PLC

MELSEC iQ-F Series Basics

This training course is prepared for those handling the MELSEC iQ-F Series iQ Platform-compatible programmable controller for the first time.

L(NA)00192ENG

Introduction Purpose of the Course

This training course is prepared for those handling the MELSEC iQ-F Series iQ Platform-compatible programmable controller (hereinafter referred to “MELSEC iQ-F Series”) for the first time to learn the basic methods of designing and constructing the programmable controller system.

The programmable controller system can be constructed using the following procedure:
1. Determining the contents to be automated
2. Preparing required equipment
3. Installing and wiring the prepared equipment
4. Creating programs for operating the installed and wired equipment

This course explains the above procedure.

Those who will learn this course should have fundamental knowledge of programmable controllers.
Complete the following course in advance:

- FA Equipment for Beginners (PLCs)

Introduction Course structure

This course consists of the following chapters.
It is recommended to learn these chapters in order from Chapter 1.

Chapter 1: Introduction of MELSEC iQ-F Series

You can learn about the outline of the MELSEC iQ-F Series and the lineup of products.

Chapter 2: Design of Programmable Controller System

You can learn about the system configuration of the MELSEC iQ-F Series and how to select modules.

Chapter 3: Installation and Wiring

You can learn about how to attach and wire modules.

Chapter 4: Creation and Execution of Sequence Program

You can learn about a series of procedures from creation to execution of a sequence program.

Final Test

Passing grade: 60% or more

Introduction

How to Use This e-Learning Tool

Go to the next page	>	Go to the next page.
Back to the previous page	<	Back to the previous page.
Move to the desired page	TOC	"Table of Contents" will be displayed, enabling you to navigate to the desired page.
Exit the learning	X	Exit the learning.

Cautions for Use

Safety precautions

When you learn based on using actual products, please carefully read the safety precautions in the corresponding manuals.

Precautions in this course

The displayed screens of the software version that you use may differ from those in this course.
This course uses the following software version:

- GX Works3 Version 1.060N

Chapter 1 Introduction of MELSEC iQ-F Series

In this chapter, you can learn about the outline of the MELSEC iQ-F Series and the lineup of products.

1.1 Outline of MELSEC iQ-F Series

1.2 Built-in functions of MELSEC iQ-F Series

1.3 System configuration of MELSEC iQ-F Series

1.4 CPU modules

1.5 Extension modules

1.6 Expansion boards and expansion adapters

1.7 Bus conversion modules

1.8 Introduction of spring clamp terminal block type products

1.9 Introduction of FX5UJ added to iQ-F Series lineup

1.10 Introduction of safety extension modules added to iQ-F Series lineup

1.11 Development and maintenance of sequence programs

1.12 Summary

1.1 Outline of MELSEC iQ-F Series

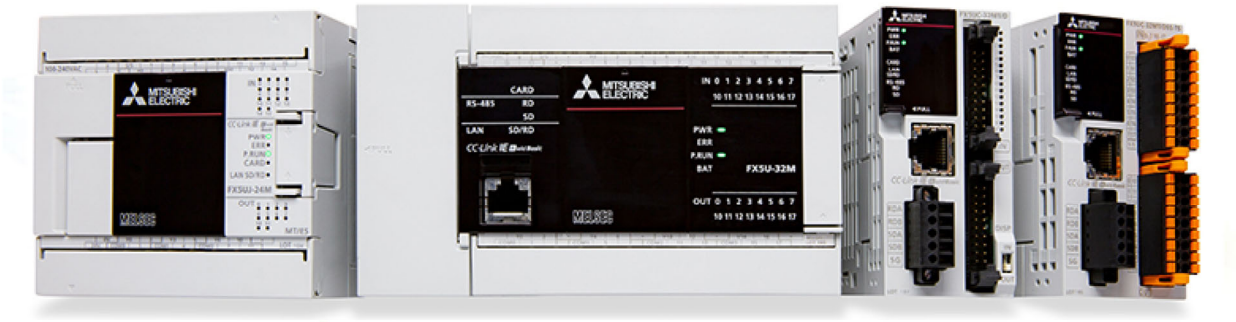
Programmable controllers of Mitsubishi Electric Corporation are developed to automate equipment, and are generally called PLCs.

Designed on the concepts of outstanding performance, superior drive control, and user centric programming, Mitsubishi's MELSEC-F Series has been reborn as the MELSEC iQ-F series.
From stand alone use to network system application, MELSEC iQ-F Series brings your business to the next level of industry.

MELSEC iQ-F series

GOOD DESIGN AWARD 2015

DESIGN AWARD 2016



The next level of industry

1.2 Built-in functions of MELSEC iQ-F Series

Advanced built-in functions

MELSEC iQ-F Series PLCs are compact next-generation models in which one CPU module incorporates various built-in functions. We can offer two types of series, standard FX5U Series and space saving FX5UC Series. (Click the tab to switch the display.)

FX5U | FX5UC

CPU performance

A new sequence execution engine is at the core of MELSEC iQ-F, capable of running structured programs and multiple programs, and supports structured text and function blocks, etc.

Built-in positioning function

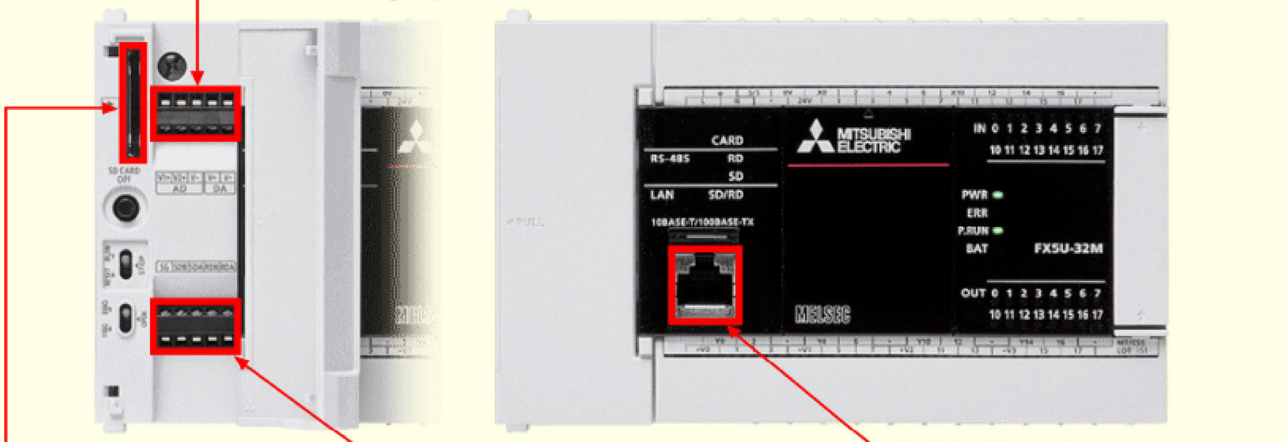
FX5U/FX5UC has built-in positioning functions for 8 channels high speed pulse input and 4 axes pulse output.

Built-in analog inputs and output

The FX5U incorporates 2 channels of 12-bit analog input and 1 channel of analog output.

Batteryless and maintenance-free

Programs can be held without a battery. Clock data is held for 10 days by supercapacitor.



Built-in SD memory card slot

The built-in SD memory card slot is convenient to update programs and mass-produce products.

Built-in RS-485 ports

Built-in RS-485 communication ports enable communication with up to 16 Mitsubishi general-purpose inverters in a distance of 50 m maximum.

Built-in Ethernet port

The Ethernet communication port handles communication with up to 8 connections in the network, and enables connection of many personal computers and equipment.

1.3 System configuration of MELSEC iQ-F Series

This section explains the basic system configuration of the MELSEC iQ-F Series.
Let's confirm the role of each module in the FX5U Series/FX5UC Series.(Click the tab to switch the display.)

FX5U | FX5UC

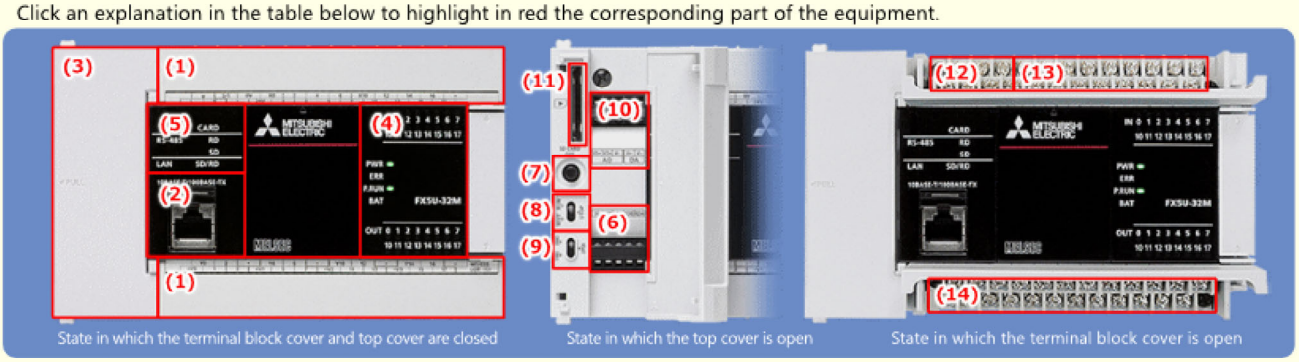
Click the device to get its explanation.

1.4 CPU modules

Let's learn about the name and role of each part of the CPU module.

FX5U FX5UC

Click a red frame of the equipment to highlight in red the corresponding explanation in the table below.
Click an explanation in the table below to highlight in red the corresponding part of the equipment.



State in which the terminal block cover and top cover are closed | State in which the top cover is open | State in which the terminal block cover is open

No	Name	Role
(1)	Terminal block cover	Protects the terminal block. This cover can be opened for wiring.
(2)	Built-in Ethernet communication connector	Connects Ethernet-enabled equipment. (with cover)
(3)	Top cover	Protects the SD memory card slot, [RUN/STOP/RESET] switch and others.
(4)	LED area [1]	Indicates the operation status of the CPU module. The operator can check the CPU module power ON/OFF state, error condition, input/output ON/OFF state and others.
(5)	LED area [2]	Indicates the operation status of the SD memory card, built-in RS-485 communication and built-in Ethernet communication.
(6)	Built-in RS-485 communication terminal block	Connects RS-485-enabled equipment.
(7)	SD memory card disable switch	Disables accesses to the SD memory card before removal of the SD memory card.

No	Name	Role
(8)	RUN/STOP/RESET switch	Changes the operation status of the CPU module.
(9)	RS-485 terminal resistor selector switch	Switches the terminal resistor for built-in RS-485 communication.
(10)	Built-in analog I/O terminal block	Provided for using the built-in analog function.
(11)	SD memory card slot	Accepts the SD memory card.
(12)	Power terminals	Provided for wiring the power supply. Wiring will be explained in Chapter 3.
(13)	Input terminals	Provided for wiring external equipment on the input side such as switches and sensors. Wiring will be explained in Chapter 3.
(14)	Output terminals	Provided for wiring external equipment on the output side such as devices to be driven. Wiring will be explained in Chapter 3.

1.5 Extension modules(1)

Let's learn about extension modules.
Up to 16 extension modules (excluding power extension modules) can be connected to the right side of the CPU module.
Up to 4 high-speed pulse I/O modules can be connected (Extension power supply modules and connector conversion modules are not included in the number of connected modules).

