

# ***FATEC***

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## **Mitsubishi Programmable Controller Training Manual MELSEC iQ-F Series Basic Course (for GX Works3)**

## ● Safety Precautions ●

**(Be sure to read this before the training.)**

Before designing a system, be sure to read this manual and pay close attention to safety.

During the training, pay attention to the following points to ensure correct handling.

### **[Precautions for Training]**

#### **WARNING**

- To prevent electric shock, do not touch the terminals while they are powered ON.
- Before removing safety covers, either turn the power supply OFF or confirm safety.
- Do not put your hand into moving parts.

#### **CAUTION**

- Proceed with the training under the guidance of a teacher.
- Connect the power plug with grounding terminal to the 3-pole socket.  
When using a 3-pole to 2-pole Conversion adapter, connect the grounding wire on the Conversion adapter to the grounding terminal on the socket.
- Do not remove the training machine module or change the wiring without permission. Doing so may result in malfunction, misoperation, injury or fire.
- Before attaching or detaching the module, turn the power OFF.  
Attaching or detaching the module while it is still ON may cause the module to malfunction or cause an electric shock.
- If unusual odor or abnormal noise is detected with the training machine immediately turn the power switch to OFF.
- If an abnormal event occurs, immediately contact your teacher.

# INTRODUCTION

This manual covers general information on the basics to the application of the MELSEC iQ-F Series.

The contents include explanations on the PLC, and explanations on the instructions with examples.

The PLC is explained based on the FX5U.

Persons who do not have a basic understanding of the PLC should prepare by reading the "Your First PLC Introduction" FX-NYUM-TEXT textbook.

## **The following related materials are available.**

- |   |               |
|---|---------------|
| (1) Your First PLC Introduction .....   | JY997D22101   |
| (2) MELSEC iQ-F FX5 User's Manual (Startup).....  | JY997D58201   |
| (3) MELSEC iQ-F FX5U User's Manual (Hardware) .....   | JY997D55301   |
| (4) MELSEC iQ-F FX5 User's Manual (Application).....  | JY997D55401   |
| (5) MELSEC iQ-F FX5 Programming Manual (Program Design).....                                      | JY997D55701   |
| (6) MELSEC iQ-F FX5 Programming Manual<br>(Instructions, Standard Functions/Function Blocks)..... | JY997D55801   |
| (7) MELSEC iQ-F FX5 User's Manual (Analog Control).....   | JY997D60501   |
| (8) GX Works3 Operation Manual .....  | SH-081215ENG  |
| (9) MELSEC iQ-F Series iQ Platform-compatible PLC.....  | L(NA)08428ENG |

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## Chapter 1

# INTRODUCTION

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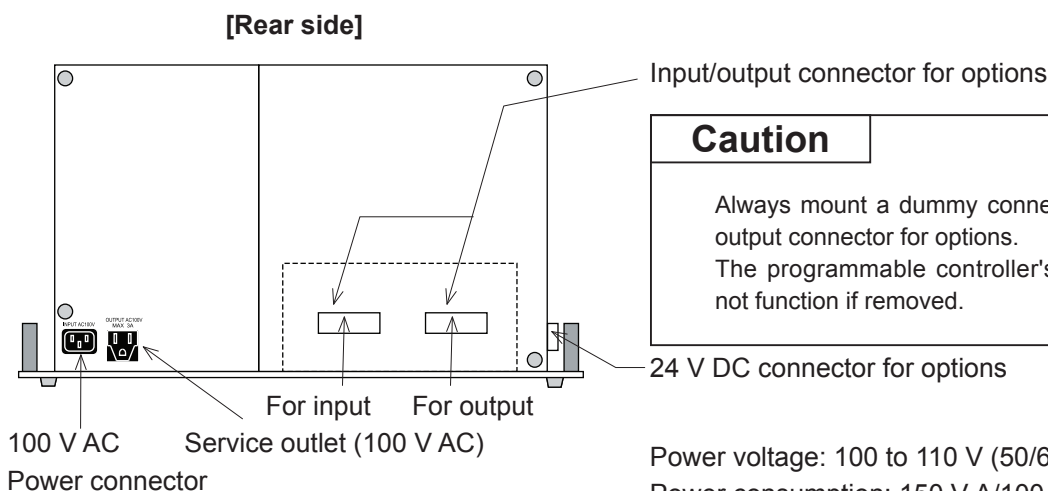
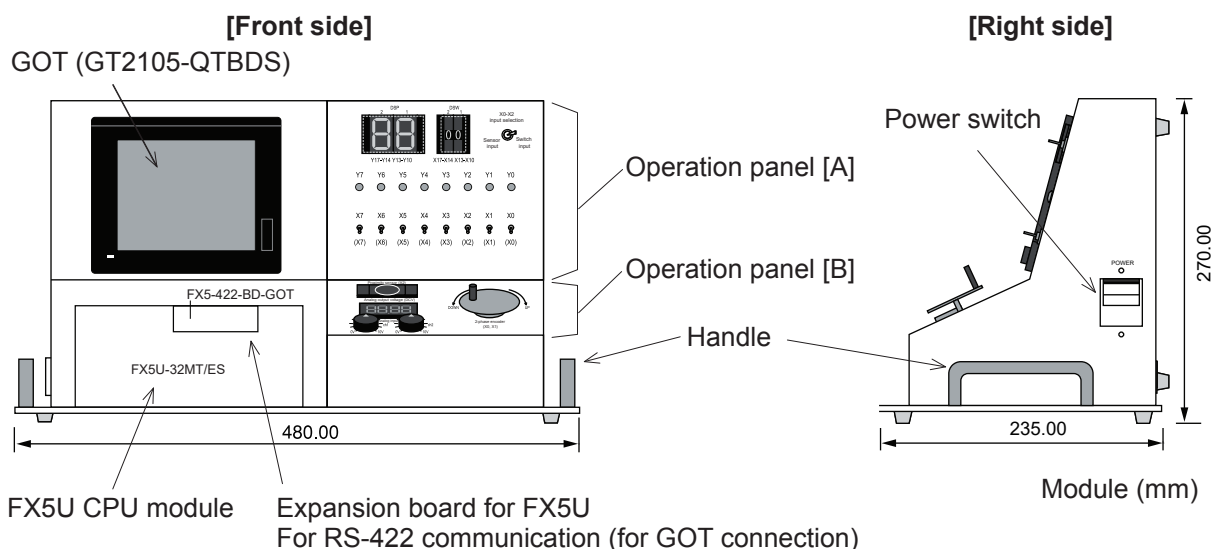
Let's understand the configuration of the training machine you will use!

The key to creating sequence programs is to first understand what equipment is connected to each input or output terminal of the PLC.

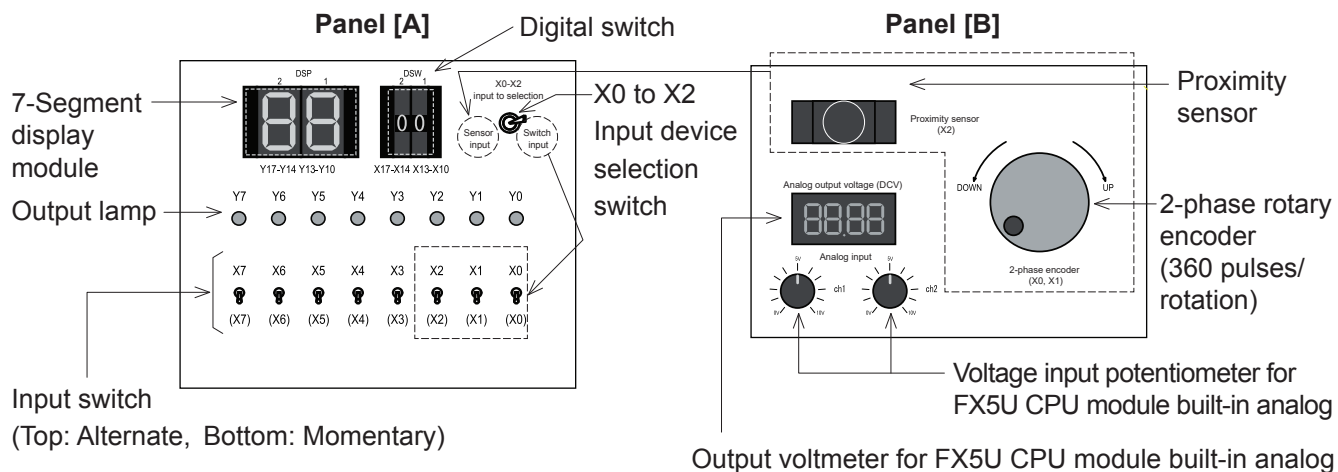
In this chapter, the configuration of the training machine will be described.

