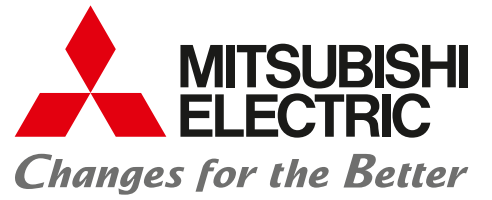**MITSUBISHI ELECTRIC**
Changes for the Better

FACTORY AUTOMATION

MELSEC iQ-F Series
iQ Platform-compatible PLC

FX5-SF-MU4T5, FX5-SF-8DI4

MELSEC iQ-F series

The iQ-F provides

a new level of safety.

Bringing safety and peace of mind to devices and equipment

Device safety is highly important amid the globalization of various industries and systems.
The MELSEC iQ-F series also treats safety very importantly, and modules that support safety standards have newly been added to its lineup.

Safety extension modules are indicated by this yellow line.

Safety main module
FX5-SF-MU4T5

Safety input expansion module
FX5-SF-8DI4

	Safety main module FX5-SF-MU4T5	Safety input expansion module FX5-SF-8DI4
Maximum number of connected modules	1 module	2 modules
Number of safety inputs	4 points	8 points
Number of safety outputs	4 points	—
Safety control programs	9 types	9 types

	Maximum number of inputs/outputs for the safety control system	
Number of safety inputs	20 points	
Number of safety outputs	4 points	

What is the safety extension module?

By using the safety extension module, it is possible to receive input from a safety input device (such as an emergency stop button or a light curtains) and turn the output OFF based on the calculation result of a safety control program when a hazard is detected. Thereby, the power to the hazard source (the moving part of a robot, conveyor, or similar device) will be interrupted. Malfunctions on the safety extension module can be detected by its self diagnostics, in which case the output is forcibly turned OFF. Hence the problem of malfunctions preventing the safety functions from operating does not occur.

The MELSEC iQ-F series safety extension module has obtained certification (category 4, PL e, and SIL3) as being compatible with international safety standards and is designed for constructing safety control systems.
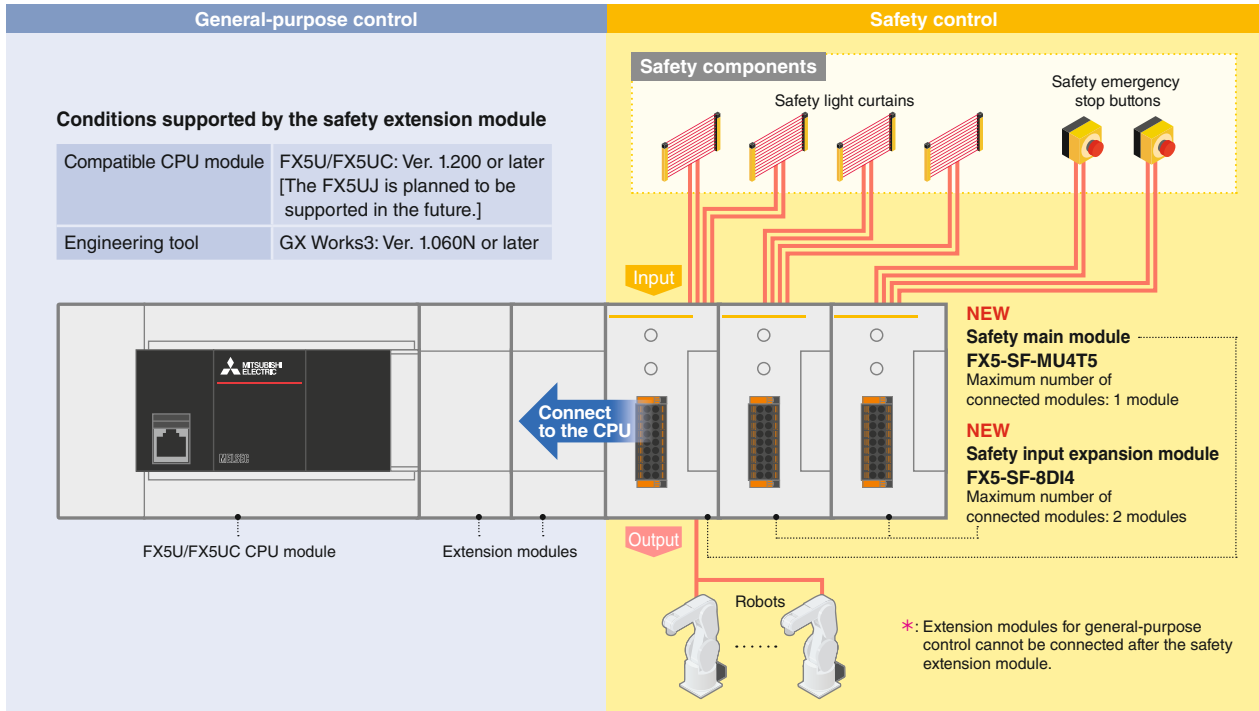
Certified as compatible with international safety standards