■ I/O modules (input/output extension modules)

These modules are available to extend the number of input/output points in increments of 8 to 32 points when the number of input/output points in the CPU module is insufficient. Some I/O modules incorporate a power supply.
There are two types – extension cable type and extension connector type.
Some I/O modules incorporate a power supply.
The following modules are the extension cable type:

Input/output modules incorporating power supply
FX5-32ER/ES
FX5-32ET/ES
FX5-32ET/ESS
FX5-32ER/DS
FX5-32ET/DS
FX5-32ET/DSS

Input/output modules
FX5-16ER/ES
FX5-16ET/ES
FX5-16ET/ESS
High-speed pulse I/O modules
FX5-16ET/ES-H
FX5-16ET/ESS-H

Input modules
FX5-8EX/ES
FX5-16EX/ES

Output modules
FX5-8EYR/ES
FX5-8EYT/ES
FX5-8EYT/ESS
FX5-16EYR/ES
FX5-16EYT/ES
FX5-16EYT/ESS

1.5 Extension modules(2)

■Analog input/output module and temperature control module (intelligent function module*)

FX5U CPU modules have built-in analog input/output functions. When combined with extension modules, FX5U CPU modules can input and output the analog amount (such as voltage and current), and control the temperature.
The analog input/output functions in CPU modules and a variety of extension modules enable analog control suitable for the application.
*Intelligent function modules indicate modules for adding various functions to the PLC.




Analog input module

FX5-4AD

Intelligent function module to convert analog input at 4 points (voltage and current) into digital values

Analog output module

FX5-4DA

Intelligent function module to convert digital values at 4 points into analog output (voltage and current)

Multiple input module

FX5-8AD

Intelligent function module to convert analog input at 8 points (voltage, current, thermocouple and resistance temperature detector) into digital values

Temperature control module

FX5-4LC

Intelligent function module equipped with input at 4 channels (thermocouple, resistance temperature detector and low-voltage input), output at 4 points (open collector transistor) and input at 4 points from current detectors, and available to control the temperature

1.5 Extension modules(3)

■Network/communication modules (intelligent function modules*)
The MELSEC iQ-F Series can construct a network according to the control contents including high-speed network by CC-Link, Ethernet, MODBUS, Sensor Solution and PROFIBUS-DP.
*Intelligent function modules indicate modules for adding various functions to the PLC, and network/communication modules are included.

CC-Link IE Field

FX5-CCLIEF

Intelligent function module to be connected as an intelligent device station of the CC-Link IE field network

CC-Link V2

FX5-CCL-MS

Intelligent function module to be connected as the master station or an intelligent device station of the CC-Link network

Ethernet

FX5-ENET

Intelligent function module to connect the CC-Link IE field network Basic (master station) and general-purpose Ethernet

Sensor Solution

FX5-ASL-M

Intelligent function module to construct the AnyWireASLINK system using an FX5 CPU module
FX5-ASL-M is jointly developed and manufactured with Anywire Corporation.
The AnyWireASLINK system is a sensor network system.

PROFIBUS-DP

FX5-DP-M

Intelligent function module to be connected as the master station of the PROFIBUS-DP network

FX5-ENET/IP

FX5-ENET/IP

Intelligent function module to connect the Ethernet/IP network

1.5 Extension modules(4)

■ Positioning/simple motion modules (intelligent function modules*)

The CPU module have the built-in positioning function for 4 axes. When a positioning/simple motion module is connected to the CPU module, complicated multi-axis/interpolation control is enabled.

*Intelligent function modules indicate modules for adding various functions to the PLC, and positioning/simple motion modules are included.

Positioning
FX5-20PG-P
FX5-20PG-D

Two-axis positioning module equipped with linear interpolation and circular interpolation.
By analyzing the positioning data in advance, it can start the positioning at high-speeds.

Simple motion
FX5-40SSC-S
FX5-80SSC-S

Modules incorporating the positioning function for 4 or 8 axes compatible with SSCNET III/H.
High-speed/high-precision positioning can be achieved in combination with MR-J4 servo motor.
Parameter settings and table operation settings can easily be made with GX Works3.

■ Power extension module

The FX5-1PSU-5V is available when the built-in power supply of the CPU module is insufficient.
This module can supply power to I/O modules, intelligent function modules and bus conversion modules.
Up to 2 power extension modules can be connected to the CPU module.

Power extension module
FX5-1PSU-5V

1.5 Extension modules(5)

■Safety extension modules

With these modules, a safety control system can be introduced easily. This single system enables both general control and safety control.

Each safety extension module has nine types of built-in programs.

Just turn the rotary switch on the front of the module to select a built-in program to run. This eliminates the need for sequence programs designed for safety control.

Safety main module

FX5-SF-MU4T5

When this module is connected to the FX5U/FX5UC CPU module, the number of safety input points can be extended.

Safety input expansion module

FX5-SF-8DI4

When this module is connected to the right side of the safety main module (FX5-SF-MU4T5), the number of safety input points can be expanded.

	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 input	4 points	8 points
Number of safety output	4 points	–
Safety control programs	9 types	9 types

Certified as compatible with international safety standards

Category 4 | PL e | SIL3

1.6 Expansion boards and expansion adapters(1)

Let's learn about expansion boards and expansion adapters.

■ Expansion boards

Function expansion boards can be connected to the PLC to extend its functions.
Only 1 function expansion board can be connected to the front face of the CPU module. (One function expansion board and up to 6 expansion adapters can be used together.)

For communication	
Easily achieves data link and communication with external serial interface equipment.	
FX5-232-BD	For communication in accordance with RS-232C
FX5-485-BD	For communication in accordance with RS-485
FX5-422-BD-GOT	For communication with peripheral equipment (GOT) in accordance with RS-422

Communications with data link or external serial interface device can be realized easily by adding an expansion board.

1.6 Expansion boards and expansion adapters(2)

■ Expansion adapters

Expansion adapters can be connected to the CPU module to add special controls.

Up to the following number of modules can be connected to the left side of the CPU module:

FX5U/FX5UC CPU module: Up to 6 modules

FX5UJ CPU module: Up to 4 modules

For communication	
Easily achieves data link and communication with external serial interface equipment.	
FX5-232ADP	For RS-232C communication
FX5-485ADP	For RS-485 communication

Communications with data link or external serial interface device can be realized easily by adding an expansion adapter.

For analog	
Inputs and outputs voltage/current signals and analog data sent from temperature sensors.	
FX5-4AD-ADP	4 channels for voltage input/current input
FX5-4DA-ADP	4 channels for voltage output/current output
FX5-4AD-PT-ADP	4 ch temperature sensor (resistance temperature detector) input
FX5-4AD-TC-ADP	4 ch temperature sensor (thermocouple) input

These modules input and output voltage/current signals and analog data sent from temperature sensors.

1.7 Bus conversion modules

In the FX5 system, FX3 intelligent function modules can be connected when used together with the bus conversion module.

Bus conversion module

FX5-CNV-BUS

■ Connectable FX3 intelligent function module list

Analog	
FX3U-4AD	4 channels for voltage input/current input
FX3U-4DA	4 channels for voltage output/current output
FX3U-4LC	4 channels for temperature control (resistance thermometer, thermocouple and low voltage) 4 points for transistor output
Positioning	
FX3U-1PG	Pulse output for independent 1-axis control
High-speed counter	
FX3U-2HC	2 channels for high-speed counter
Network	
FX3U-16CCL-M	Master station for CC-Link (compatible with Ver. 2.00 and Ver. 1.10)
FX3U-64CCL	Intelligent device station for CC-Link
FX3U-128BTY-M	Master station for AnyWire® Bitty*
FX3U-128ASL-M	Master station for AnyWire® ASLINK*
FX3U-32DP	PROFIBUS-DP slave station

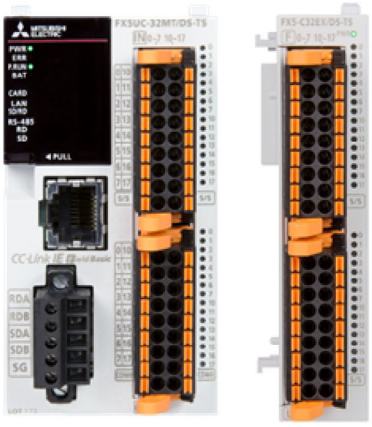
* AnyWire is a registered trademark of AnyWire Corporation.

1.8 Introduction of spring clamp terminal block type products (1)

This section introduces MELSEC iQ-F Series spring clamp terminal block type products.

■ Spring clamp terminal block type product list

Spring clamp terminal block type products are added to the lineup of CPU modules and I/O modules.
Wiring is possible quickly and easily without extra time for wire processing.



CPU modules

FX5UC-32MT/DS-TS	DC	D2	T1
FX5UC-32MT/DSS-TS	DC	D2	T2
FX5UC-32MR/DS-TS	DC	D2	R

Input: 16 points/output: 16 points

I/O modules*1

Input module
FX5-C32EX/DS-TS — D2

Output modules
FX5-C32EYT/D-TS — T1
FX5-C32EYT/DSS-TS — T2
FX5-C16EYR/D-TS — R

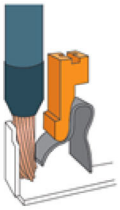
I/O modules
FX5-C32ET/DS-TS — D2 T1
FX5-C32ET/DSS-TS — D2 T2

DC	DC power supply	T1	Transistor output (sink)	R	Relay output
D2	DC input (sink/source)	T2	Transistor output (source)		

*1: When connecting to FX5U CPU module, FX5-CNV-IF is required.

What is a spring clamp terminal block?

Spring clamp terminal blocks hold wires in place by the force of internal springs.
Constant force holds wires in place, preventing wires from falling out due to vibration.



Internal construction

Securely fixed by elastic force!

1.8 Introduction of spring clamp terminal block type products (2)

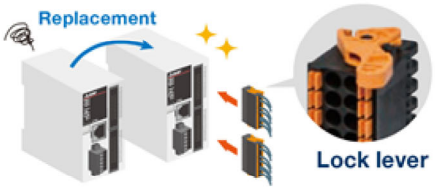
What are the advantages?

There is no need for crimp terminals or crimp tools!
Wiring is possible without extra time or cost.

Attaching crimp terminals to cables one by one is tedious!

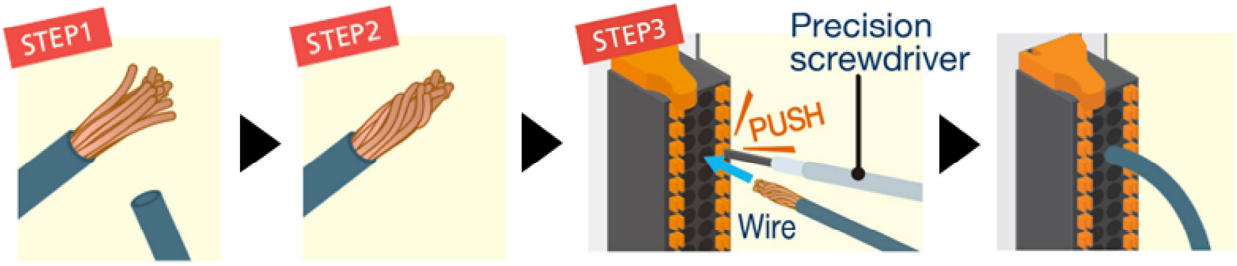
No need for crimp terminals or crimp tools!
Just prepare the cables!