# 1.1 Configuration of the Training Machine (FX5U-32MT-SIM)

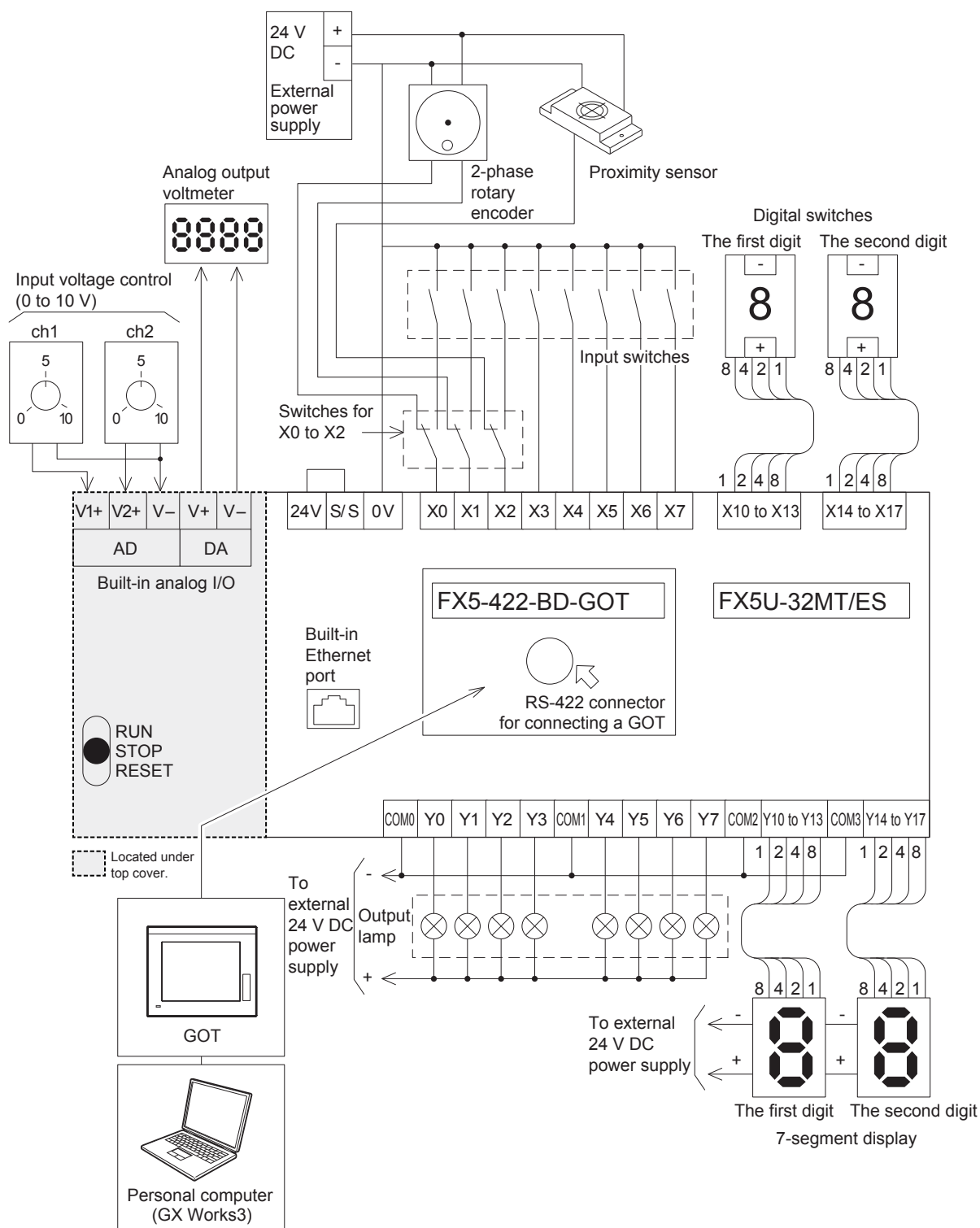
## 1.1.1 Appearance and Operation Panel



Power voltage: 100 to 110 V (50/60 Hz)  
Power consumption: 150 V A/100 V AC  
Rush current: maximum 40 A 7.3 ms/100 V AC  
Exterior color: Munsell 0.08GY/7.64/0.81  
Weight: approx. 10 kg



## 1.1.2 External I/O Assignment and Wiring



### <<Note>> Handling the S/S terminal

- When the S/S terminal and 24 V terminal are connected, the sink input is activated.
- When the S/S terminal and 0 V terminal are connected, the source input is activated.



# MEMO

## Chapter 2

### GUIDING COURSE: DO YOU REMEMBER?

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#### The Definition of a PLC...

A Programmable Controller (PLC) is also referred to as a Programmable Controller or Sequence Controller.

A PLC is defined as "an electronic device which controls many types of systems through its I/O ports and incorporates a memory to store programmable instructions."

#### Actual Usages...

PLCs are broadly used as core components for FA (Factory Automation) and as electronic application products essential for saving labor costs and improving automation.

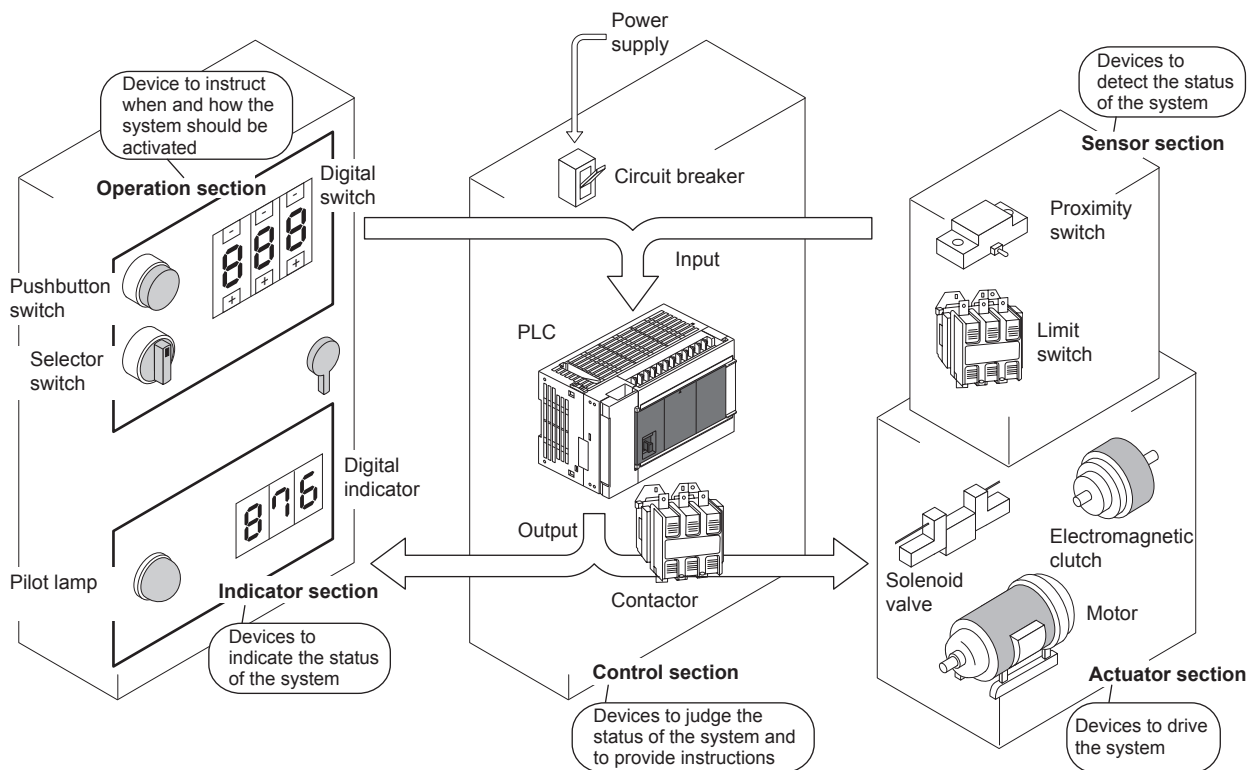
PLCs can be used for many types of applications such as systematic applications which control the entire factory, standalone types that control various dispersed machines independently, and PLCs for non-FA applications such as for leisure devices.

