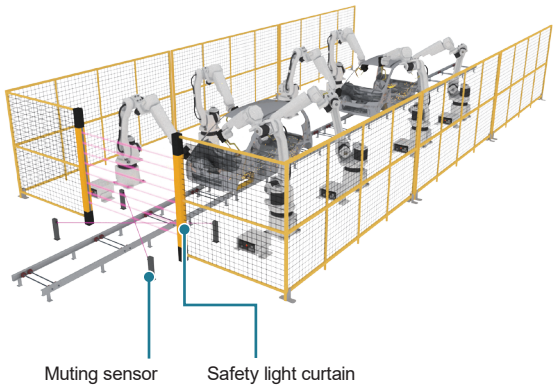
Program 2: OR control (2)

When both the non-contact safety switch and safety light curtain are turned OFF, all the safety outputs turn OFF.



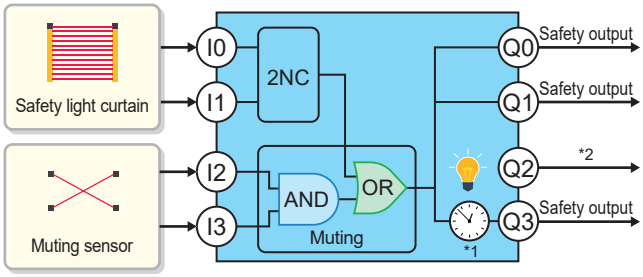
*: This is an off delay time. The factory default setting of the rotary switch is 0 second.

Case example



Program 3: Muting control

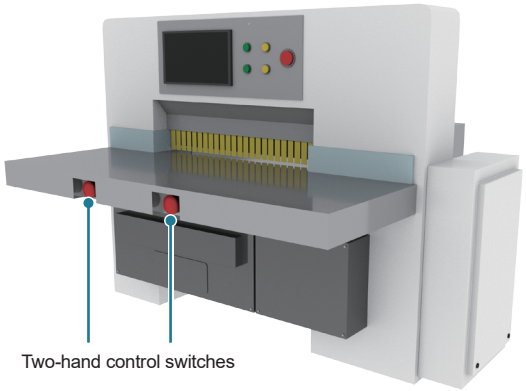
When the muting sensor input is turned ON, the safety light curtain is temporarily disabled.



For details on the muting control, refer to the following.

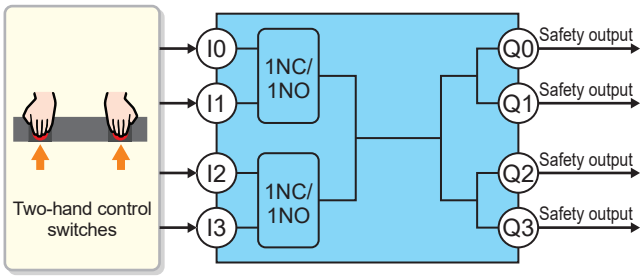
➡ Sections 4.4 Muting Function and 6.5 Installation of Muting Sensors in the MELSEC iQ-F MELSEC iQ-F FX5 User's Manual (Safety Control)

Case example



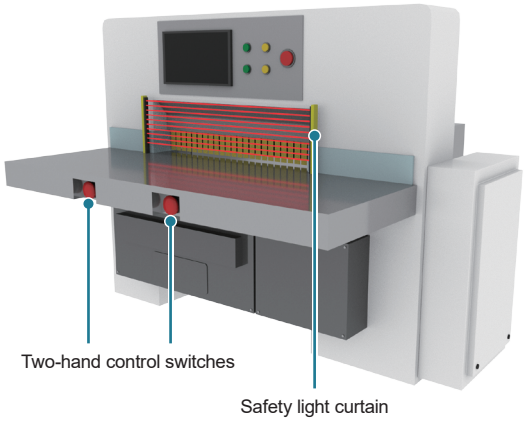
Program 4: Two-hand control (1)

The safety outputs turn ON only when the two-hand control switches are pressed.