No external terminal block is needed!
Easily detachable and securely fixed by a lock lever!



With detachable terminal blocks, the change of wiring is not needed even when replacing the modules!

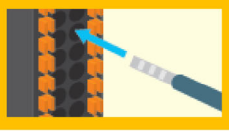
With the spring clamp terminal block type, wiring is complete in three steps!



Strip wire | Twist wire | Precision screwdriver | Wiring complete!

Additionally!

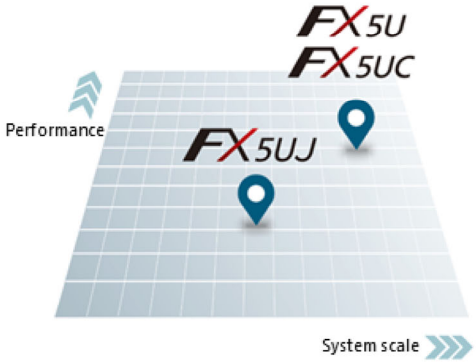
By using a ferrule terminal, wiring can be completed just by inserting with the push-in method.
Complete wiring smoothly, even in a confined panel.



1.9 Introduction of FX5UJ added to iQ-F Series lineup (1)

FX5UJ is added to the lineup of MELSEC iQ-F Series CPU modules.

FX5UJ, which excels in cost performance, is equipped with various built-in functions which earned popularity in FX5U(C), and promotes increased ease of use.



Highly functional models

FX5U/FX5UC

- Up to 512 points of control
- FX5U CPU module: 32/64/80 points
- FX5UC CPU module: 32/64/96 points

FX5UJ

- Up to 256 points of control
- CPU module: 24/40/60 points

FX5UJ-24MR/ES	AC	D2	R
FX5UJ-24MT/ES	AC	D2	T1
FX5UJ-24MT/ESS	AC	D2	T2

FX5UJ-40MR/ES	AC	D2	R
FX5UJ-40MT/ES	AC	D2	T1
FX5UJ-40MT/ESS	AC	D2	T2

FX5UJ-60MR/ES	AC	D2	R
FX5UJ-60MT/ES	AC	D2	T1
FX5UJ-60MT/ESS	AC	D2	T2

AC AC power supply
D2 DC input (sink/source)
R Relay output
T1 Transistor output (sink)
T2 Transistor output (source)

1.9 Introduction of FX5UJ added to iQ-F Series lineup (2)

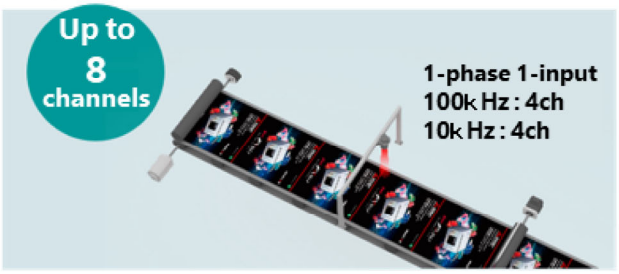
■ Built-in functions

Built-in positioning function

- Supports positioning of up to 3 axes.
- Outputs pulse trains of 200 kpps (transistor output).

Built-in high-speed counter function

- The CPU module has 8 channels of built-in high-performance high-speed counters.
- This enables match output and range output control that do not depend on the scan time.



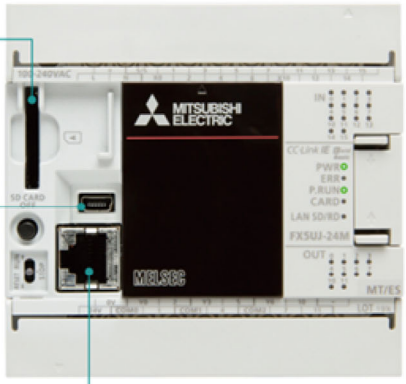
■ Built-in ports

SD memory card slot

Standard-equipped with an SD memory card slot, which is essential for functions such as logging and backup/restore.

USB (Mini-B) connector

Another interface for programming, in addition to the Ethernet port. The standard equipped USB (Mini-B) connector makes it easier to connect engineering tools.



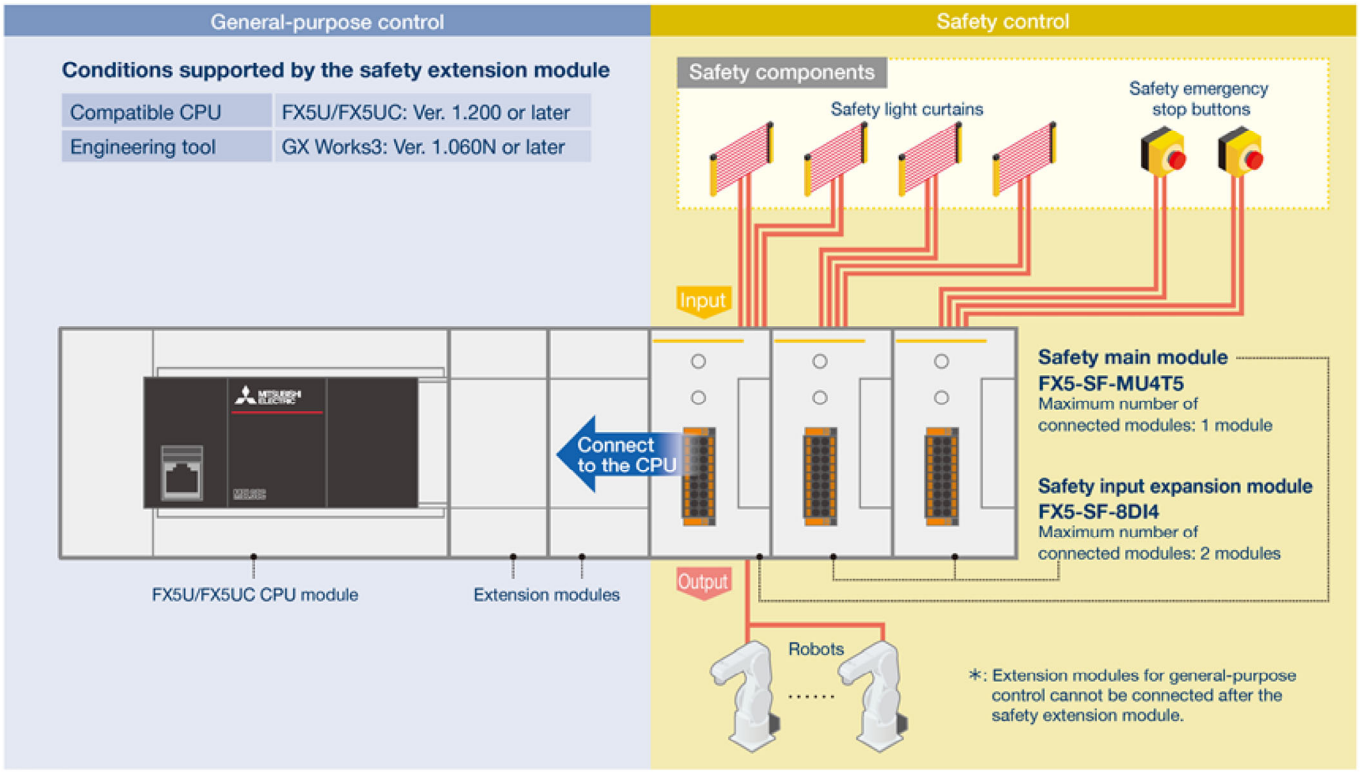
Ethernet port

The Ethernet port enables communication through up to 8 connections on the network.
CC-Link IE field network Basic is also supported.
This lets you construct a network with general-purpose Ethernet.

1.10 Introduction of safety extension modules added to iQ-F Series lineup (1)

Point Easily create a system just by connecting a safety extension module.

A safety control system can be easily installed just by connecting a safety extension module to the 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 or the logic wiring needed between relays when constructing a system with safety relays.

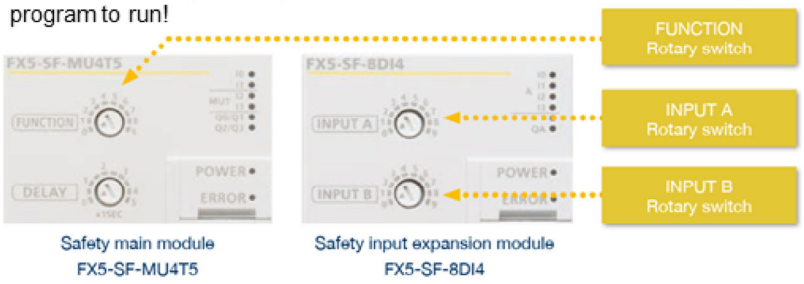


1.10 Introduction of safety extension modules added to iQ-F Series lineup (2)

Product features

Point There is no need for safety control programs!

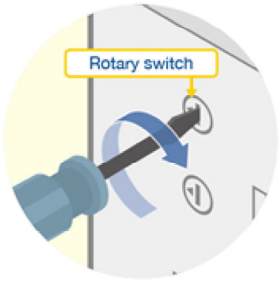
There is no need for safety control programs.
Each safety extension module has nine types of built-in safety control programs.
Just turn the rotary switch provided on the module front face to select a built-in program to run!



Safety main module
FX5-SF-MU4T5

Safety input expansion module
FX5-SF-8DI4

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

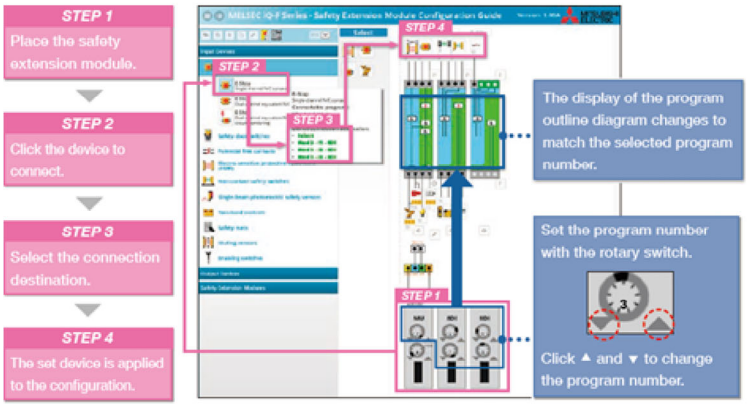


Point Using the Safety Extension Module Configuration Guide (provided free of charge) to determine the wiring at a glance!

This configuration guide is a tool for easily checking the system configuration and wiring of safety extension modules.

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. etc



1.11 Development and maintenance of sequence programs

GX Works3 is an engineering tool for creating and maintaining sequence programs for PLCs including the MELSEC iQ-F Series and MELSEC iQ-R Series.
By connecting a Windows® personal computer in which GX Works3 is installed and an Ethernet port or the like, built into the CPU module, you can develop programs, check program operations, write programs to the CPU module, and check the module status.

* Windows is a registered trademark or trademark of Microsoft Corporation (USA) in the USA and other countries.
* Ethernet is a trademark of Xerox Corporation (USA).

1.12 Summary

The table below summarizes the contents you have learned in Chapter 1.