#### In this chapter...

The functions, construction, and features of PLCs, mainly in regard to small standalone PLCs, are described in a summarized manner.

## 2.1 PLC - Small, reliable, flexible brain

An automation solution for the machining, assembly, transfer, inspection, and packaging of a workpiece



The PLC is activated by **command inputs** such as inputs from pushbutton switches, selector switches and digital switches located at the operating panel, and by **sensor inputs**, such as inputs from limit switches, proximity switches and photoelectric switches, which detect the status of the system, in order to control **drive loads** such as solenoid valves, motors and electromagnetic clutches, and **indication loads** such as pilot lamps and digital indicators.

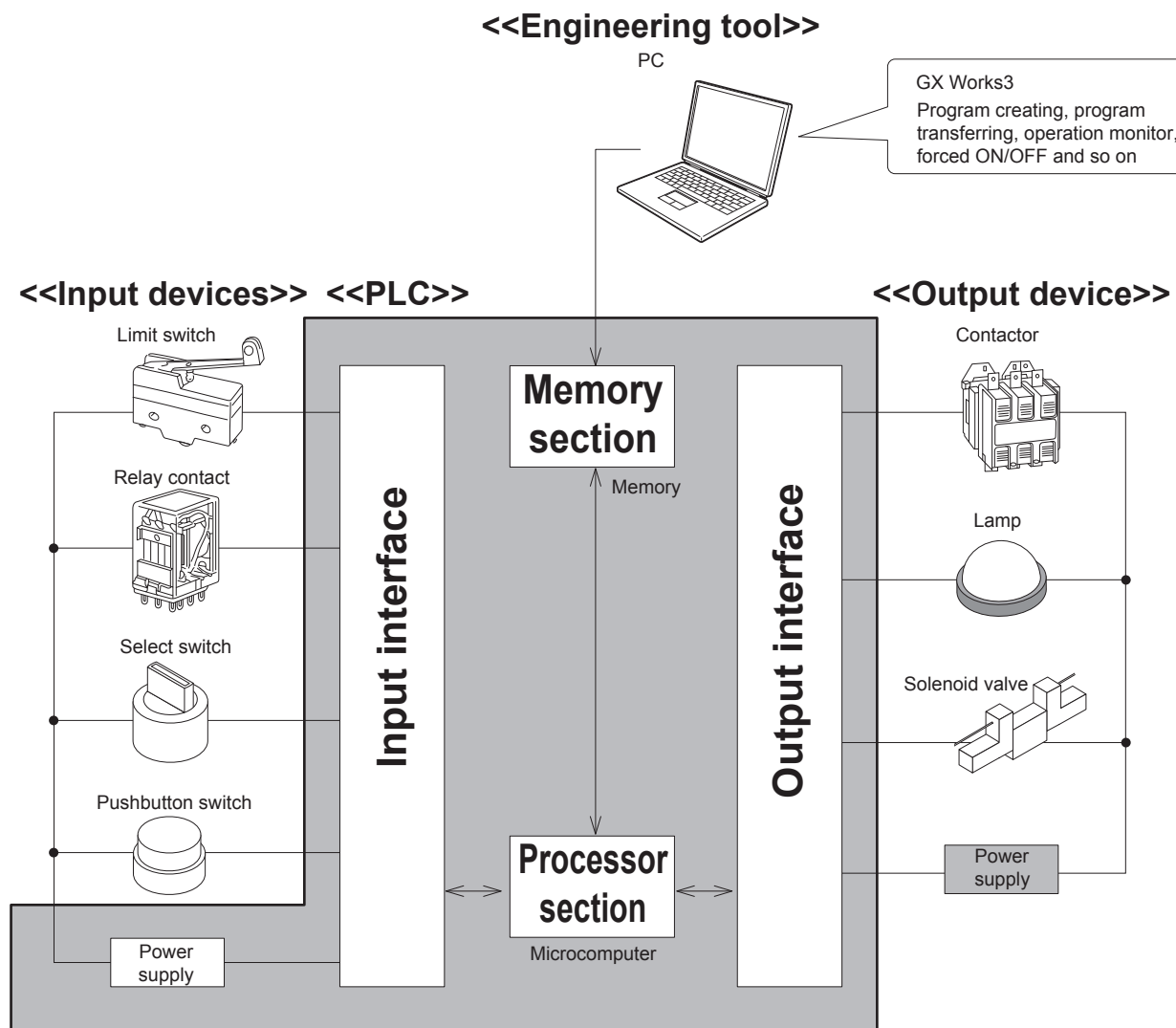
**The behaviors of output signals corresponding to the input signals are determined by the contents of programs provided to the PLC.**

Light loads such as small solenoid valves and pilot lamps can be directly driven by a PLC, but loads such as 3-phase motors and large solenoid valves must be driven through contactors and intermediate relays.

As well as PLCs, contactors, intermediate relays and circuit breakers for the power supply are installed in the control box.

## 2.2 Mechanism of PLC

### 2.2.1 The PLC is a microcomputer for industrial purposes.



A PLC incorporates an electrical circuit mainly comprised of a microcomputer and memory. Input/output interfaces exist between input/output devices and the electronic circuit to connect them. The engineering tool is used to write a program to the memory in the PLC.

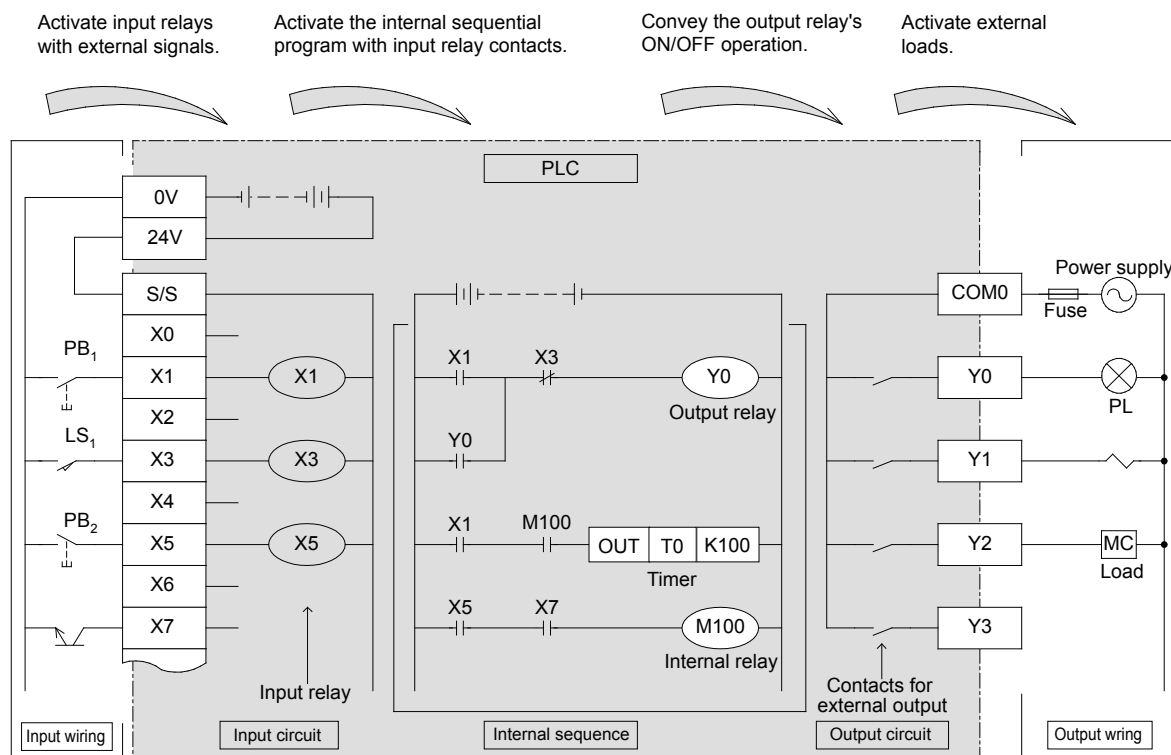
#### Reference

#### Is the term "sequencer" coined by Mitsubishi Electric?

In Japan, the term "sequencer" is widely used. While Japan Electrical Manufacturer's Association (JEMA) officially names them Programmable Logic Controller (PLC), the name "sequencer" seems easier to pronounce and more widely known.