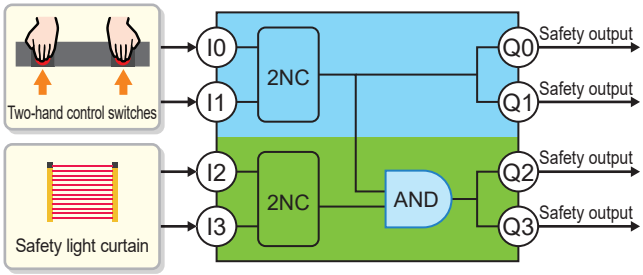
*1: This is an off delay time. The factory default setting of the rotary switch is 0 second.
*2: Output for a muting lamp and reset request lamp

Case example

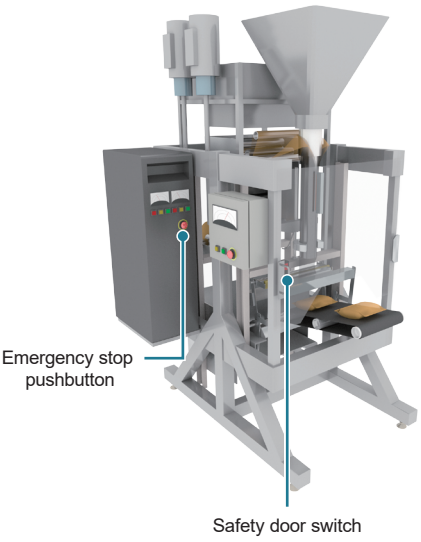


Program 5: Two-hand control (2)

When both the two-hand switches and safety light curtain are turned ON, all the safety outputs turn ON.

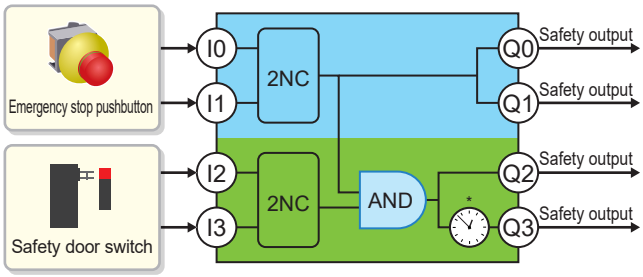


Case example



Program 6: AND control (1)

When the emergency stop pushbutton is turned OFF, all the safety outputs turn OFF.
When the safety door switch input is turned OFF, only the safety outputs Q2 and Q3 turn OFF.

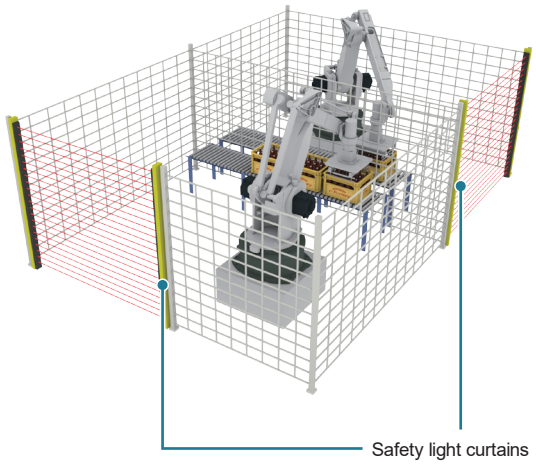


Program 7: AND control (2)

For the program 7, refer to ➡ P. 13 .

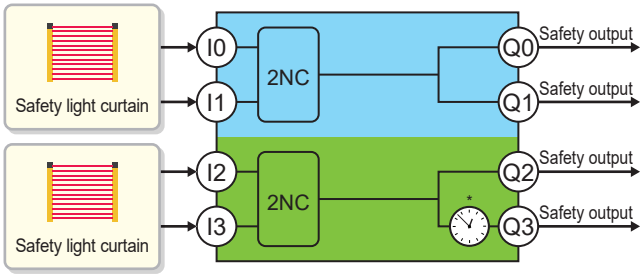
*: This is an off delay time. The factory default setting of the rotary switch is 0 second.

Case example

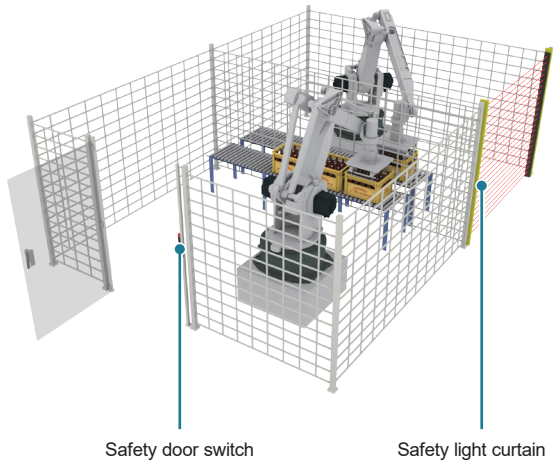


Program 8: Independent control

When the safety light curtains are turned OFF, the safety outputs turn OFF.
Each safety light curtain independently controls the safety output status.