Built-in functions of MELSEC iQ-F Series	The CPU module incorporates the following functions: •Analog inputs and outputs •Positioning •Ports for Ethernet communication •Ports for RS-485 communication •SD memory card slot
System configuration of MELSEC iQ-F Series	You have learned about the basic system configuration of the MELSEC iQ-F Series and roles of the following modules: •CPU modules •Extension modules •Expansion boards and adapters •Bus conversion module
Introduction of spring clamp terminal block type products	Regarding the spring clamp type terminal block type added to the MELSEC iQ-F Series lineup, features and advantages are introduced. This type saves the wire processing process, and realizes quick and simple wiring.
Introduction of FX5UJ added to iQ-F Series lineup	Regarding the FX5UJ CPU module added to the MELSEC iQ-F Series lineup, features and built-in functions are introduced. FX5UJ, which excels in cost performance, is equipped with various built-in functions which earned popularity in FX5U(C), and promotes increased ease of use.
Introduction of safety extension modules added to iQ-F Series lineup	Regarding the safety extension modules added to the MELSEC iQ-F Series lineup, important points of the safety control system and features of the modules are introduced. Only by connecting a safety extension module to the CPU module, a safety control system can be easily constructed. Because these modules have nine types of built-in safety control programs, there is no need for safety control programs.
Development and maintenance of sequence programs	Programming of the MELSEC iQ-F Series requires a personal computer in which the engineering tool GX Works3 is installed.

Chapter 2 Design of Programmable Controller System

In this chapter, you can learn about the system configuration of the MELSEC iQ-F Series and how to select modules.

2.1 Example of PLC system

2.2 Configuration of PLC and equipment used in labeling system example

2.3 How to select CPU module

2.4 How to read product model

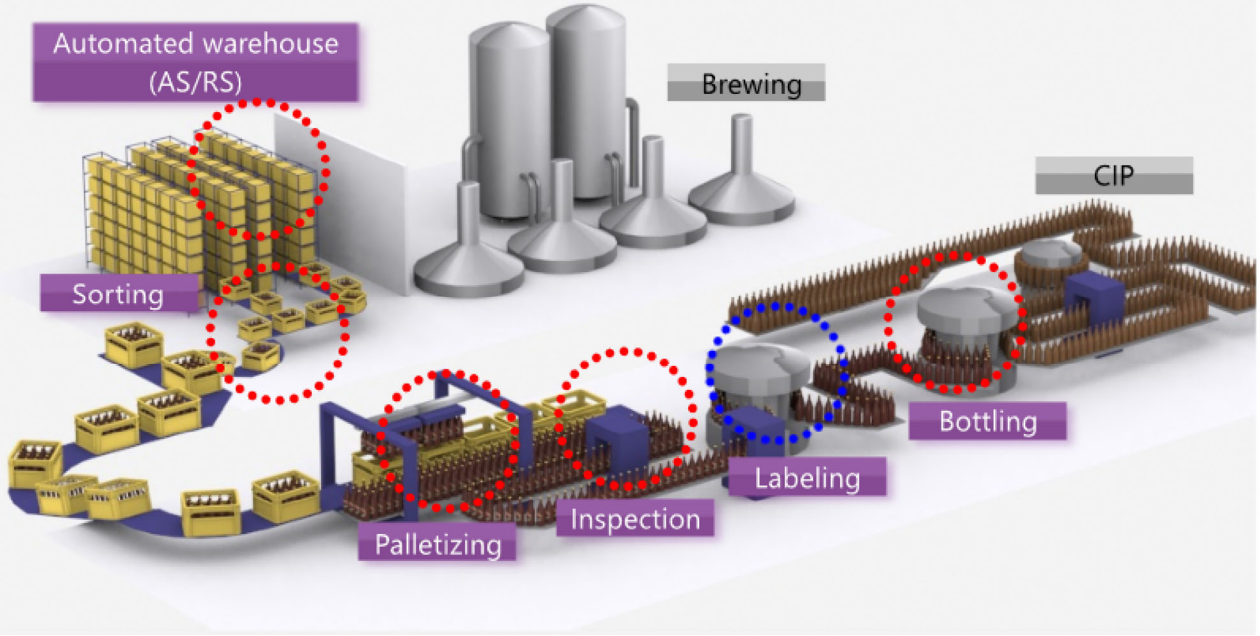
2.5 Summary

2.1 Example of PLC system

This e-Learning is based on a beverage production line, showing various aspects of automation from CIP, bottling, labeling, to sorting and an automated retrieval/storage system (AS/RS). Programmable controllers are often used in such production sites which require a high-level of automation.

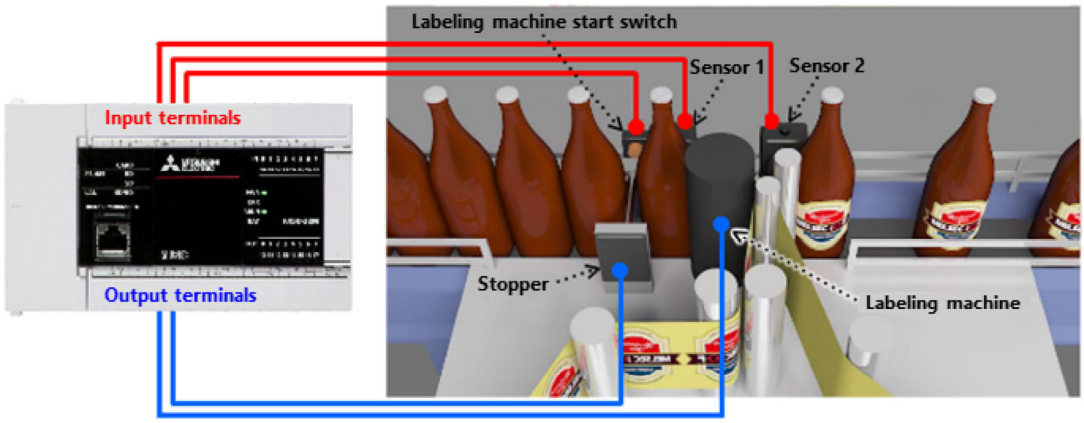
First the process specifications are introduced. Next the control suitable for the specification are considered. In this course, control in the labeling process is picked up as an example.

Click the corresponding process to view more information.



2.2 Configuration of PLC and equipment used in labeling system example

This section explains the configuration of PLC and external I/O equipment used in the labeling system example.
The labeling system consists of 1 CPU module and 5 external I/O equipment.



Item	Equipment name	Model	Role/function
PLC system	CPU module	FX5U-32MR/ES	Controls operation by transferring ON/OFF signals to external I/O equipment in accordance with the contents of the sequence program.
External I/O equipment	Sensor 1	–	Turns ON when detecting the passage of a bottle. When this sensor turns ON, the stopper starts close.
	Stopper	–	Keeps a constant interval between bottles.
	Labeling machine start switch	–	Turns ON when the stopper is completely closed. While this switch is ON, the labeling machine operates. When this switch turns OFF, the labeling machine stops.
	Labeling machine	–	Sticks labels on bottles.
	Sensor 2	–	Turns ON when detecting the passage of a bottle. When this sensor turns ON, the closed stopper opens.

2.3 How to select CPU module

For constructing the PLC system, select a CPU module suitable for the system specifications.

The table below shows the specifications of each CPU module.
Select the proper CPU module model in consideration of the required number of I/O points, external power supply, program capacity, types of available instructions, required processing speed, etc.

On factory sites, 24 V DC is generally used as the power for driving sensors and switches.
In the subject (labeling system) in this course, it is assumed that the I/O specifications are as follows:
(1) Total number of I/O points and I/O type
(a) Input: 24 V DC, ON/OFF input, 3 points
(b) Output: 24 V DC, relay output, 2 points
Total: 5 points
The capacity of the program to be written to the PLC is within 1k steps.
(2) Sequence program capacity: Within 1k steps
The supply voltage specification shall be as follows:
(3) Supply voltage: 100 V AC

FX5U-32MR/ES

<Applicable CPU modules>

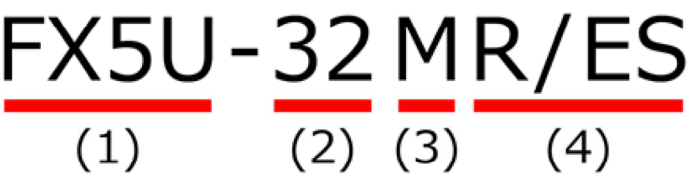
You can select either CPU module shown in the table below in accordance with the condition.
*** In this course, learning will proceed on the assumption that "FX5U-32MR/ES" is selected.**

Module model	Rated input voltage		Relay output specifications		Program capacity	Supply voltage
	Rated input voltage	Number of input points	Rated load voltage	Number of output points		
FX5U-32MR/ES	24 V	16 points	30 V DC or less, 240 V AC or less	16 points	64k steps	100 to 240 V AC
FX5U-64MR/ES	24 V	32 points	30 V DC or less, 240 V AC or less	32 points	64k steps	100 to 240 V AC
FX5U-80MR/ES	24 V	40 points	30 V DC or less, 240 V AC or less	40 points	64k steps	100 to 240 V AC

The following tool is convenient to examine the PLC system whole configuration:
<MITSUBISHI ELECTRIC FA Global Website - Model selection tool MELSEC iQ-F Series>
https://www.mitsubishielectric.com/fa/ssl/products/cnt/plcf/ex/select/index.html

2.4 How to read product model

The product model name contains the following information.
The CPU module "FX5U-32MR/ES" selected in this course is explained as an example.



(1)	Series name	FX5U, FX5UC
(2)	Total number of I/O points	32, 64, 80, etc.
(3)	Module category	M: CPU module E: I/O module EX: Input module EY: Output module
(4)	Power supply and input/output system	Examples ■In case of CPU module R/ES: AC power supply, 24 V DC (sink/source) input, relay output T/ES: AC power supply, 24 V DC (sink/source) input, transistor (sink) output T/ESS: AC power supply, 24 V DC (sink/source) input, transistor (source) output T/DS-TS: DC power supply, 24 V DC (sink/source) input, transistor (sink) output *"TS" in the model name indicates the spring clamp terminal block type. ■In case of I/O module X/ES : 24 V DC (sink/source) input YR/ES : relay output

2.5 Summary

The table below summarizes the contents you have learned in Chapter 2.

Example of PLC system	As an example of the PLC system, this course picks up the labeling process in which labels are stuck on bottles in the beverage manufacturing line.
Configuration of PLC and equipment used in labeling system example	You have learned about the configuration of PLC and external I/O equipment used in the labeling system example. The labeling system consists of 1 CPU module and 5 external I/O equipment.
How to select CPU module	You have learned about how to select the CPU module suitable for the system specifications. •Selection condition •Total number of I/O points and I/O type •Sequence program capacity •Supply voltage
How to read product model	You have learned about how to read the product model name. Example: FX5U-32MR/ES •FX5U ... Series name •32 ... Total number of input and output points •M ... Module category (CPU module) •R/ES ... I/O type and power supply

Chapter 3 Installation and Wiring

In this chapter, you can learn about how to attach and wire modules.