Though there is evidence that the term "sequencer" was used before PLCs were invented, it is a fact that Mitsubishi Electric made it popular by releasing K and F series PLCs with the name of "sequencer."

## 2.2.2 The PLC can be, in effect, considered as an aggregate of relays and timers.



The PLC is an electronic device mainly comprised of a microcomputer.

**However in effect...**

The user does not need any knowledge of a microcomputer to operate a PLC and it can be regarded as an aggregate of relays, timers, and counters.

### Internal operation of PLC

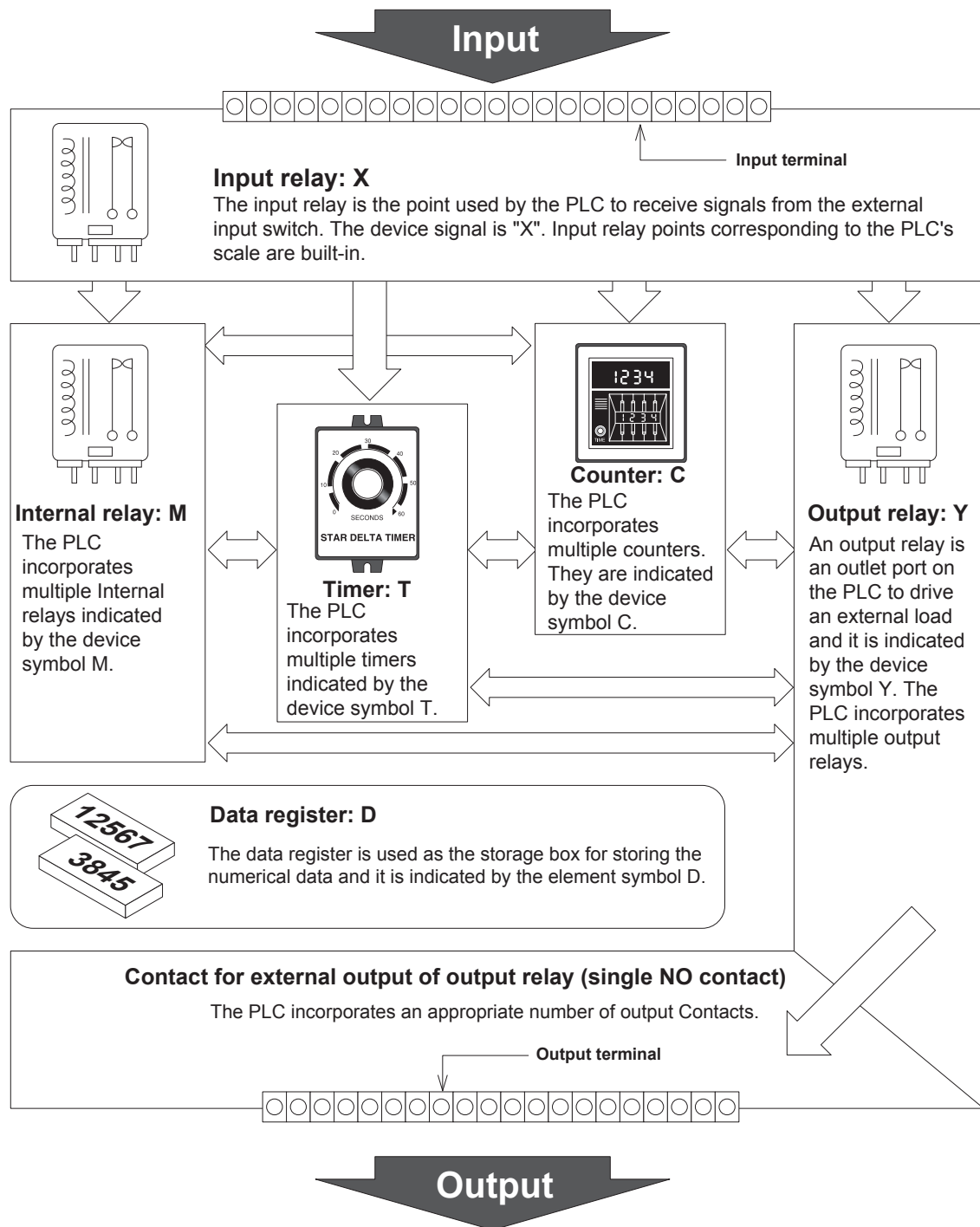
#### Signal Flow of PLC

- When the pushbutton switch PB1 is pushed, the coil of the input relay X1 is energized.
- When the coil of the input relay X1 is energized, the NO contact of X1 is closed and the coil of the output relay Y0 is energized.
- When the coil of the output relay Y0 is energized, the NO contact of Y0 is closed, then the pilot lamp PL is illuminated.
- When the pushbutton switch PB1 is released, the coil of the input relay X1 is de-energized and the NO contact of X1 is opened.  
But the output relay Y0 is still energized since the NO contact is closed. (Self-maintaining action)
- When the input relay X3 is energized by closing the limit switch LS1, the NC contact of X3 is opened, then the coil of the output relay Y0 is de-energized (Reset). As a result, the pilot lamp PL turns off and the self-maintaining action of the output relay Y0 is cleared.

## 2.2.3 Types of relay and timers

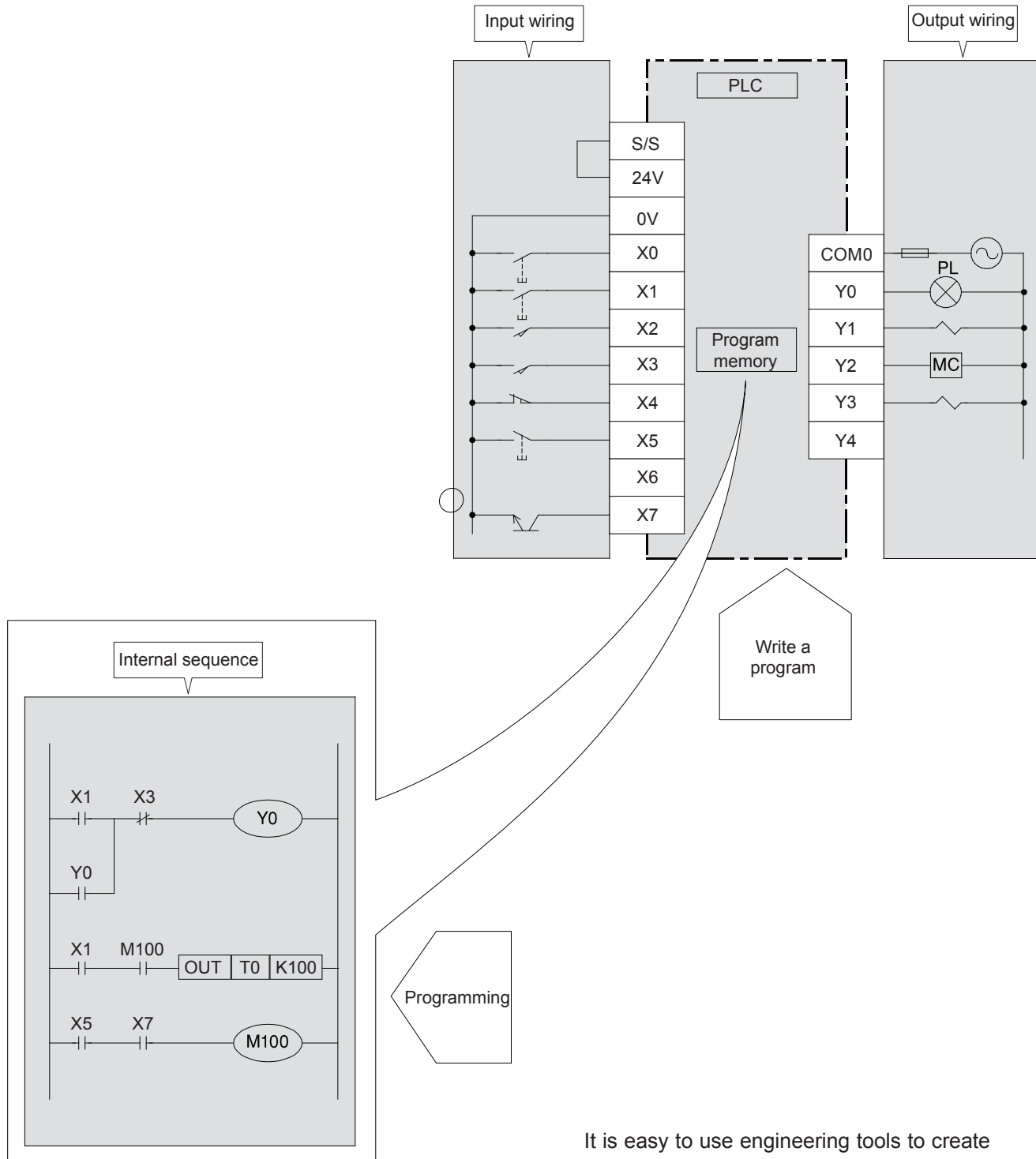
As shown below, a PLC incorporates multiple relays, timers and counters with countless NO and NC contacts. A sequential circuit is formed by connecting the contacts and coils.