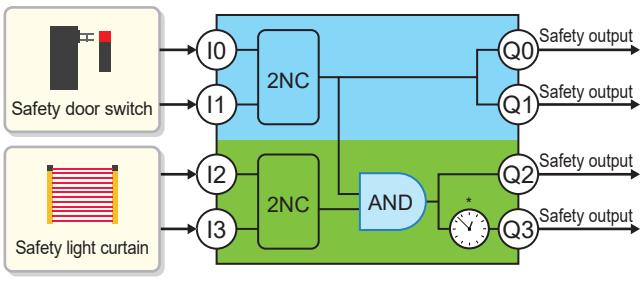


Case example



Program 9: AND control (3)

When the safety door switch is turned OFF, all the safety outputs turn OFF.
When the safety light curtain is turned OFF, only the safety outputs Q2 and Q3 turn OFF.



*: This is an off delay time. The factory default setting of the rotary switch is 0 second.

2 Increasing Safety Inputs

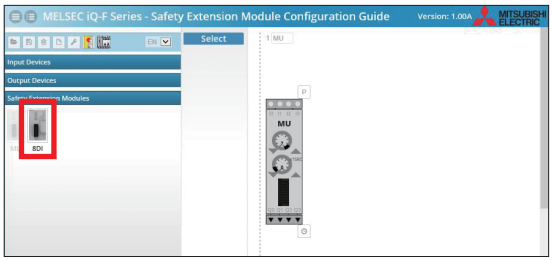
The number of inputs of the safety main module can be increased by adding the safety input expansion module (FX5-SF-8DI4) to the system.
This section describes the built-in program settings, part names, and LED indications of the safety input expansion module.
For the number of connectable modules and position to connect, refer to ➡ Section 5 SYSTEM CONFIGURATION in the MELSEC iQ-F FX5 User's Manual (Safety Control).

2.1 Built-In program settings

Input conditions of the safety main module can be increased in the built-in program settings of the safety input extension module.
The following describes the procedure for setting the safety input expansion modules in the program 7 (➡ P. 15) using MELSEC iQ-F Series Safety Extension Module Configuration Guide.

■ Procedure for adding the safety input extension modules

1 Click  "8DI".



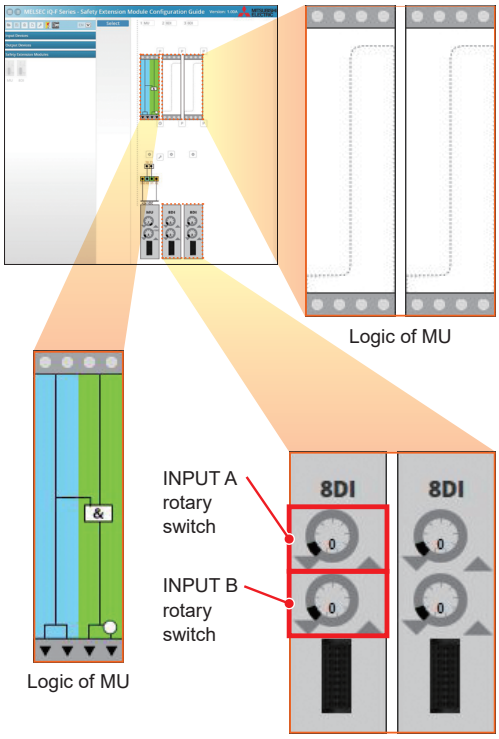
2 Click  "8DI" again.

3 Two safety input extension modules (8DI)* are added to the safety main module (MU).
*: Up to two safety input expansion modules (8DI) can be added.

4 Click  (Logic) on the toolbar.
The logic of the program 7 is displayed on "MU".
Since the following rotary switches are set to "0", no logics are displayed on "8DI".

1st 8DI	
INPUT A rotary switch	0
INPUT B rotary switch	0

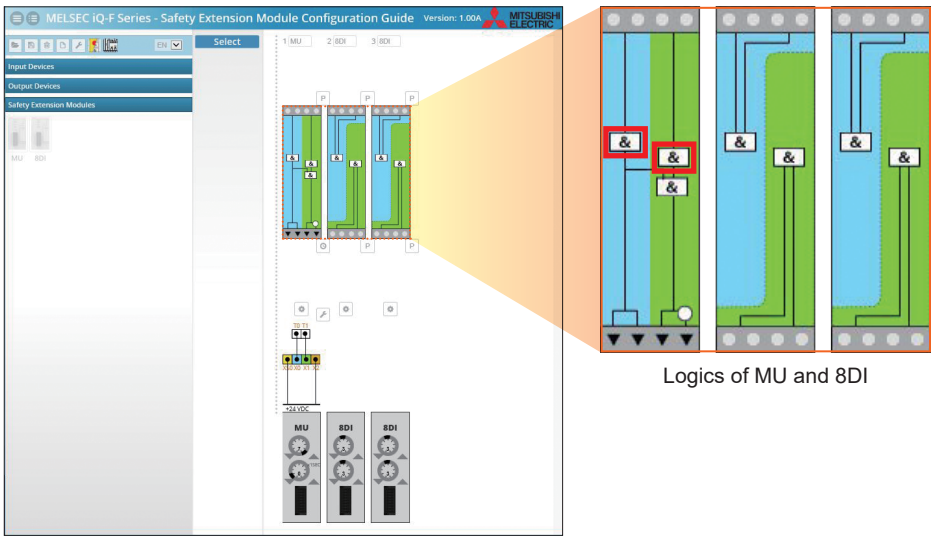
2nd 8DI	
INPUT A rotary switch	0
INPUT B rotary switch	0