3.1 PLC installation environment

3.2 Installation location

3.3 Grounding

3.4 Attachment of CPU module battery

3.5 Assignment of I/O numbers

3.6 Wiring of power supply

3.7 Wiring of input equipment

3.8 Wiring of output equipment

3.9 Summary

3.1 PLC installation environment

PLCs have a certain degree of environment resistance because they are usually used on manufacturing sites.
However, PLCs are generally installed inside the control panel so that they can offer stable performance for a long time.

Refer to "General Specifications" described in the manual for detailed conditions.

Do not install PLCs in the following environment:

• High ambient temperature

• High ambient humidity and condensation

• Vibration or heavy impacts

• Excessive dust
• Combustible gas or corrosive gas

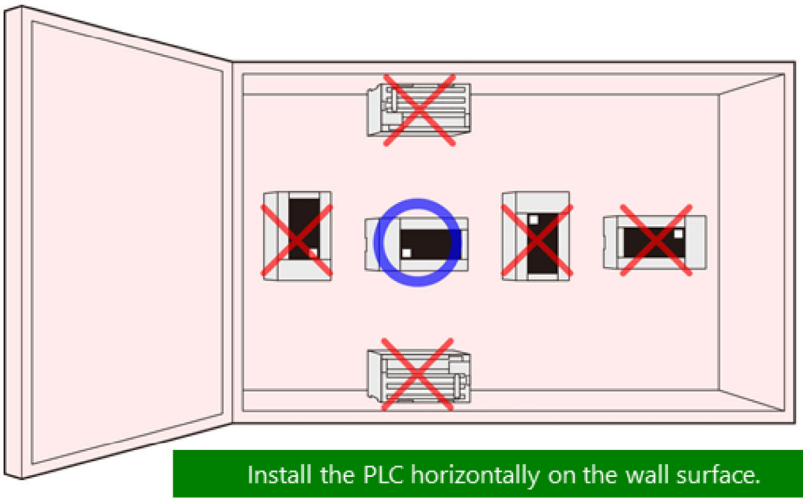
3.2 Installation location

■ Installation location and space inside the panel

・Do not install the PLC on the floor surface or ceiling surface or in the vertical direction to prevent temperature rise. Make sure to install the PLC horizontally on the wall surface as shown in the figure below.

・Ensure a space of 50 mm or more between the PLC main module and another equipment and between the PLC main module and the structure.
Keep the PLC main module away from high-voltage lines, high-voltage equipment and power equipment as much as possible.

・In the MELSEC iQ-F Series, extension device can be connected to both the left side and the right side of the CPU module. If extension device may be added in the future, ensure the required space on the left side and right side.



Install the PLC horizontally on the wall surface.

Esnure a space of 50 mm or more.

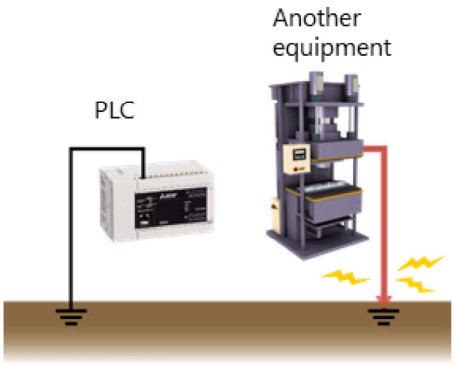
3.3 Grounding

- To prevent electrical shock and malfunction, perform grounding while paying attention to the following contents:
  Perform independent grounding in which each equipment has its own grounding wire.
  If independent grounding is impossible, perform shared grounding in which all grounding wires have the same length. Perform Class D grounding (Grounding resistance: 100 Ω or less).

- Shorten the distance between the grounding point and the PLC as much as possible, and shorten the grounding wire as much as possible.

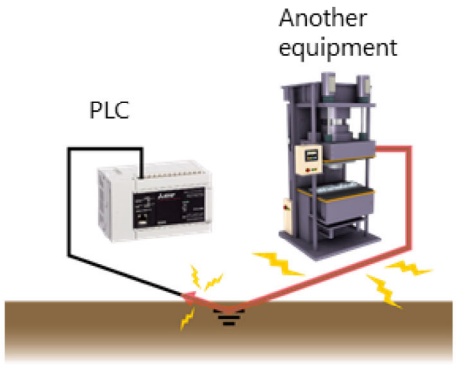
(1)Grounding each equipment independently

Independent grounding...**Best**



(2)Using grounding wires of the same length

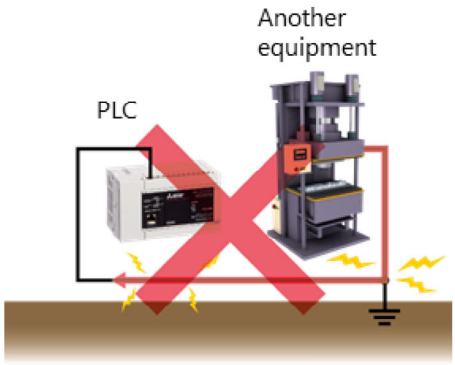
Shared grounding...**Good**



(3)Branching one grounding wire

Common grounding

...**Not allowed**



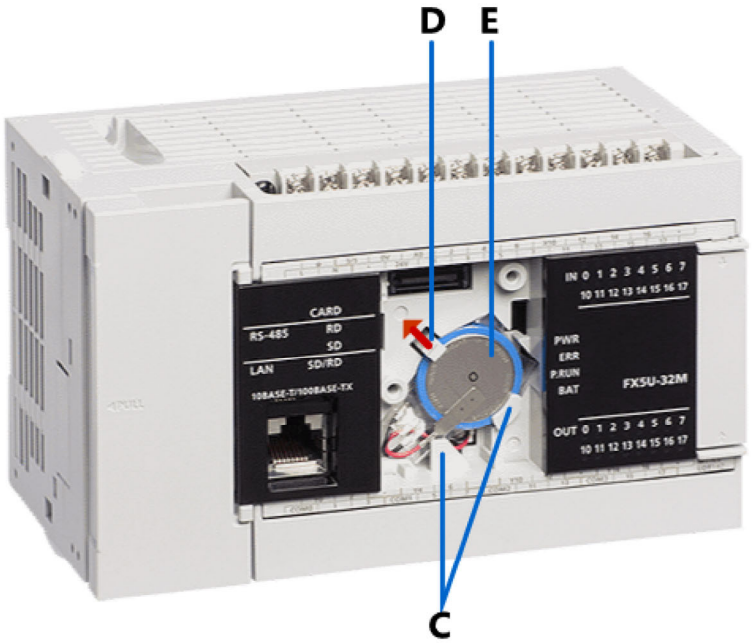
*In common grounding, the PLC is grounded by way of the grounding system of another equipment, and is affected by the other equipment.

3.4 Attachment of CPU module battery

Use the battery for latching (holding against power interruption) device memories and clock data.
A battery is not supplied with the CPU module when shipped from the factory.
Arrange the battery if necessary.
Confirm the connection method in the animation.

The animation is finished.
Click [>] to proceed to the next step.
Click the [Play again] button to start from the beginning again.

Play again



Step 1: Turn OFF the power.

Step 2: Connector cover for expansion board connection (Remove A in the figure.)

Step 3: Insert the battery connector (B in the figure) of the battery.

Step 4: Insert the battery inside the lower hook (C in the figure), and fit the battery into the battery holder (E in the figure) while pushing up the upper hook (D in the figure) toward the left.
Attach the connector cover for expansion board connection.
If the expansion board was removed in the step 2, attach it again.

3.5 Assignment of I/O numbers

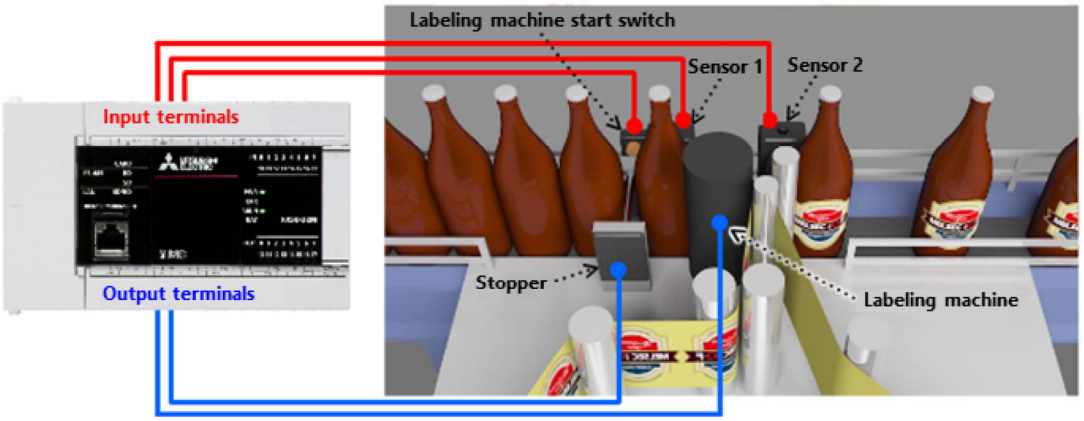
Numbers in increments of 8 points are assigned to I/O terminals of the CPU module for wiring I/O equipment.
These numbers called "I/O numbers" are provided so that the CPU module can recognize signals sent from I/O equipment.
・I/O numbers are numbers beginning with "0", and expressed in octal notation.

・At assignment, "X" is added before a number for input equipment, and "Y" is added before a number for output equipment.

In the labeling system adopted as an example in this course, I/O numbers shown in the table below are assigned.

■ Assignment of I/O numbers and applicability of I/O equipment in the labeling system example

	I/O equipment name	I/O number
Input equipment	Sensor 1	X0
	Sensor 2	X1
	Labeling machine start switch	X2
Output equipment	Stopper	Y0
	Labeling machine	Y1

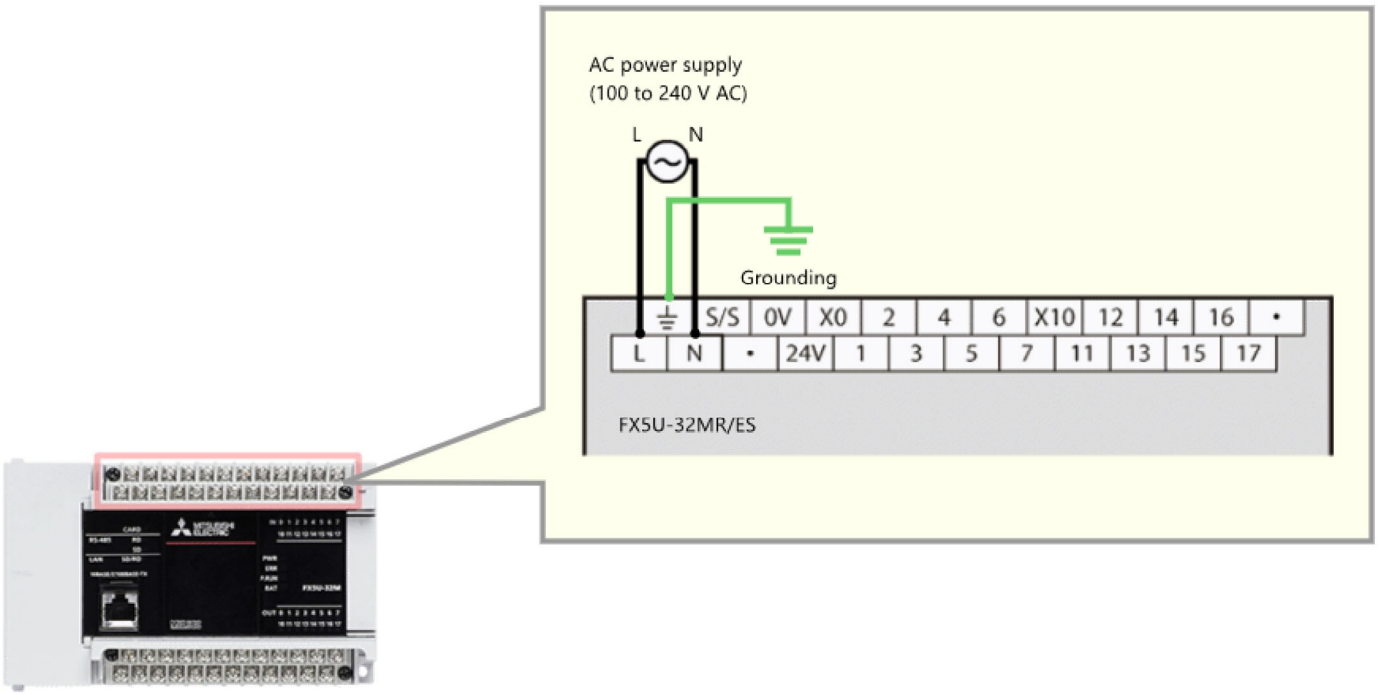


3.6 Wiring of power supply

This section explains the wiring of the power supply.