Category 4   PL e   SIL3

It's too late once an accident occurs! Countermeasures must be implemented to prevent accidents!
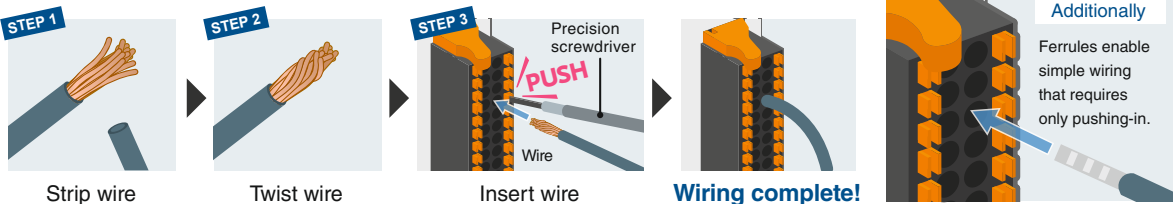
Easily create a system just by connecting a safety extension module.

A safety control system can easily be installed just by connecting a safety main module (FX5-SF-MU4T5) to an FX5U/FX5UC CPU module. This single system can then be used to perform general-purpose control and safety control. Therefore, there is no need for wiring such as the one needed for monitoring the safety status (as is necessary with a safety controller) or the wiring needed between relays when constructing a system with safety relays. Furthermore, the number of safety inputs can be expanded by connecting safety input expansion modules (FX5-SF-8DI4).

General-purpose control	Safety control

Safety components

Safety light curtains

Safety emergency stop buttons

Conditions supported by the safety extension module

Compatible CPU module	FX5U/FX5UC: Ver. 1.200 or later [The FX5UJ is planned to be supported in the future.]
Engineering tool	GX Works3: Ver. 1.060N or later

Input

NEW
Safety main module
FX5-SF-MU4T5
Maximum number of connected modules: 1 module

NEW
Safety input expansion module
FX5-SF-8DI4
Maximum number of connected modules: 2 modules

Connect to the CPU

FX5U/FX5UC CPU module

Extension modules

Output

Robots

＊: Extension modules for general-purpose control cannot be connected after the safety extension module.

Use a spring clamp terminal block to complete the wiring in three steps!

No crimp connectors and crimp tools are needed.
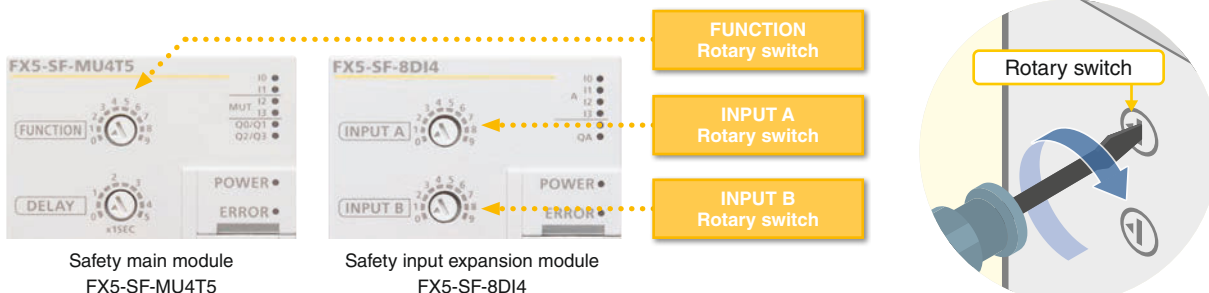Wiring can be performed just by preparing cables, and wiring man-hours can be reduced.

STEP 1 — Strip wire

STEP 2 — Twist wire

STEP 3 — Insert wire
Precision screwdriver
PUSH
Wire

Wiring complete!

Additionally

Ferrules enable simple wiring that requires only pushing-in.

Turn the rotary switch to select the built-in program.

Each safety extension module has nine types of built-in programs. To build a safety control system, just use the rotary switch on the front of the module to select the built-in program to run. This eliminates the need for sequence programs designed for safety control.

Just turn the switch with a precision screwdriver or a similar tool!
Nine types of built-in programs!

FX5-SF-MU4T5
I0
I1
MUT
I2
I3
Q0/Q1
Q2/Q3
FUNCTION
POWER
DELAY
ERROR
×1SEC

FX5-SF-8DI4
I0
I1
A
I2
I3
INPUT A
QA
POWER
INPUT B
ERROR

FUNCTION Rotary switch

INPUT A Rotary switch

INPUT B Rotary switch

Safety main module
FX5-SF-MU4T5

Safety input expansion module
FX5-SF-8DI4

Rotary switch

Using the Safety Extension Module Configuration Guide to determine the wiring at a glance!