5 Set the following program, as an example, using ▲ and ▼ of "8DI".

1st 8DI	
INPUT A rotary switch	3
INPUT B rotary switch	3
2nd 8DI	
INPUT A rotary switch	3
INPUT B rotary switch	3

Check that the "&" icons are added on the logic of the safety main module.

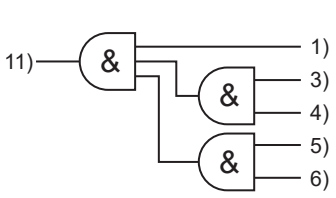


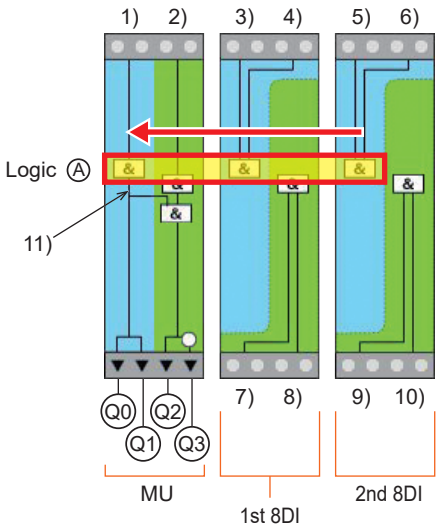
Logics of MU and 8DI

■ How to read the logics of MU and 8DI

The logic Ⓐ, as an example, is shown with the inputs 1) to 11) on the right figure.

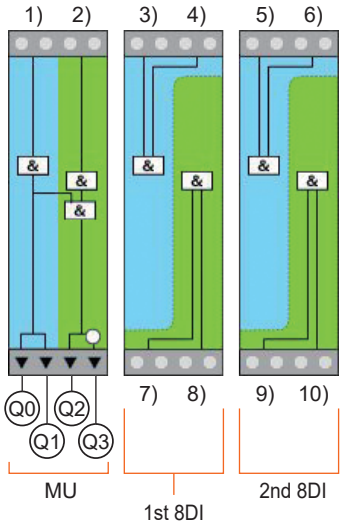
• The logic Ⓐ is equivalent to the following logic.
The same logic is applied to other logics.

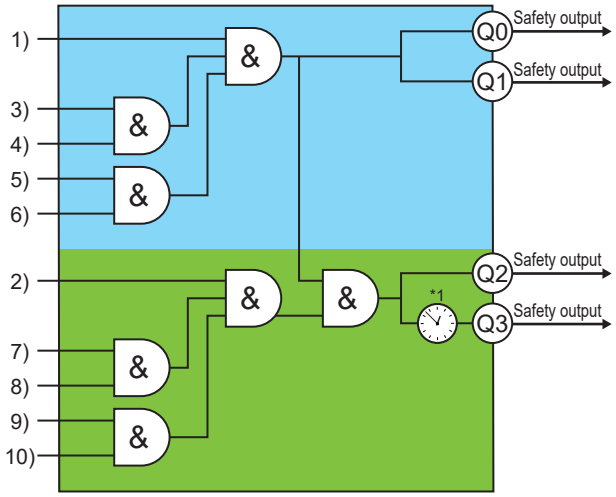




■ Entire logics

The following show the entire logics using inputs 1) to 10) and outputs Q0 to Q3.