- In wiring, it is necessary to open the terminal block cover provided on the module front face.
- Connect the input AC power supply to the power input terminals (L and N).
  (Check the printed characters "L" and "N" during wiring.)
- Make sure to ground the grounding terminal to ensure stable operation.

Note that cable colors vary depending on the country.



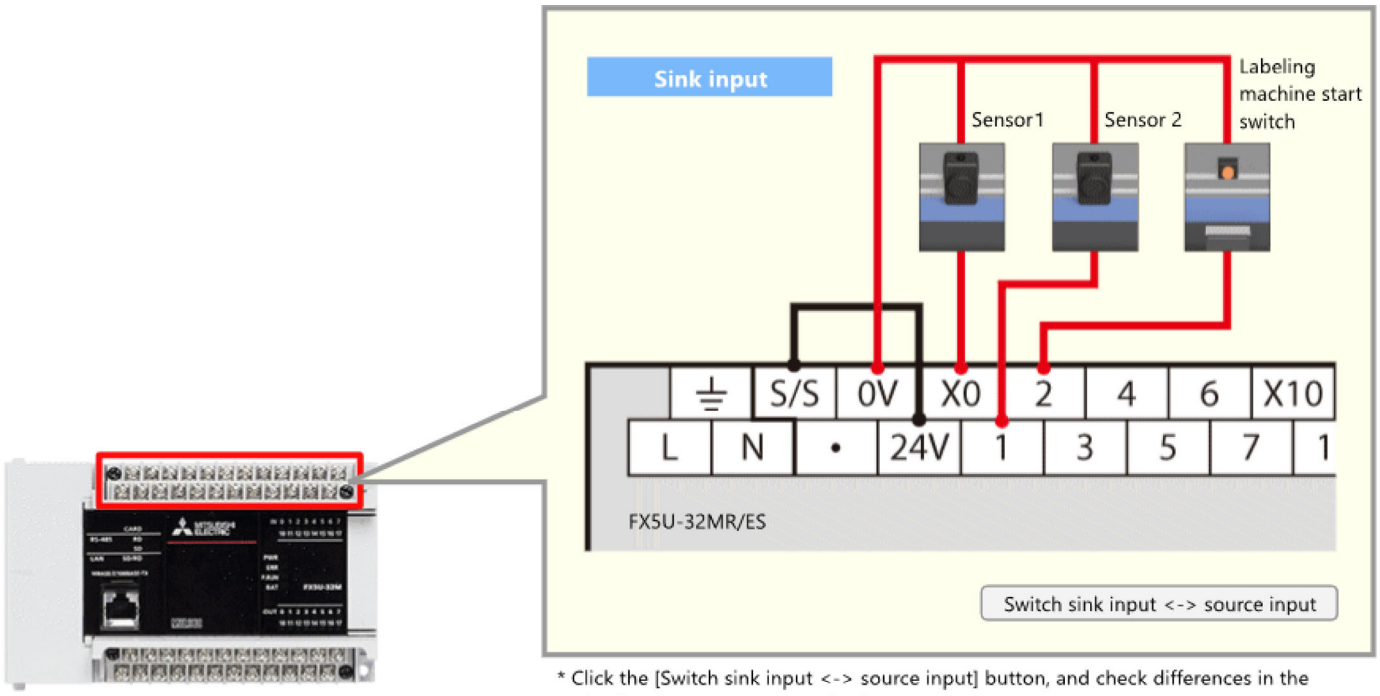
3.7 Wiring of input equipment

Wire input equipment to input terminals of the CPU module.
"Sink input" and "source input" are available for wiring input terminals. Select either method in accordance with the external equipment to be connected.

■ "Sink input" and "source input"

- In the sink input method, DC input signals flow out of input (X) terminals. Connect the [24 V] terminal and [S/S] terminal.
- In the source input method, DC input signals flow into input (X) terminals. Connect the [0 V] terminal and [S/S] terminal.

*The sink input method in which the [24 V] terminal and [S/S] terminal are connected is generally adopted in Japan.



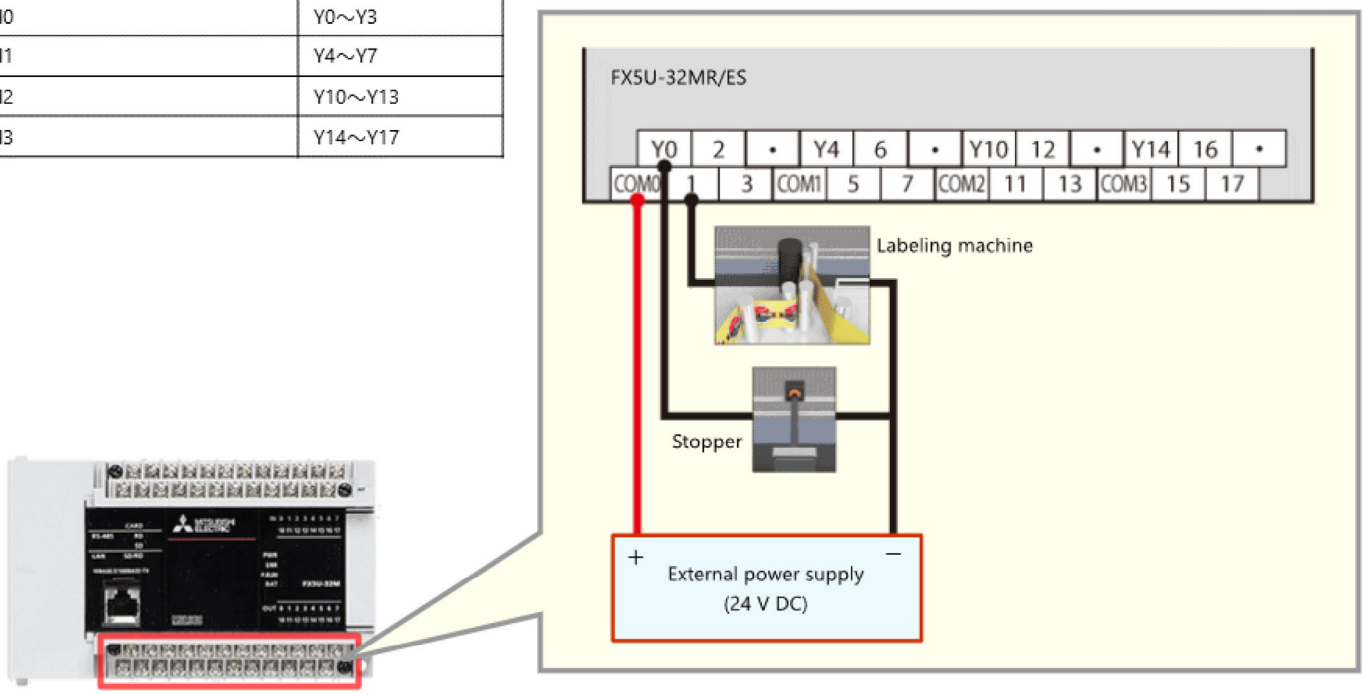
* Click the [Switch sink input <-> source input] button, and check differences in the wiring between two input methods.

3.8 Wiring of output equipment

Wire output equipment to output terminals of the CPU module.

- Four outputs share 1 common terminal (COM).
  Even when two or more output equipment are connected, the space and wiring can be saved if the common terminals can be shared.
- The FX5U-32MR has 4 common terminals, COM0 to COM3.
  Each common terminal corresponds to output numbers (Y) shown in the table below, and can be used to drive the load belonging to a different circuit voltage system (for example: 100 V AC and 24 V DC).

Common terminal number (COM)	Output number (Y)
COM0	Y0～Y3
COM1	Y4～Y7
COM2	Y10～Y13
COM3	Y14～Y17



3.9 Summary

The table below summarizes the contents you have learned in Chapter 3.

PLC installation environment	Do not install PLCs in the following places: •High ambient temperature •High ambient humidity and condensation •Vibration or heavy impacts •Excessive dust. Combustible gas or corrosive gas
Installation location	You have learned about the installation location and space inside the panel. •Make sure to install the PLC horizontally on the wall surface. Do not install the PLC on the floor surface or ceiling surface or in the vertical direction to prevent temperature rise. •Ensure a space of 50 mm or more between the PLC main module and another equipment and between the PLC main module and the structure.
Grounding	You have learned about proper grounding to prevent electrical shock and malfunction. •Perform independent grounding in which each equipment has its own grounding point.
Attachment of CPU battery	You have learned about the procedure to attach the battery to the CPU module. •Use the battery for latching (holding against power interruption) device memories and clock data.
Assignment of I/O numbers	You have learned about assignment of I/O numbers to I/O terminals. •I/O numbers are numbers expressed in octal notation assigned so that the CPU module can recognize signals from I/O equipment. •At assignment, "X" is added before a number in input equipment, and "Y" is added before a number in output equipment.
Wiring of power supply	You have learned about the wiring of the power supply. •Connect the input AC power supply to the power input terminals (L and N). •Make sure to ground the grounding terminal to ensure stable operation.
Wiring of input equipment	You have learned about the wiring of input equipment to input terminals. "Sink input" and "source input" are available for wiring input terminals. Select either method in accordance with the external equipment to be connected. •In the sink input method, DC input signals flow out of input (X) terminals. Connect the [24 V] terminal and [S/S] terminal. •In the source input method, DC input signals flow into input (X) terminals. Connect the [0 V] terminal and [S/S] terminal.
Wiring of output equipment	You have learned about the wiring of output equipment to output terminals. •Four outputs share 1 common terminal (COM). Even when two or more output equipment are connected, the space and wiring can be saved if the common terminals can be shared.

Chapter 4 Creation and Execution of Sequence Program

In this chapter, you can learn about a series of procedures from creation to execution of a sequence program.