We have prepared the MELSEC iQ-F Series Safety Extension Module Configuration Guide to enable users to use the safety extension module.
This configuration guide is a tool for easily checking the system configuration, settings, and wiring of the safety extension module.
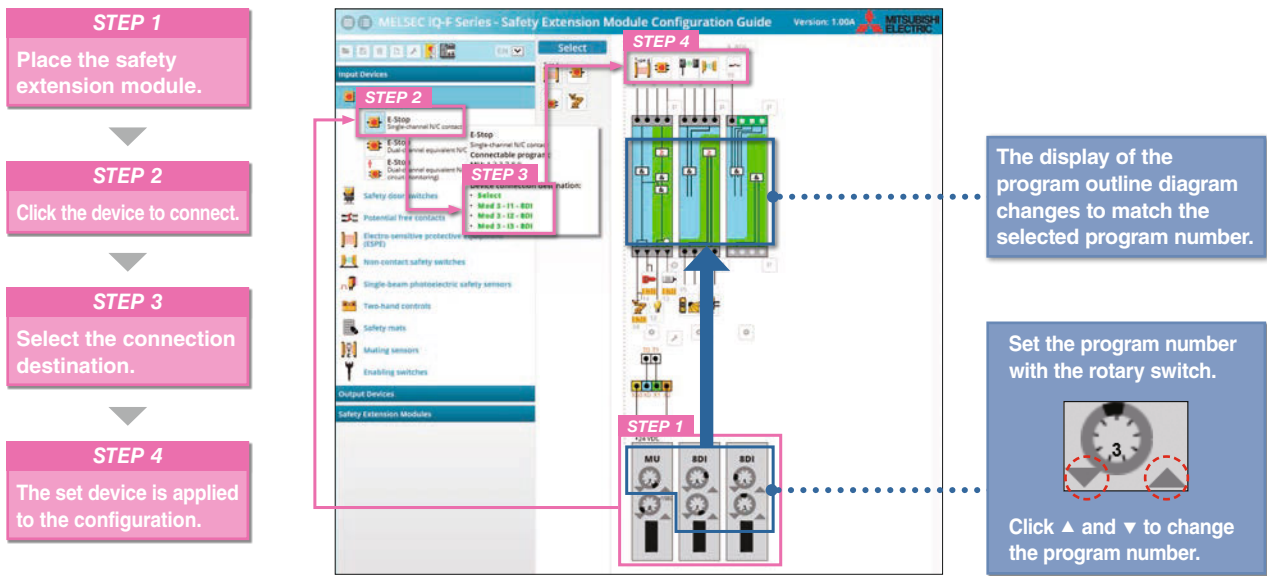
The configuration guide is free of charge! *

Check the printed configuration guide to wire the module.

*: Please contact your local Mitsubishi Electric sales office or representative.

The configuration guide makes it possible to:

- Check the connection terminals of the I/O devices.
- Check when the rotary switch was changed.
- Check the wiring diagram.
- Print the created wiring diagram.

STEP 1
Place the safety extension module.

STEP 2
Click the device to connect.

STEP 3
Select the connection destination.

STEP 4
The set device is applied to the configuration.

The display of the program outline diagram changes to match the selected program number.

Set the program number with the rotary switch.

Click ▲ and ▼ to change the program number.

Module diagnosis with GX Works3, a useful function when problems occur!

Safety extension module information such as its I/O, settings, and error codes is stored in the buffer memory of the safety main module. The error history records up to 16 items.
When an error occurs, information such as the error details and countermeasures can be checked from the module diagnosis function of GX Works3, which makes troubleshooting easier.
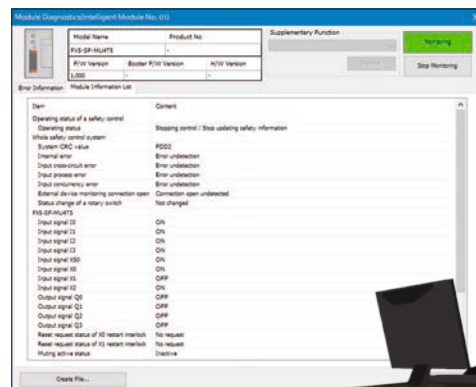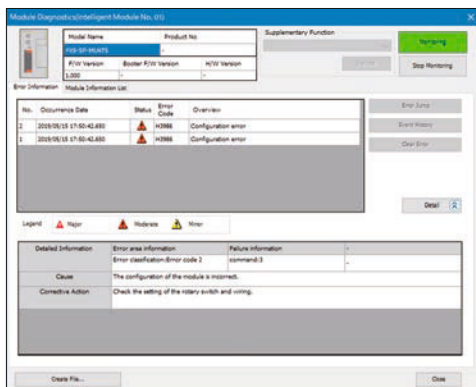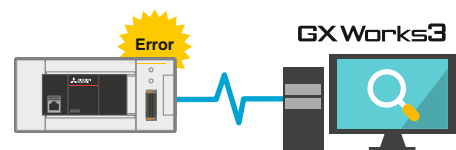
Module diagnostics screen examples