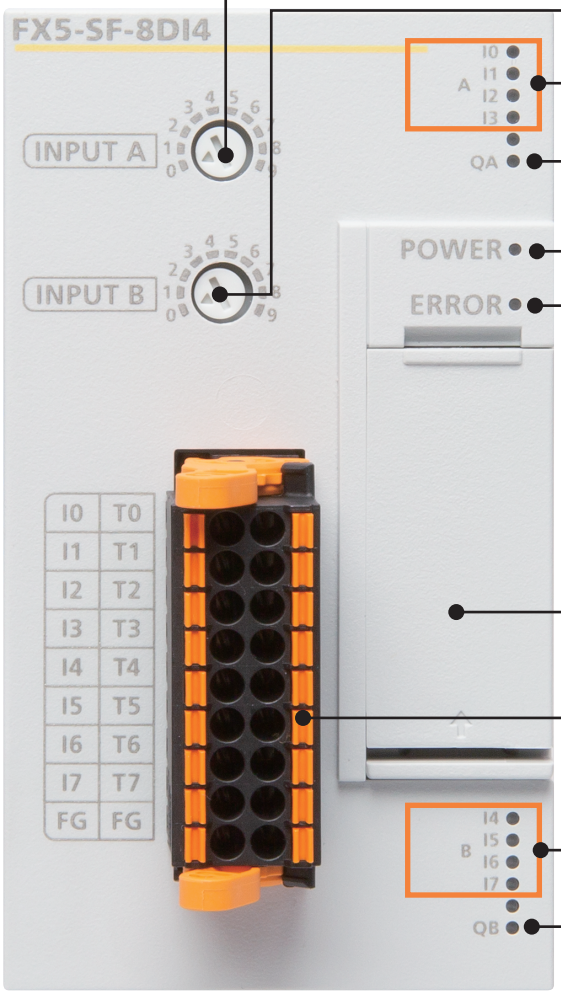


*1: This is an off delay time. The factory default setting of the rotary switch is 0 second.

■ Operations

[Entire stop]
When any one of the inputs 1) and 3) to 6) turns OFF, all the outputs Q0 to Q3 turn OFF.
[Partial stop]
When any one of the inputs 2) and 7) to 10) turns OFF, only the outputs Q2 and Q3 turn OFF.

2.2 Part Names of the Safety Input Expansion Module (FX5-SF-8DI4)



INPUT A rotary switch
Sets a built-in program.

INPUT B rotary switch
Sets a built-in program.

Safety control input LEDs
Indicate the ON/OFF status of the safety control input.

QA LED
Indicates whether the input conditions of inputs I0 to I3 are satisfied.

POWER LED
Indicates the power supply status.

ERROR LED
Indicates the error status of the safety input expansion module.

Extension connector cover
Protects a connector for connecting an extension module.

Terminal block (spring clamp terminal block)
Connects safety devices and general control devices.

Safety control input LEDs
Indicate the ON/OFF status of the safety control input.

QB LED
Indicates whether the input conditions of inputs I4 to I7 are satisfied.

For details on the part names, refer to ➡ Section 2.6 Parts Names in the MELSEC iQ-F FX5 User's Manual (Safety Control).

2.3 LED indications

Checking the LED status is the primary diagnostics without using GX Works3. It narrows down a cause of an error. The following table lists the LEDs of the safety input expansion module (FX5-SF-8D14) and the descriptions of each status.

LED	LED color (during normal operation)	LED status	Description
I0 LED	Green	ON	Input ON
		Flashing	A process error occurred or synchronous time (1500 ms) was exceeded.
		Flashing (I0 and I1 flash in phase)	A cross-circuit occurred between I0 and I1.
		OFF	Input OFF
I1 LED	Green	ON	Input ON
		Flashing	A process error occurred or synchronous time (1500 ms) was exceeded.
		Flashing (I0 and I1 flash in phase)	A cross-circuit occurred between I0 and I1.
		OFF	Input OFF
I2 LED	Green	ON	Input ON
		Flashing	A process error occurred or synchronous time (1500 ms) was exceeded.
		Flashing (I2 and I3 flash in phase)	A cross-circuit occurred between I2 and I3.
		OFF	Input OFF
I3 LED	Green	ON	Input ON
		Flashing	A process error occurred or synchronous time (1500 ms) was exceeded.
		Flashing (I2 and I3 flash in phase)	A cross-circuit occurred between I2 and I3.
		OFF	Input OFF
I4 LED	Green	ON	Input ON
		Flashing	A process error occurred or synchronous time (1500 ms) was exceeded.
		Flashing (I4 and I5 flash in phase)	A cross-circuit occurred between I4 and I5.
		OFF	Input OFF
I5 LED	Green	ON	Input ON
		Flashing	A process error occurred or synchronous time (1500 ms) was exceeded.
		Flashing (I4 and I5 flash in phase)	A cross-circuit occurred between I4 and I5.
		OFF	Input OFF
I6 LED	Green	ON	Input ON
		Flashing	A process error occurred or synchronous time (1500 ms) was exceeded.
		Flashing (I6 and I7 flash in phase)	A cross-circuit occurred between I6 and I7.
		OFF	Input OFF
I7 LED	Green	ON	Input ON
		Flashing	A process error occurred or synchronous time (1500 ms) was exceeded.
		Flashing (I6 and I7 flash in phase)	A cross-circuit occurred between I6 and I7.
		OFF	Input OFF

For details on the LED status, refer to ➡ Section 10.1 Checking Errors with LEDs in the MELSEC iQ-F FX5 User's Manual (Safety Control).