The PLC, which is a microcomputer application device, features multiple value data storage boxes called "data registers".



## 2.3 Wiring and instructions

Perform the wiring work for input and output devices.



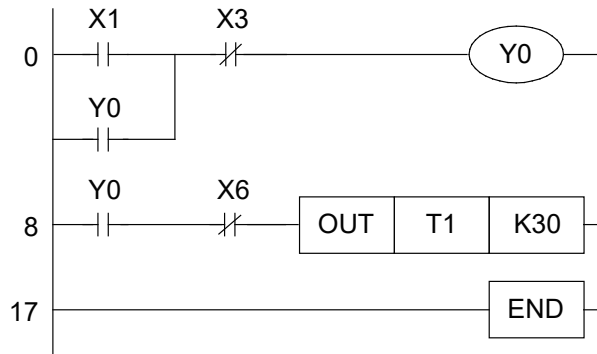
It is easy to use engineering tools to create the internal sequence program, which is equivalent to internal PLC wiring.

## 2.4 Instruction and programs

### 2.4.1 Mechanism of programs

The internal sequence for the sequence control is created as a sequence program in the format of circuit diagram (ladder diagram) and instruction list.

**Circuit diagram (ladder diagram)**



**Instruction list (program list)**

| Step number | Instruction      |                           |
|-------------|------------------|---------------------------|
|             | Instruction code | Device (number) (operand) |
| 0           | LD               | X1                        |
| 2           | OR               | Y0                        |
| 4           | ANI              | X3                        |
| 6           | OUT              | Y0                        |
| 8           | LD               | Y0                        |
| 10          | ANI              | X6                        |
| 12          | OUT              | T1 K30                    |
| 17          | END              |                           |

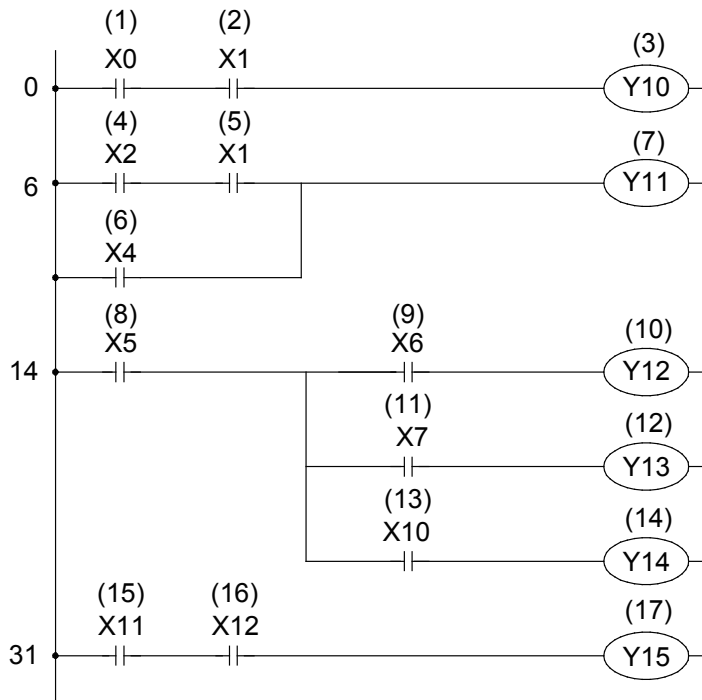


- A program is comprised of multiple instruction codes and device numbers (operands). These instructions are numbered in turn. This number is referred to as **the step number**. (Step numbers are automatically controlled.)
- Each "**instruction**" is comprised of "**instruction code + device**". However, there are some instructions without devices. Also in some cases, instruction codes are just referred to as instructions.
- The max steps that can be programmed depend on the "program memory capacity" of the PLC that is used. This is called the **PLC program capacity**. There is a program memory with the capacity of "64000" steps in the FX5U CPU module.
- The PLC repeatedly performs instructions from step 0 to the END instruction. This operation is referred to as **cyclic operation**, and the time required to perform one cycle is referred to as **the operation cycle (scan time)**. The operation cycle will change according to the contents of the programs and the actual operating orders, ranging from several msec to several tens of msec.



## 2.4.2 The processing order of the program

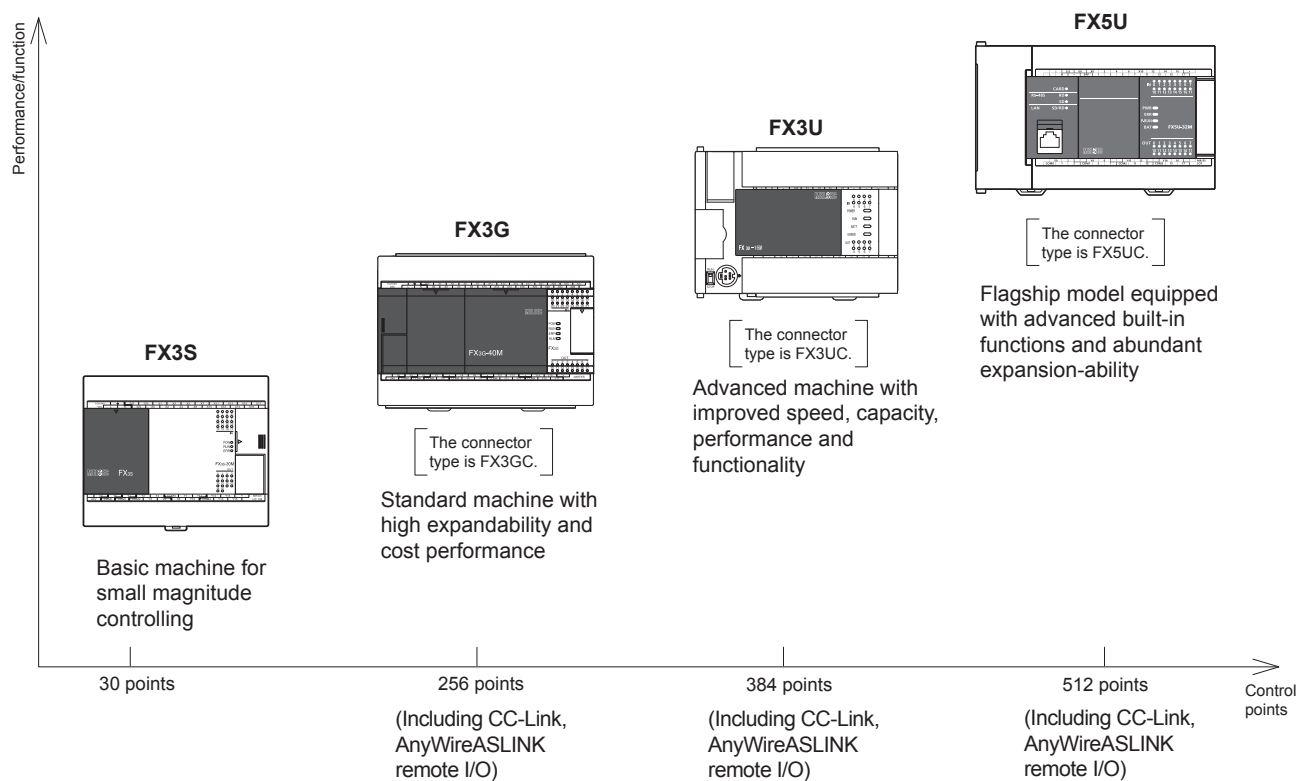
The program processes sequentially from the first step to the end of the program memory in block modules with the order from left to right, up to down. (in order of (1), (2), .....(17) )



# 2.5 The configuration of a micro PLC

## 2.5.1 Brief introduction of the CPU module

A micro PLC is a standalone module that can be easily used as a PC, so it has a series of advantages such as high speed, high performance and good expandability.