Enables visualization of the equipment status by linking with external devices!
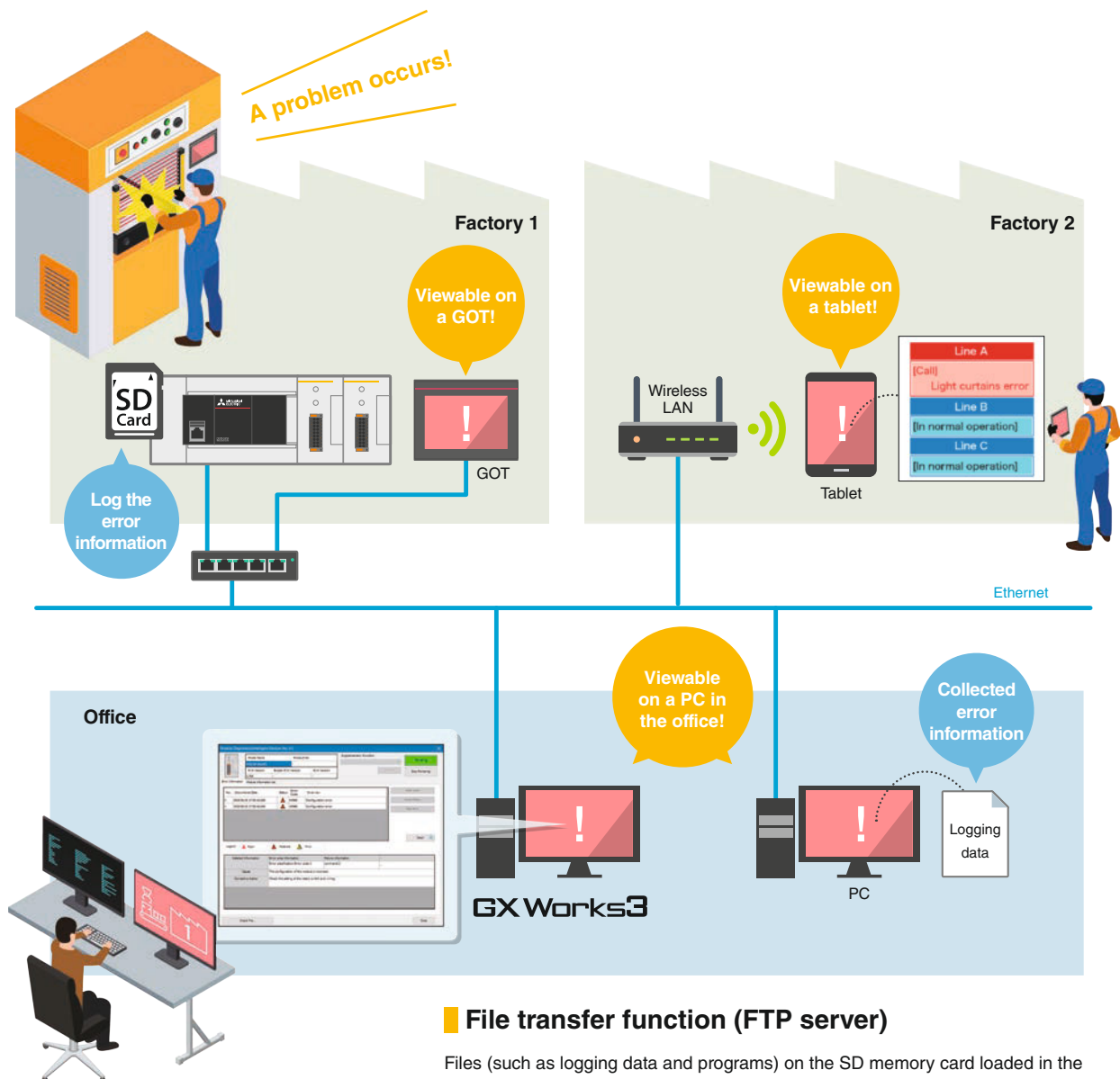
Device linking using a GOT, the built-in function of the FX5U/FX5UC CPU module, or a similar method enables on-site workers to share information. Also, the safety status of devices can be monitored (including error monitoring and information collecting) over a network from an office or other such remote location.