3 When MELSEC iQ-F Series Safety Extension Module Configuration Guide Does Not Start

This section describes the corrective actions to be taken when MELSEC iQ-F Series Safety Extension Module Configuration Guide does not operate normally.

When MELSEC iQ-F Series Safety Extension Module Configuration Guide does not start normally on Internet Explorer®11 (1)

Perform the following operation.

Step 1. Opening a folder

Start Windows Explorer and open the folder where MELSEC iQ-F Series Safety Extension Module Configuration Guide is stored.

Step 2. Changing the properties of "START.html"

Right-click "START.html", and select [Properties] from the shortcut menu.

Step 3. Unblocking security

Select the Unblock checkbox of "Security", and click the OK button.

Step 4. Executing "START.html"

Execute "START.html" again.
If the message "Internet Explorer restricted this webpage from running scripts or ActiveX® controls." is displayed on the lower side of the window when Internet Explorer®11 starts, click the Allow blocked content button.

When MELSEC iQ-F Series Safety Extension Module Configuration Guide does not start normally on Internet Explorer®11 (2)

Perform the following operation.

Step 1. Opening the "Compatibility View Settings" window on Internet Explorer®11

Select the setting icon and "Compatibility View settings" on Internet Explorer®11.

Step 2. Deselecting "Display intranet sites in Compatibility View"

Deselect the "Display intranet sites in Compatibility View" checkbox, and click the Close button.

Step 3. Executing "START.html"

Execute "START.html" again.
If the message "Internet Explorer restricted this webpage from running scripts or ActiveX® controls." is displayed on the lower side of the window when Internet Explorer®11 starts, click the Allow blocked content button.

4 Buffer Memory

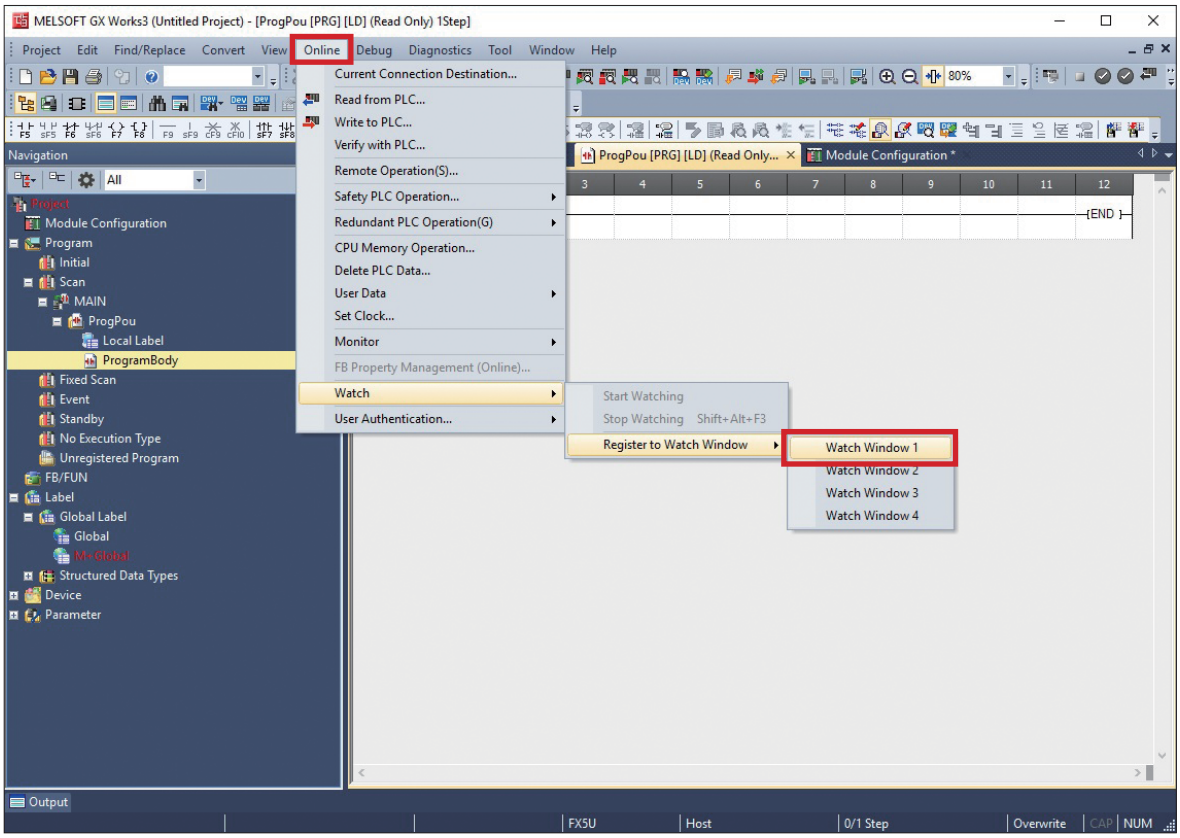
When an error occurs in the running safety main module (FX5-SF-MU4T5), the error flag turns ON and the error code is stored in "Latest error code" (U1\G0) of the buffer memory.