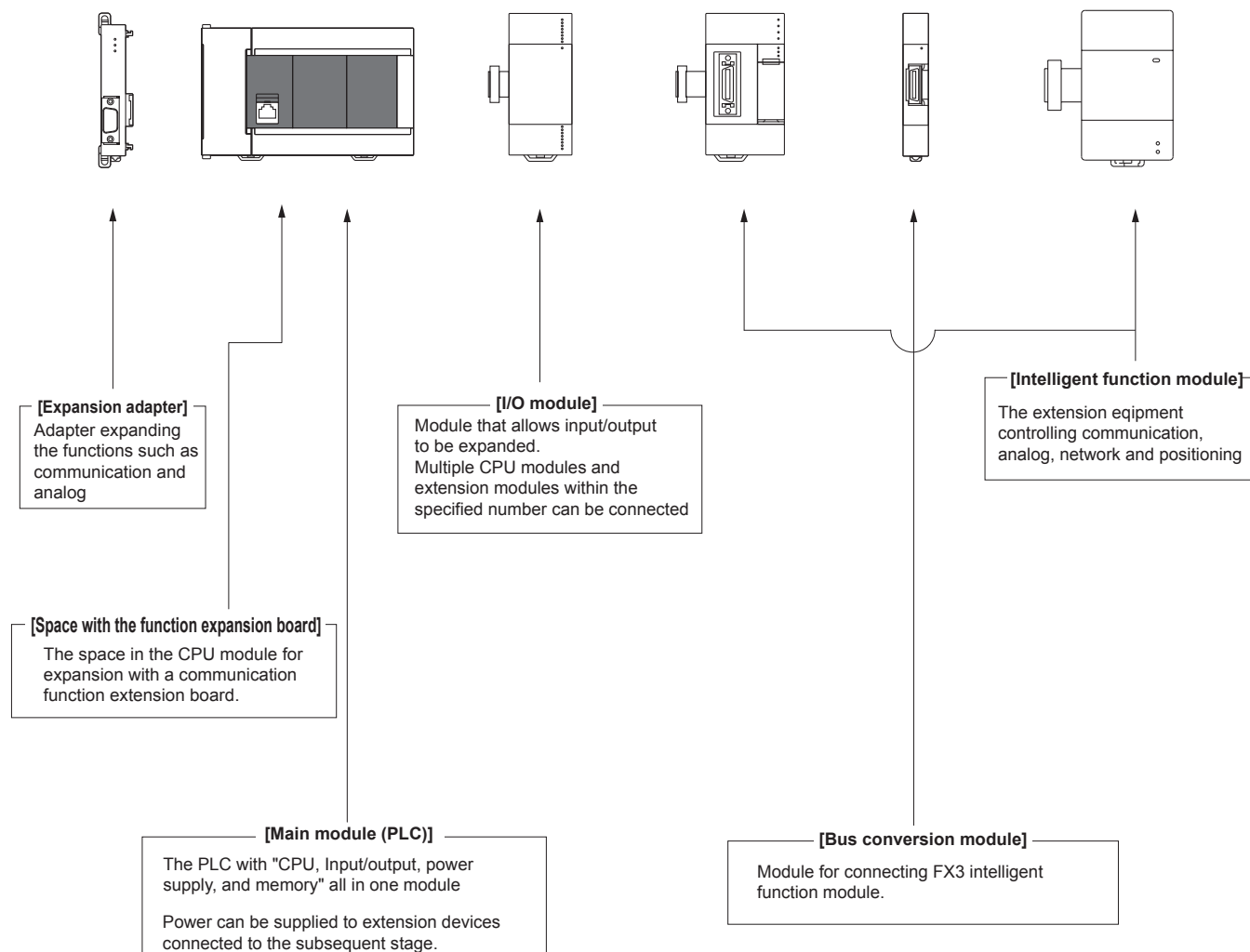
### Function list (provided on the screw terminal type PLC)

✓: Available —: Unavailable

| Function  | Terminal block type     |                         |       |       |
|---|-------------------------|-------------------------|-------|-------|
|   | FX3S                    | FX3G                    | FX3U  | FX5U  |
| Memory capacity (step)  | 16000                   | 32000                   | 64000 | 64000 |
| Input/output extension  | —                       | ✓                       | ✓     | ✓     |
| Intelligent function module connection                              | —                       | ✓                       | ✓     | ✓     |
| Extension board installation  | ✓                       | ✓                       | ✓     | ✓     |
| Special adapter   | ✓                       | ✓                       | ✓     | ✓     |
| Display module installation   | ✓                       | ✓                       | ✓     | —     |
| Built-in high speed counter function                                | ✓                       | ✓                       | ✓     | ✓     |
| High speed processing by input interrupt/pulse catch function       | ✓                       | ✓                       | ✓     | ✓     |
| High speed processing by timer interrupt/counter interrupt function | Timer interrupt enabled | Timer interrupt enabled | ✓     | ✓     |
| Built-in real time clock (clock function)                           | ✓                       | ✓                       | ✓     | ✓     |
| Built-in analog volume  | ✓                       | ✓                       | —     | —     |
| Built-in 24 V DC service power supply                               | ✓                       | ✓                       | ✓     | ✓     |
| Constant scan function  | ✓                       | ✓                       | ✓     | ✓     |
| Input filter adjustment function                                    | ✓                       | ✓                       | ✓     | ✓     |
| Comment registration function                                       | ✓                       | ✓                       | ✓     | ✓     |
| Function modifying the program during RUN                           | ✓                       | ✓                       | ✓     | ✓     |
| Built-in RUN/STOP switch  | ✓                       | ✓                       | ✓     | ✓     |
| Function protecting the program by keywords                         | ✓                       | ✓                       | ✓     | ✓     |
| Built-in Ethernet function  | —                       | —                       | —     | ✓     |

## 2.5.2 The basic configuration of the system





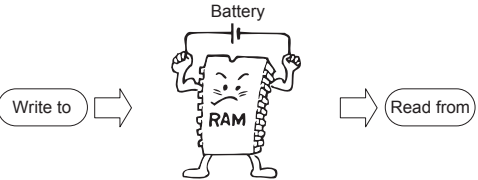

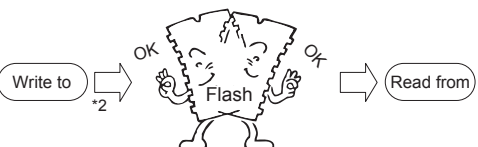
The configuration of a micro PLC will be described by taking an example using the FX5U CPU module.



The types and the number of the equipments that can be connected depend on the series and the model name of the CPU module.