GOT connection

Items such as the operating time, error information, and safety I/O ON/OFF information can be displayed on the GOT connected to the FX5U/FX5UC CPU module. Anyone can easily check the current operating status. For example, it is possible to quickly recover from a problem when an emergency stop occurs by displaying the cause of the problem on the screen.

Web server function

This function can be used to monitor, change, and diagnose errors in devices and buffer memory from general-purpose web browsers (such as Internet Explorer® and Safari®) on tablets and PCs connected to the same network. The status of devices can be checked from remote locations.

A problem occurs!

Factory 1

Viewable on a GOT!

SD Card

GOT

Log the error information

Factory 2

Viewable on a tablet!

Wireless LAN

Tablet

| Line A |
| [Call] Light curtains error |
| Line B |
| [In normal operation] |
| Line C |
| [In normal operation] |

Ethernet

Office

Viewable on a PC in the office!

GX Works3

Collected error information

PC

Logging data

File transfer function (FTP server)

Files (such as logging data and programs) on the SD memory card loaded in the FX5U/FX5UC CPU module can be read, written, and deleted. As well, the file names can be viewed from devices (such as PCs) that are equipped with an FTP client and that are connected to the same network.

This makes it possible to perform operations from a PC in the office such as batch management of multiple logging files and analyzing the causes of problems using the collected data.

The MELSEC iQ-F series also makes it easy to install a safety system!

STEP 1
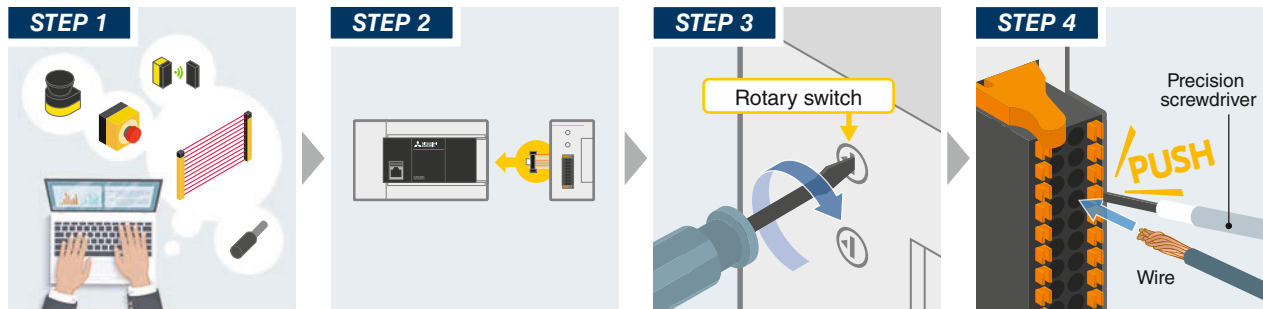
Consider the application and select the sensors.

Use the module configuration guide to select the safety emergency stop buttons, safety light curtains, and other such safety devices to use.

STEP 2

Add the safety extension module.

Connect the safety extension module to the FX5U/FX5UC CPU module.