4.1 Outline of sequence programs

4.2 Connection of CPU module and personal computer

4.3 Creation of a sequence program

4.4 Writing and execution of a sequence program

4.5 Operations in labeling system example

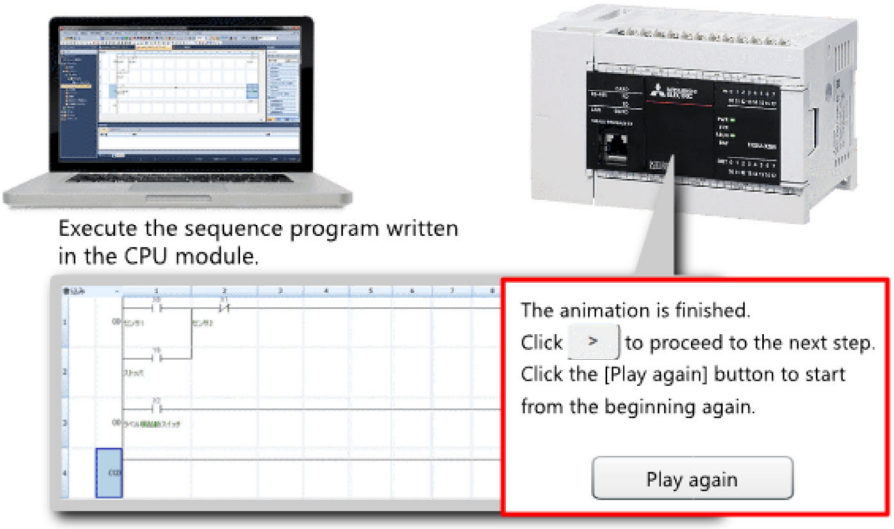
4.6 Summary

4.1 Outline of sequence programs

Sequence programs are required to operate the MELSEC iQ-F Series.
Sequence programs are such that the contents of sequence control are described in a dedicated programming language such as ladder, ST and function block (FB).

Sequence programs can be created in a personal computer in which the engineering tool (GX Works3) for the MELSEC iQ-F Series is installed, and can be executed after they are written to the CPU module.
Changes and extension of the specifications can be handled flexibly by changing sequence programs.

In this course, the basic program creation procedure is explained using a programming language called ladder.
It is recommended to take the basic programming course for acquiring more knowledge of programming.



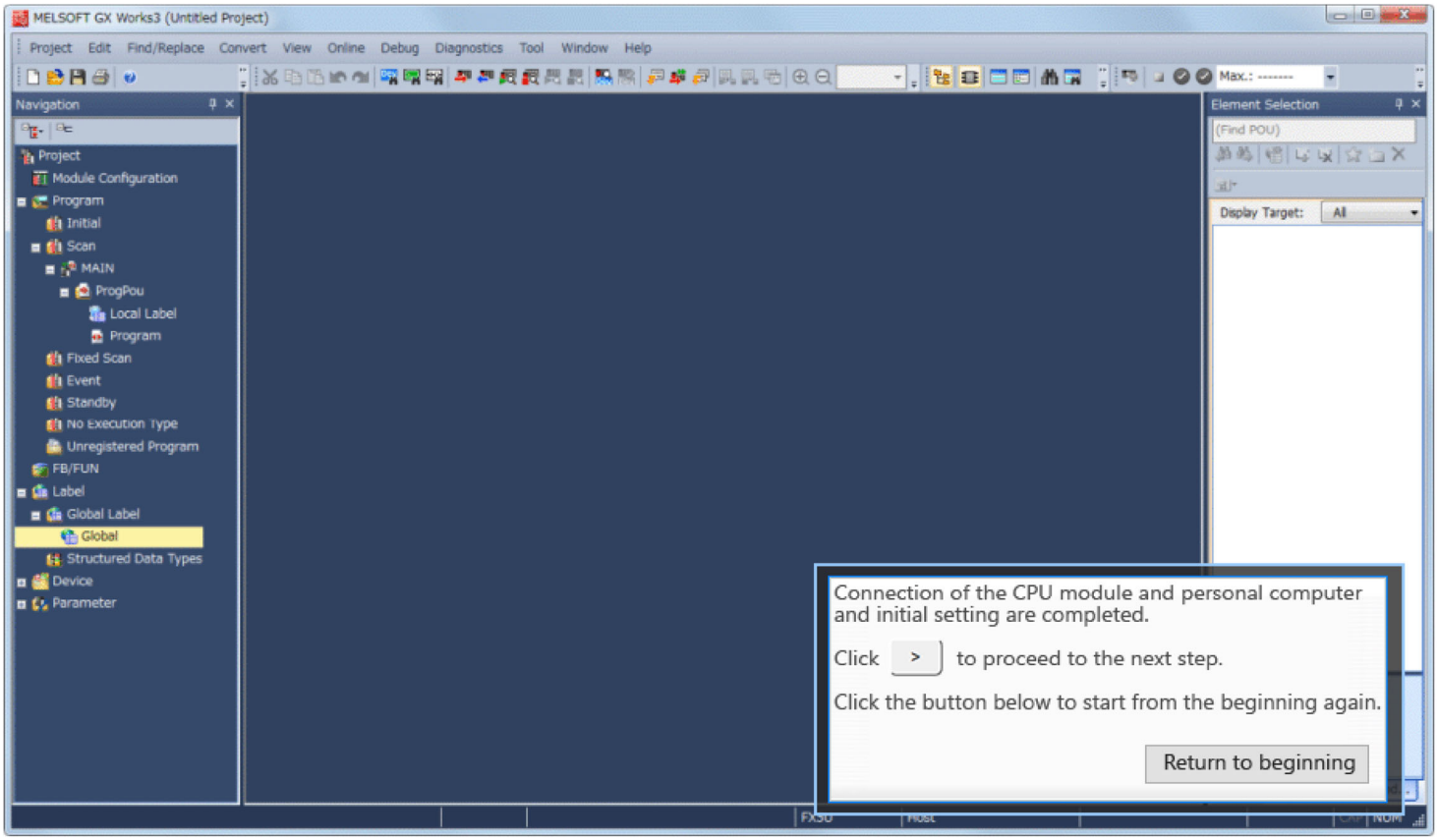
1. Create a sequence program.

2. Write the sequence program.

3. Execute the sequence program written in the CPU module.

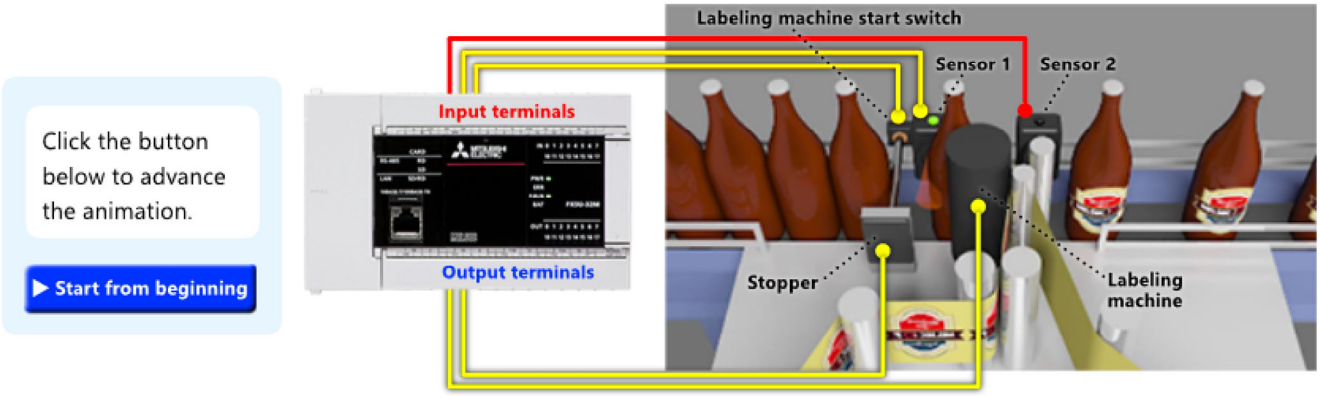
4.2 Connection of CPU module and personal computer

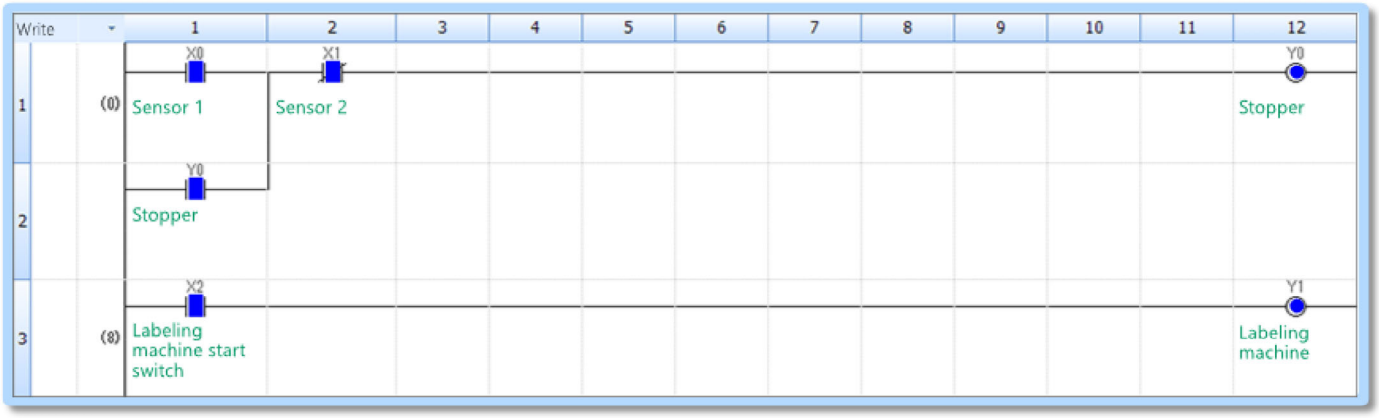
This section explains the procedure to connect the CPU module and personal computer.
It is necessary to perform this connection procedure before writing sequence programs.