## 2.5.3 The types and advantages of the program memory

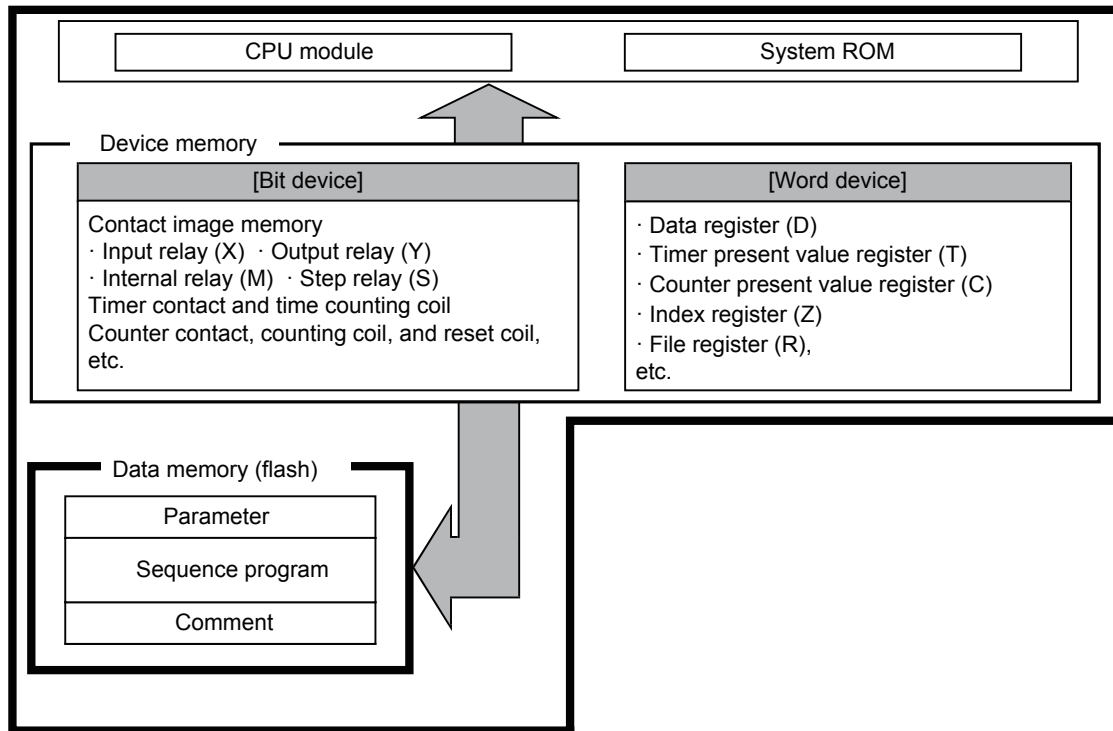
The following table lists the types of built-in program memories for micro PLCs.

| Series   | Built-in memory |                 |                    | Advantage  |
|--|-----------------|-----------------|--------------------|--|
|  | Type            | Memory capacity | Backup method      |  |
| <br><b>FX3S</b><br><br><br><b>FX3G/FX3GC</b> | EEPROM memory   | 16000 steps     | Backup unnecessary | <p>It is easy to write to/read from the memory, and battery backup is not required.</p>  <p>*1: The memory can be written up to 20000 times.</p>   |
|  |                 | 32000 steps     |                    |  |
| <br><b>FX3U/FX3UC</b>   | RAM memory      | 64000 steps     | Battery backup     | <p>It is easy to write/read at high speed. The content in the memory is stored by using the backup battery.</p>  <p>There are optional memories (EEPROM/FLASH) which do not require battery backup. However, it is necessary to use the battery if the latch memory and clock function are used.</p> |
| <br><b>FX5U/FX5UC</b>   | FLASH memory    | 64000 steps     | Backup unnecessary | <p>It is easy to write to/read from the memory, and battery backup is not required.</p>  <p>*2: The memory can be written up to 20000 times.</p>   |

## Reference

### PLC's Memory Structure (FX5U CPU module)

FX5U CPU module is supplied with flash memory.

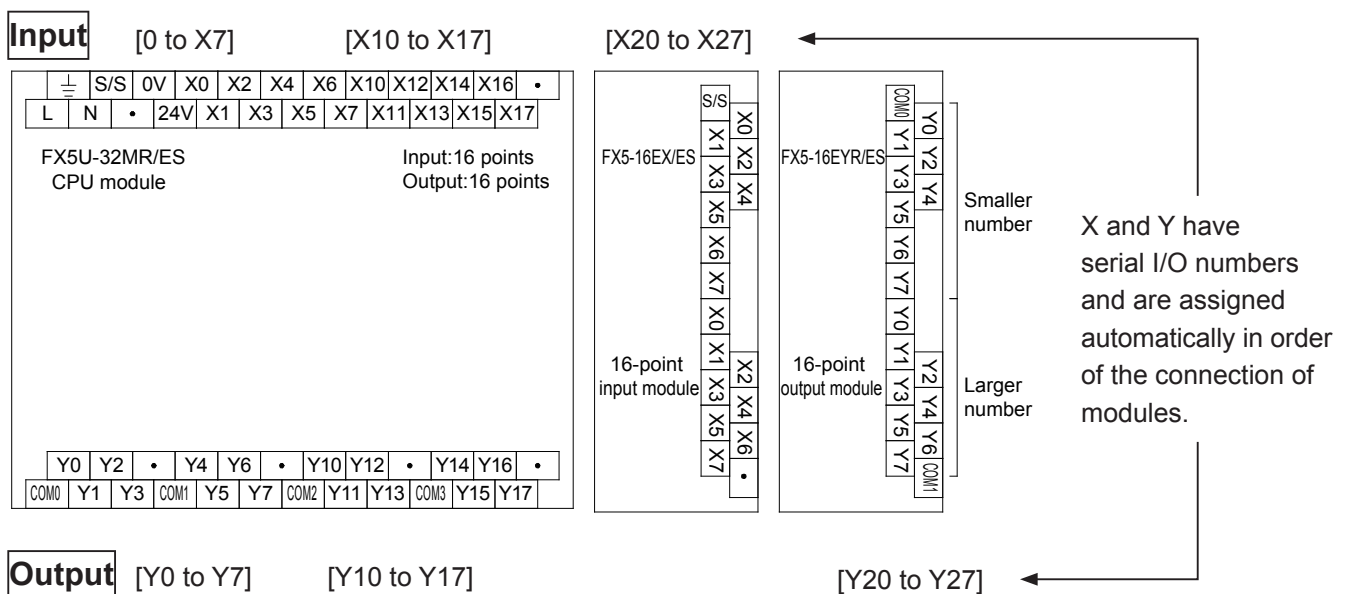


## 2.5.4 Micro PLC I/O number assignment

Each CPU module has I/O numbers assigned by an octal number system such as X0 to X7, X10 to X17, Y0 to Y7, Y10 to Y17 and so forth.

The I/O module is assigned a serial No. that follows the CPU module.

### [System configuration example and I/O numbers]



- I/O numbers of expansion modules are assigned with subsequent numbers to those of the CPU module with the I/O more adjacent to the CPU module having lower numbers.  
It is not necessary to set the parameters by using engineering tools.

# MEMO

## Chapter 3

# THE OPERATION OF GX Works3

---

### Using a personal computer, programming becomes easy...

GX Works3<sup>\*1</sup> software provides an efficient and easy way to create and edit sequence programs for PLCs.

Once the basic operations are mastered, programming often involves straightforward repetition.

This is software with many easy-to-use functions, but the required operations should be mastered in order first.

<sup>\*1</sup>: GX Works3 is an engineering tool for setting, programming, debugging, and maintenance of projects for the programmable controllers including the MELSEC iQ-F series on a personal computer.

### Smoothly begin new projects and update them with ease...

Programs require debugging.

The operation status of the PLC and program can be monitored with the personal computer screen, so if some parts are not working as planned, changes and updates can be conducted at once.

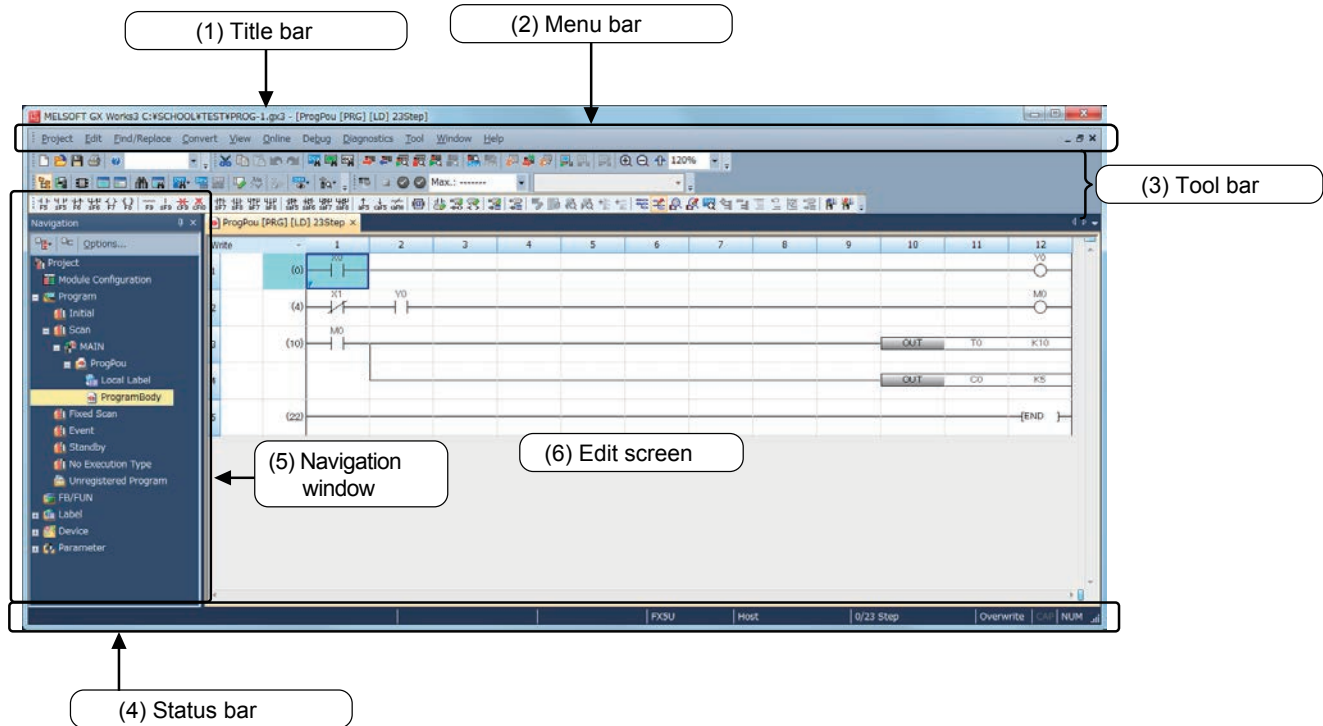
### Make the program easy to read...