STEP 3
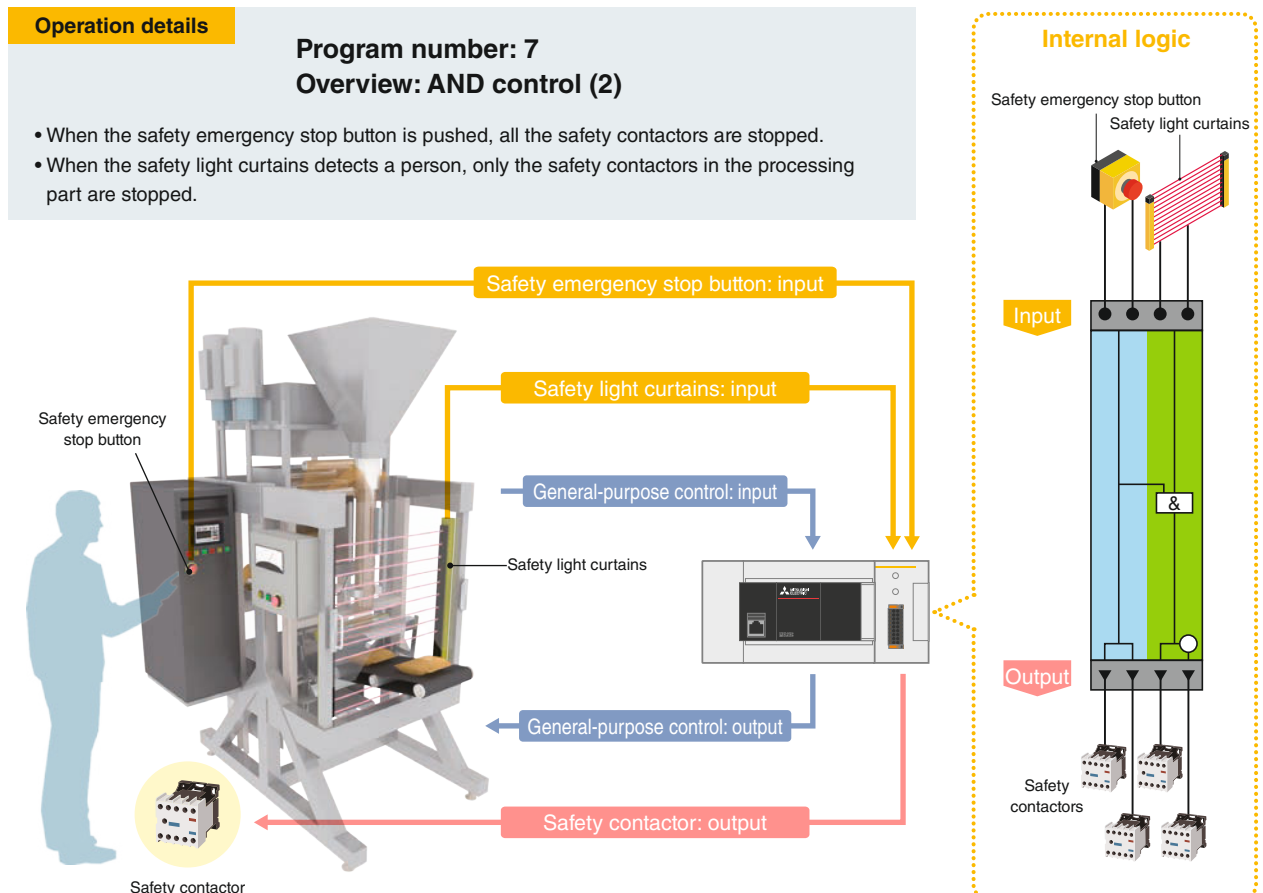
Rotary switch

Select the built-in program.

To select a built-in program to run using the rotary switch(es) on the front of a module.

STEP 4

Precision screwdriver

PUSH

Wire

Perform wiring.

Use a spring clamp terminal block for the wiring terminals. The push-in wiring, which only requires the connection terminals to be inserted into the terminal block, eliminates the need for specialized tools when attaching cables.

Application example: packaging machine

An example of the operation when a safety extension module is used with a packaging machine is shown below.

Operation details

Program number: 7
Overview: AND control (2)

- When the safety emergency stop button is pushed, all the safety contactors are stopped.
- When the safety light curtains detects a person, only the safety contactors in the processing part are stopped.

Internal logic

Safety emergency stop button
Safety light curtains

Input

&

Output

Safety contactors

Safety emergency stop button: input

Safety light curtains: input

General-purpose control: input

Safety emergency stop button

Safety light curtains

General-purpose control: output

Safety contactor: output

Safety contactor

Safety main module
FX5-SF-MU4T5

The safety extension module has been developed and manufactured in collaboration with SICK AG, so the warranty details differ from those of our other PLC products.
For the warranty and specifications, refer to the manual.

■ General specifications

The general specifications other than below are the same as those of the CPU module to be connected.

Item	Specifications
Electromagnetic Compatibility (EMC)	EN 61000-6-2, EN 61131-2, DIN EN 61326-3-1, EN 55011 (class A)

■ Safety specifications

Item	Specifications
Safety integrity level	SIL3 (IEC 61508)/SILCL 3 (IEC 62061)
Category	Category 4 (DIN EN ISO 13849-1)
Performance level	PL e (DIN EN ISO 13849-1)
PFHd	1.5×10^{-9} to 1.5×10^{-8}
TM (mission time)	20 years (EN ISO 13849-1)

■ Power supply specifications

Item	Specifications
Internal power supply	5 V DC 200 mA, 24 V DC 5 mA
External power supply	24 V DC (+20%, -15%) 125 mA
Power supply voltage circuit system	PELV or SELV*1, max. 6 A*2
Rated input current*3	5.2 A

*1: PELV (protective extra low voltage) and SELV (safety extra low voltage) are circuits that are protected by voltage limit or insulation.
*2: The current of the power supply that powers the module must be limited to a maximum of 6 A, either through the power supply itself or a fuse.
*3: The maximum current supplied from the external power supply when using all output terminals in the maximum configuration that can be configured (attaching FX5-SF-MU4T5 (one module) and FX5-SF-8DI4 (two modules)).