The error code can be checked as follows.

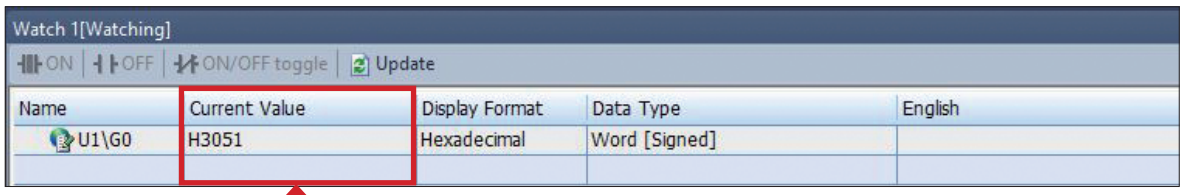
Buffer memory	Name	Description
U1\G69.15	Error flag	Turns ON when an error occurs.
U1\G0	Latest error code	Stores the latest error code.

Procedure for monitoring the buffer memory area (U1\G0)

1 Select [Online] ➡ [Watch] ➡ [Register to Watch Window] ➡ [Watch Window 1].



2 Enter "U1\G0" in "Name", select "Hexadecimal" in "Display Format", right-click "U1\G0", and select [Start Watching].



An error code is displayed.

5 Examples of Sequence Programs for Checking the Safety Extension Module Status

Example of a sequence program for checking the rotary switch settings of the safety extension modules

Buffer memory areas of the safety extension modules

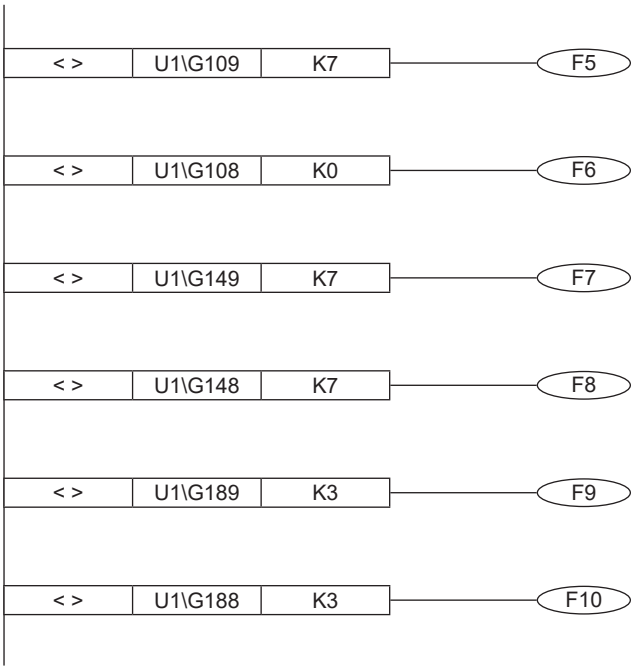
Buffer memory name	Device
1st Module Lower Rotary Switch state	U1\G108
1st Module Upper Rotary Switch state	U1\G109
2nd Module Lower Rotary Switch state	U1\G148
2nd Module Upper Rotary Switch state	U1\G149
3rd Module Lower Rotary Switch state	U1\G188
3rd Module Upper Rotary Switch state	U1\G189

For details on the buffer memory, refer to ➡ Appendix 5 Buffer Memory in the MELSEC iQ-F FX5 User's Manual (Safety Control).

Sequence program example

The following is a program to check whether the rotary switch settings of the safety extension modules are correct using the annunciator (F).

Safety extension module	Rotary switch	Setting value
Safety main module	FUNCTION	7
	DELAY	0
1st safety input expansion module	INPUT A	7
	INPUT B	7
2nd safety input expansion module	INPUT A	3
	INPUT B	3



If the FUNCTION rotary switch of the safety main module is not set to '7', the annunciator number 5 turns ON.