4.3 Creation of a sequence program(1)

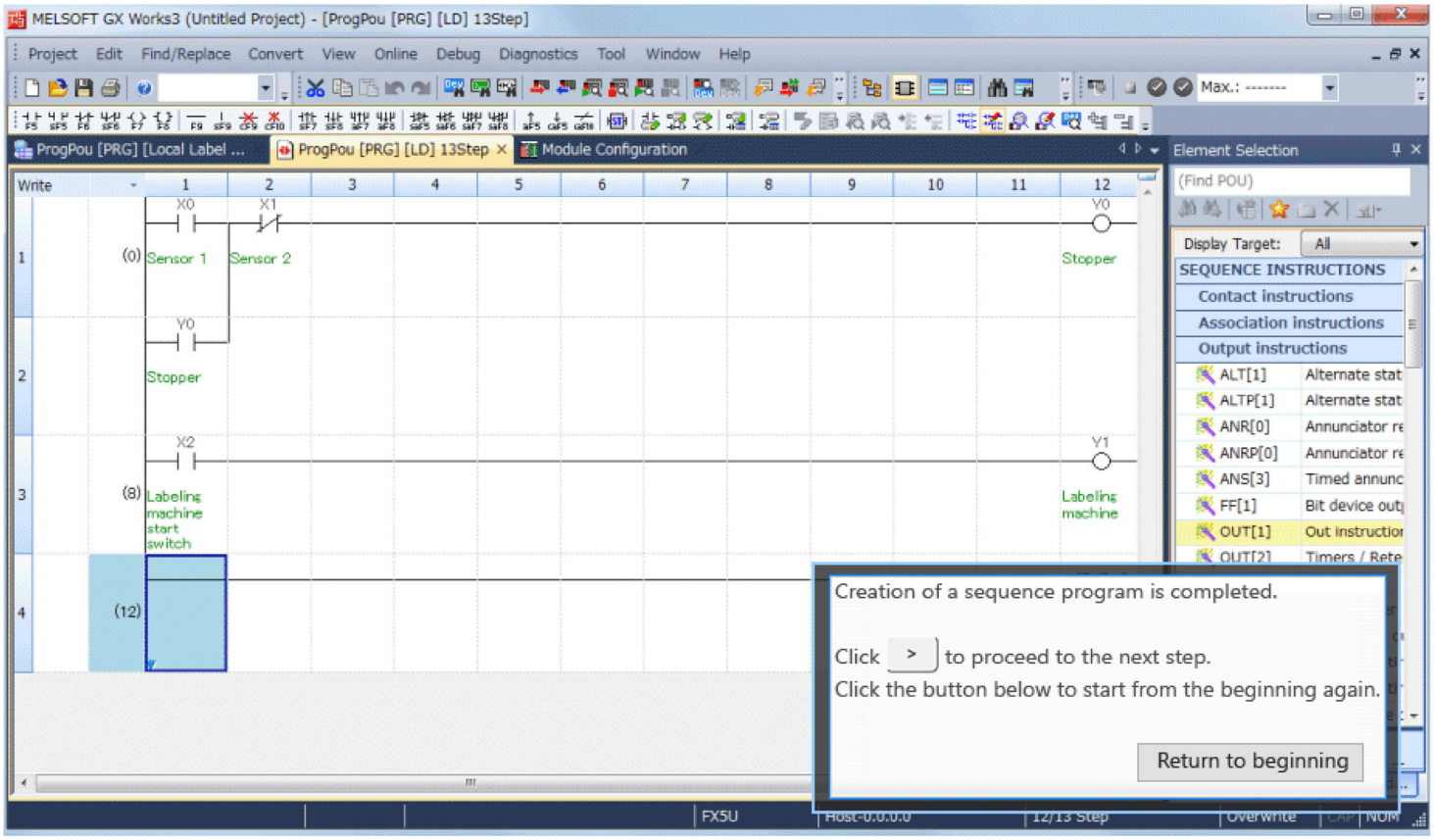
This section explains a sequence program used in the labeling system example.
Confirm the correspondence between the operation of the sequence program and the operation of each equipment in the following animation:





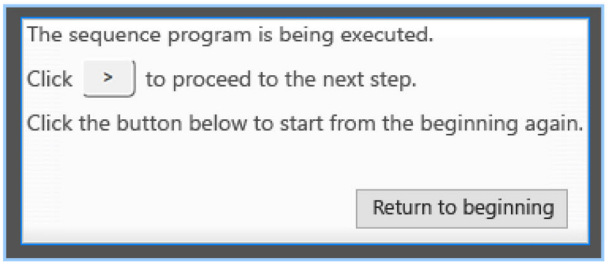
4.3 Creation of a sequence program(2)

This section explains the sequence program creation method.
You can easily create sequence programs mainly using the mouse.



4.4 Writing and execution of a sequence program

For executing a created sequence program, it is necessary to write it to the CPU module first.
This section explains the procedure to write and execute a sequence program.

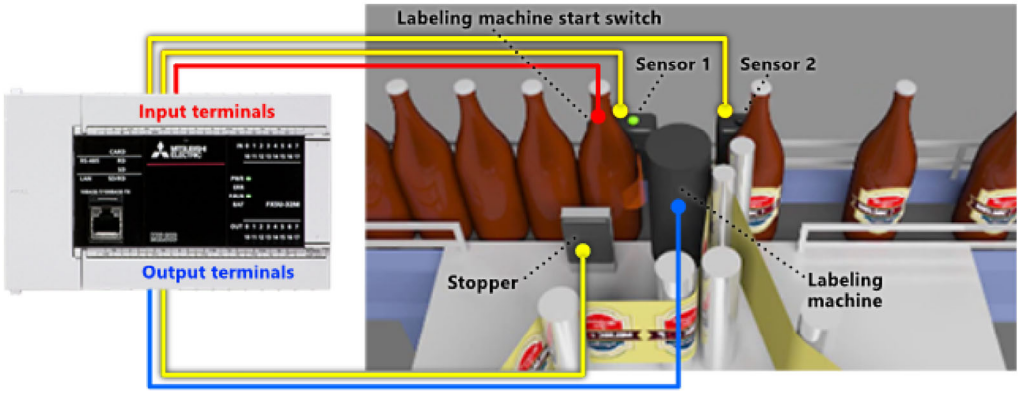


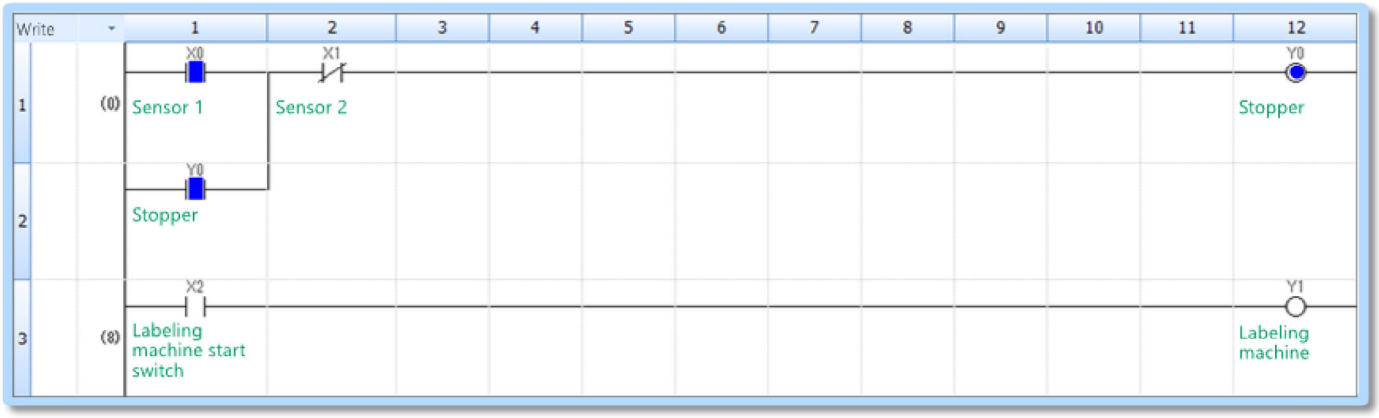
4.5 Operations in labeling system example

The labeling system is completed.
Learning in this course is finished.
Operation of the labeling system example is shown here one more time.

Click the button below to advance the animation.

▶ Start from beginning





4.6 Summary

The table below summarizes the contents you have learned in Chapter 4.

Outline of sequence programs	In this course, you have learned about the basic program creation procedure using the programming language called ladder. •Creating a sequence program •Writing the sequence program to the CPU module •Executing the sequence program written in the CPU module
Connection of CPU module and personal computer	You have learned about the procedure to connect the CPU module and personal computer. •Connecting a personal computer in which the engineering tool GX Works3 is installed and CPU module with the Ethernet connection cable •Starting GX Works3 in the personal computer, setting the connection with the CPU module, and then performing the communication test •Initializing the memory of the CPU module
Creation of a sequence program	You have learned about the sequence program creation method. •Creating a sequence program on the ladder editor screen of GX Works3.
Writing and execution of a sequence program	You have learned about the sequence program writing and execution procedures. •Writing the created sequence program to the CPU module. •Resetting the CPU module, and setting the CPU module to the sequence program execution status by using the [RUN/STOP/RESET] switch
Operations in labeling system example	In the animation, you have confirmed the operations of the labeling system learned and created in this course.

Test Final Test

Now that you have completed all of the lessons of the **MELSEC iQ-F Series Basics** course, you are ready to take the final test. If you are unclear on any of the topics covered, please take this opportunity to review those topics.

There are a total of 7 questions (7 items) in this Final Test.

You can take the final test as many times as you like.

Score results

The number of correct answers, the number of questions, the percentage of correct answers, and the pass/fail result will appear on the score page.

Test **Final Test 1**

Functions built in the MELSEC iQ-F Series
Select connection ports built in the CPU module of the MELSEC iQ-F Series PLCs. (Multiple answers allowed)

Q1

- [x] **Ethernet connection port**
- [x] **RS-485 communication port**
- [ ] **RS-232 communication port**

Test **Final Test 2**

System configuration of the MELSEC iQ-F Series
Select devices to be attached on the right side of the CPU module for addition to or extension of the CPU module of the MELSEC iQ-F Series PLCs.

Q1

- (●) **Extension module**
- ( ) **Function expansion board**
- ( ) **Expansion adaptor**

Test **Final Test 3**

How to read the product model
Select what “32” means in the MELSEC iQ-F Series PLC model “FX5U-32MR/ES”.

Q1

- ○ **Program capacity**
- ○ **Number of input points**
- ○ **Number of output points**
- ◉ **Total number of input and output points**

Test **Final Test 4**

How to read the product model
Select what “M” means in the MELSEC iQ-F Series PLC model “FX5U-32MR/ES”.

Q1

- ○ **Extension module**
- ◉ **CPU module**
- ○ **Expansion board or expansion adapter**
- ○ **Bus conversion module**

Test **Final Test 5**

Grounding
Select proper choices to make correct sentences explaining the grounding method for the MELSEC iQ-F Series PLC system.

Perform independent grounding in which the grounding wire is **(Q1)** in each model.
Perform class D grounding.

Q1	independent
Q2	length
Q3	short

Test **Final Test 6**

Assignment of I/O numbers
Select proper choices to make correct sentences explaining the assignment of I/O numbers while wiring I/O equipment to the MELSEC iQ-F Series PLC.

Numbers in increments of 8 points are assigned to I/O terminals of the CPU module for wiring I/O equipment. These numbers called “I/O numbers” are provided so that the CPU module can recognize signals sent from I/O

Q1 octal notation

Q2 X

Q3 Y

Test **Final Test 7**

Creation and execution of a sequence program
Select the correct sequence of procedures A to D required before execution of a sequence program in the MELSEC iQ-F Series PLC.

Procedure A: Writing a created sequence program to the CPU module
Procedure B: Connecting the personal computer and CPU module with the Ethernet connection cable

Q1

- A→B→C→D
- **B→C→A→D**
- B→D→A→C

Test | **Test Score**

You have completed the Final Test. You results area as follows.
To end the Final Test, proceed to the next page.

		1	2	3	4	5	6	7	8	9	10
	Final Test 1	✓									
	Final Test 2	✓									
	Final Test 3	✓									
	Final Test 4	✓									
	Final Test 5	✓	✓	✓							
	Final Test 6	✓	✓	✓							
	Final Test 7	✓									

Total questions: **11**

Correct answers: **11**

Percentage: **100** %

Clear

You have completed the MELSEC iQ-F Series Basics course.

Thank you for taking this course.

We hope you enjoyed the lessons and the information you acquired in this course will be useful in the future.

You can review the course as many times as you want.

Review

Close