■ Performance specifications

• Safety inputs

Item		Specifications
Number of inputs		4 points
Input voltage (ON)		13 V DC to 30 V DC
Input voltage (OFF)		-5 V DC to 5 V DC
Input current (ON)		3 mA (2.4 mA to 3.8 mA)
Input current (OFF)		-2.5 mA to 2.1 mA
Input response time (filter delay)		2 ms
Indication of input operation		LED lights when an input is ON.
Minimum switch-off time *1 *2 (I0/I1)	Program 1, 2, 4, 5, 6, and 9	24 ms
	Program 3.1, 7, and 8	4 ms
	Program 3.2	76 ms/24 ms
Minimum switch-off time *1 *2 (I2/I3)	Program 4, 5, and 6	24 ms
	Program 1, 2, 3, 7, 8, and 9	4 ms
Power-up time		70 ms
Synchronous time monitoring	Program 1 and 2	1500 ms
	Program 4 and 5	500 ms
Muting ON*3	Program 3	61 ms
Muting OFF	Program 3	61 ms (165 ms*4)
Muting gap suppression*5	Program 3	94 ms to 100 ms
Reset time		106 ms
Maximum teach-in time of the ENTER button*6		3 s
Duration of actuation of a reset button (X0 and X1)		50 ms to 5 s

*1: The minimum switch-off time is the minimum time takes until a switch-off condition is detected after a module is switched off.
*2: A response time without any sensors. If a sensor is connected, the response time of the connected sensor is added to this value.
*3: The time from when a muting condition is enabled (I2/I3 are turned ON) until a muting function is activated.
*4: Indicates the maximum switch-off time when a muting error occurs.
*5: A muting input (I2 or I3) keeps OFF for the specified period of time.
*6: A time from when an ERROR LED starts flashing.

• General inputs

Item	Specifications
Number of inputs	4 points (3 general inputs/1 ENABLE input)
Input voltage (ON)	13.0 V DC to 30.0 V DC
Input voltage (OFF)	-5.0 V DC to 5.0 V DC
Input current (ON)	3 mA (2.4 mA to 3.8 mA)
Input current (OFF)	-2.5 mA to 2.1 mA
Indication of input operation	LED lights when an input is ON.
Minimum switch-off time (XS0)	4 ms

• Test outputs

Item		Specifications
Number of outputs		2 points
Output method		Source output, short-circuit protection, cross-circuit detection*1
Output voltage		16 V DC to 30 V DC
Output current*2		120 mA
Test cycle (T0 and T1)	Program 1, 2, 4, 5, 6, and 9	40 ms
	Program 3.2	T0 = 400 ms T1 = 40 ms

*1: A cross-circuit detection is performed only in the module.
*2: All the output current in a system is limited. Observe the following limit values. Supply current for all sensors connected to an FX5-SF-MU4T5 (T0/T1) and FX5-SF-8DI4 (T0 to T7): I < 600 mA

• Safety outputs

Item		Specifications
Number of outputs		4 points
Output method		Source output, short-circuit protection, cross-circuit detection*1
Output voltage		18.4 V DC to 30.0 V DC
Switching current		2.0 A (@TA≤45˚C) 1.5 A (@TA≤55˚C)
Total current Isum		4.0 A (@TA≤45˚C) 3.0 A (@TA≤55˚C)
Leak current (in the switch OFF status)		1 mA or less
Indication of output operation		LED lights when an output is ON.
Response time*2 (I0/I1)	Program 1, 2, 4, 5, 6, and 9	29 ms
	Program 3.1, 7, and 8	9 ms
	Program 3.2	81 ms/29 ms
Response time*2 (I2/I3)	Program 4, 5, and 6	29 ms
	Program 1, 2, 3, 7, 8, and 9	9 ms
Response time (XS0)		9 ms
Off delay time		0 / 0.5 / 1 / 1.5 / 2 / 2.5 / 3 / 3.5 / 4 / 5 s

*1: A cross-circuit detection is performed only in the module.
*2: A response time without any sensors. If a sensor is connected, the response time of the connected sensor is added to this value.

• Performance specification

Item	Specifications
No. of occupied I/O points	8 points

■ Programs

Program	Overview
0	Inactive
1	OR control (1)
2	OR control (2)
3	Muting control
4	Two-hand control (1)
5	Two-hand control (2)
6	AND control (1)
7	AND control (2)
8	Independent control
9	AND control (3)