If the DELAY rotary switch of the safety main module is not set to '0', the annunciator number 6 turns ON.

If the INPUT A rotary switch of the first safety input extension module is not set to '7', the annunciator number 7 turns ON.

If the INPUT B rotary switch of the first safety input extension module is not set to '7', the annunciator number 8 turns ON.

If the INPUT A rotary switch of the second safety input extension module is not set to '3', the annunciator number 9 turns ON.

If the INPUT B rotary switch of the second safety input extension module is not set to '3', the annunciator number 10 turns ON.

Example of a sequence program for checking the safety output status

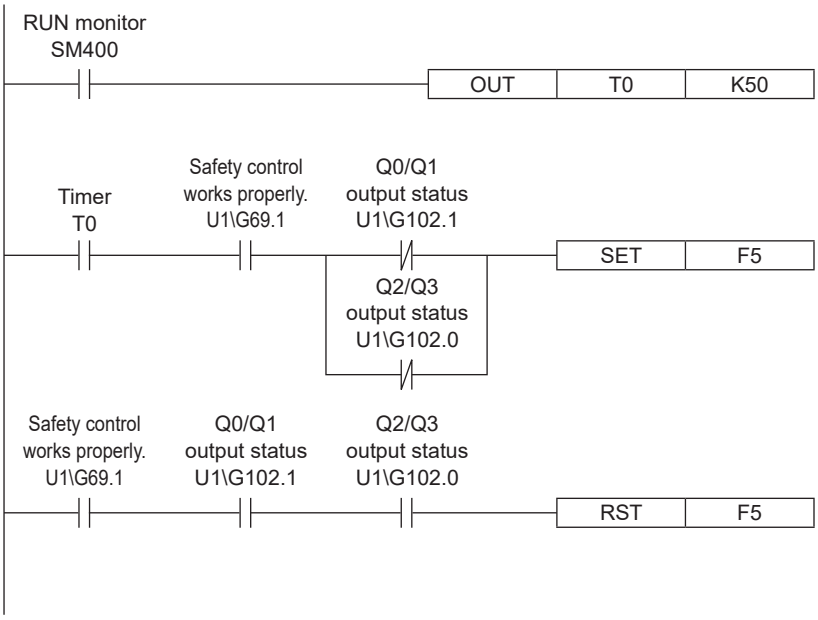
Buffer memory areas of the safety main module (FX5-SF-MU4T5)

Buffer memory name	Device	Purpose	Status when the device is ON
Input signals	**U1\G69.0**	Module READY	FX5-SF-MU4T5 initial processing is completed.
	U1\G69.1	Module Safety READY	Safety control works properly.
1st Module Output signal and Internal error	**U1\G102.0**	Q2 and Q3 output status of the FX5-SF-MU4T5	Outputs from Q2 and Q3 are ON.
	U1\G102.1	Q0 and Q1 output status of the FX5-SF-MU4T5	Outputs from Q0 and Q1 are ON.

For details on the buffer memory, refer to ➡ Appendix 5 Buffer Memory in the MELSEC iQ-F FX5 User's Manual (Safety Control).

Sequence program example

The following is a general control program to notify an error of the safety outputs using the annunciator (F).



Allowing for the start-up time of the safety main module, start a timer after the start-up of the CPU module.

After five seconds, when the safety main module operates normally and it detects a danger and any one of the safety outputs turns OFF, the annunciator number 5 turns ON.

When the safety main module operates normally and all the safety outputs turn ON, the annunciator number 5 turns OFF.

6 Safety Components Partner Products

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REVISIONS

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

Revision date	Manual number	Description
February 2020	L(NA)08708ENG-A	First edition
November 2020	L(NA)08708ENG-B	■Added or modified part RECOMMENDED POINTS
December 2022	L(NA)08708ENG-C	■Modified part Front cover, Section 1.3, WARRANTY, TRADEMARKS

WARRANTY

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

•WARRANTY in the MELSEC iQ-F FX5 User's Manual (Safety Control) (SH(NA)-082078ENG)

⚠ SAFETY PRECAUTIONS

- Before using the product introduced in this manual, please read the manuals for the product carefully to handle the products correctly.
- This product has been manufactured as a general-purpose part for general industries, and has not been designed or manufactured to be incorporated in a device or system used in purposes related to human life.
- Before using the product for special purposes such as nuclear power, electric power, aerospace, medicine or passenger movement vehicles, consult Mitsubishi Electric.
- The product has been manufactured under strict quality control. However when installing the product where major accidents or losses could occur if the product fails, install appropriate backup or failsafe functions into the system.
- For the design and wiring precautions, and other precautions, read "SAFETY PRECAUTIONS" in the relevant manuals.

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