■ External dimensions

Unit: mm
2-φ4.5 mounting hole
Mass (weight): 0.3 kg
Outer painting color: Munsell 0.6B7.6/0.2
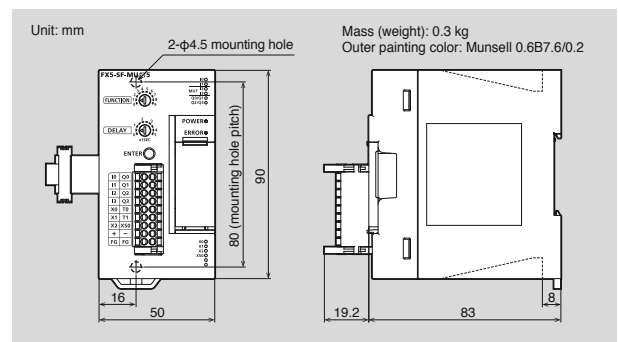
PROGRAMMABLE CONTROLLERS
MELSEC iQ-F Series

Safety input expansion module
FX5-SF-8DI4

The safety extension module has been developed and manufactured in collaboration with SICK AG, so the warranty details differ from those of our other PLC products.
For the warranty and specifications, refer to the manual.

■ General specifications

The general specifications other than below are the same as those of the CPU module to be connected.

Item	Specifications
Electromagnetic Compatibility (EMC)	EN 61000-6-2, EN 61131-2, DIN EN 61326-3-1, EN 55011 (class A)

■ Safety specifications

Item	Specifications
Safety integrity level	SIL3 (IEC 61508)/SILCL 3 (IEC 62061)
Category	Category 4 (DIN EN ISO 13849-1)
Performance level	PL e (DIN EN ISO 13849-1)
PFHd	1.5×10^{-9} to 1.5×10^{-8}
T$_M$ (mission time)	20 years (EN ISO 13849-1)

■ Power supply specifications

Item	Specifications
Internal power supply	24 V DC (+20%, -15%) 125 mA

■ Performance specifications
• Safety inputs

Item		Specifications
Number of inputs		8 points
Input voltage (ON)		13 V DC to 30 V DC
Input voltage (OFF)		-5 V DC to 5 V DC
Input current (ON)		3 mA (2.4 mA to 3.8 mA)
Input current (OFF)		-2.5 mA to 2.1 mA
Indication of input operation		LED lights when an input is ON.
Minimum switch-off time	Program 1, 2, 3, 4, 5, and 8	24 ms
	Program 6 and 7	4 ms
Synchronous time monitoring	Program 3 and 5	1500 ms
Power-up time		70 ms

• Test outputs

Item	Specifications
Number of outputs	8 points
Output method	Source output, short-circuit protection, cross-circuit detection*
Output voltage	16 V DC to 30 V DC
Output current	30 mA
Test cycle	40 ms

*: A cross-circuit detection is performed only in the module.

• Response time

Item		Specifications
Response time	Program 1, 2, 3, 4, 5, and 8	33 ms
	Program 6 and 7	13 ms

• Performance specification

Item	Specifications
No. of occupied I/O points	0 point

■ Programs

Program	Overview
0	Inactive
1	AND link (single channel)
2	AND link (dual channel) (1)
3	AND link (dual channel) (2)
4	AND link (dual channel) (3)
5	AND link (dual channel) (4)
6	AND link (dual channel) (5)
7	OR link (dual channel)
8	Bypass
9	All paths batch connection

■ External dimensions

Unit: mm
Mass (weight): 0.25 kg
Outer painting color: Munsell 0.6B7.6/0.2
2-φ4.5 mounting hole
80 (mounting hole pitch)
90
16   50   19.2   83   8

Conditions supported by the safety extension module

Compatible CPU module	FX5U/FX5UC: Ver. 1.200 or later [The FX5UJ is planned to be supported in the future.]
Engineering tool	GX Works3: Ver. 1.060N or later

Ferrule terminals

(Recommended products: PHOENIX CONTACT GmbH & Co. KG*)

Model	Type	Wire size
CRIMPFOX 6	Crimp tool	–
AI 0.5-10 WH	Crimp terminal (Ferrule with insulation sleeve)	0.5 mm²
AI 0.75-10 GY		0.75 mm²
A 1.0-10	Crimp terminal (Ferrule without insulation sleeve)	1.0 mm²
A 1.5-10		1.5 mm²

*: If the product other than the reference product is used, the wire ferrule cannot be pulled out. Sufficiently confirm that the wire ferrule can be pulled out before use.

Product list

Item	Specifications
FX5-SF-MU4T5	Safety main module
FX5-SF-8DI4	Safety input expansion module
FX5-U-SF-E	MELSEC iQ-F FX5 User's Manual (Safety Control) Model code: 09R576
FX5U-U-HW-E	MELSEC iQ-F FX5U User's Manual (Hardware) Model code: 09R536
FX5UC-U-HW-E	MELSEC iQ-F FX5UC User's Manual (Hardware) Model code: 09R558

⚠ Safety Warning

To ensure proper use of the products in this document, please be sure to read the instruction manual prior to use.

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New publication, effective Nov. 2019
Specifications subject to change without notice.