There is a "comment input function" in GX Works3 to make sequence programs easier to read.

Comments can improve the efficiency of creating and debugging ladder programs.

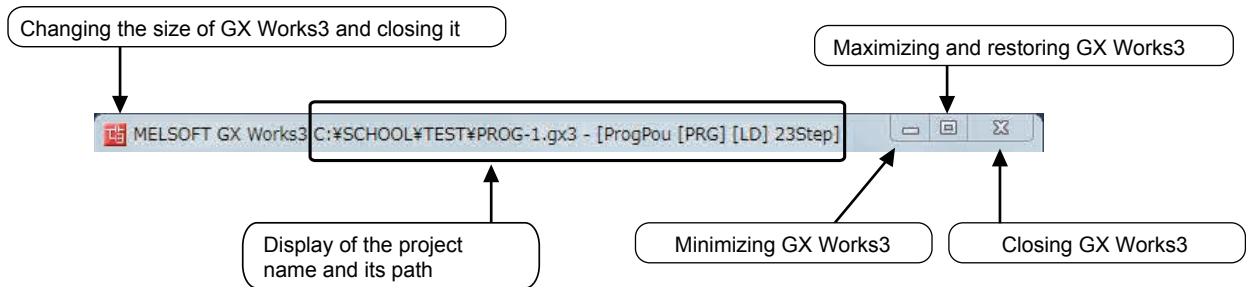


# 3.1 The layout of the GX Works3 screen

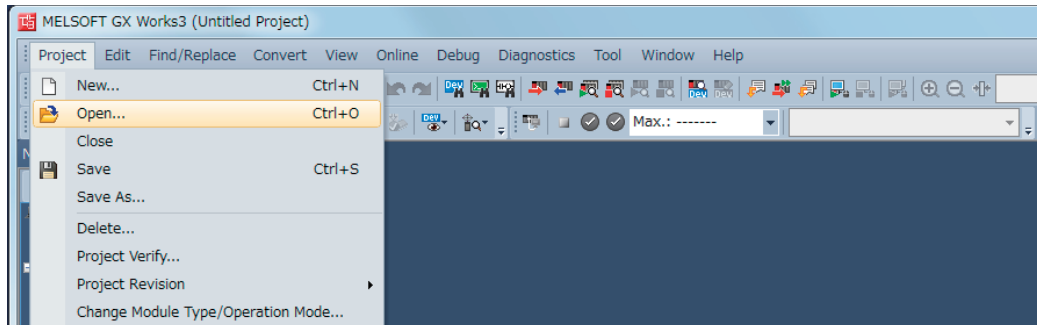


## (1) Title bar

The name of the opened project and the window operation icons are displayed.



## (2) Menu bar



Drop down menu items are displayed when a menu is selected.

## (3) Tool bar



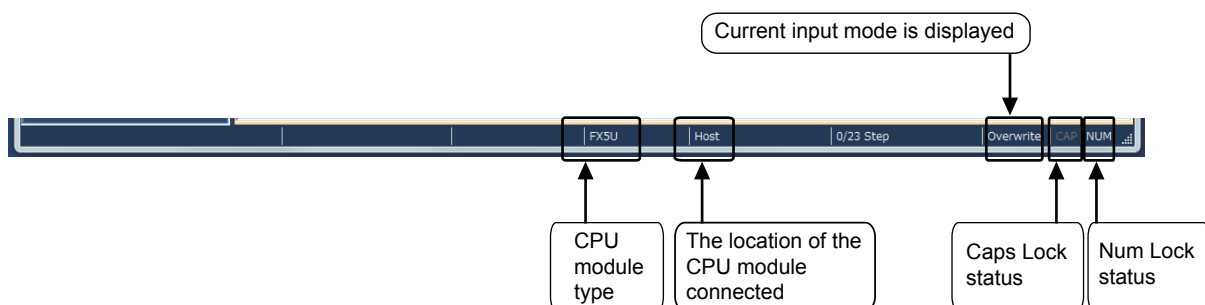
A description of the function is displayed when the mouse cursor stops over each button.

\* : The contents of the tool bar can be moved, added, and removed. Therefore, the displayed items and layout depend on saved environments.

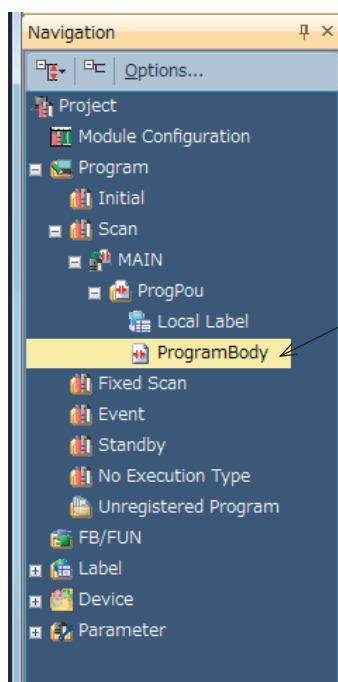
Frequently used functions are displayed with icon buttons. Compared to selecting from the menu bar, desired functions can be directly executed.

## (4) Status bar

The status of the operation and keyboard settings are displayed.

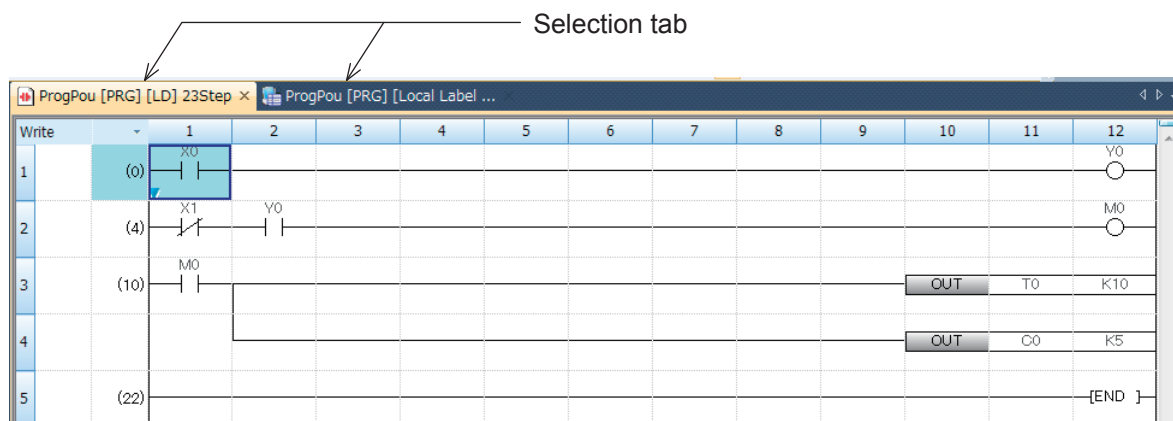


## (5) Navigation window



Double-click [Program] → [Scan] → [MAIN] → [ProgPou] → [Program Body] on the navigation window. The sequence circuit diagram will appear.

## (6) Edit screen

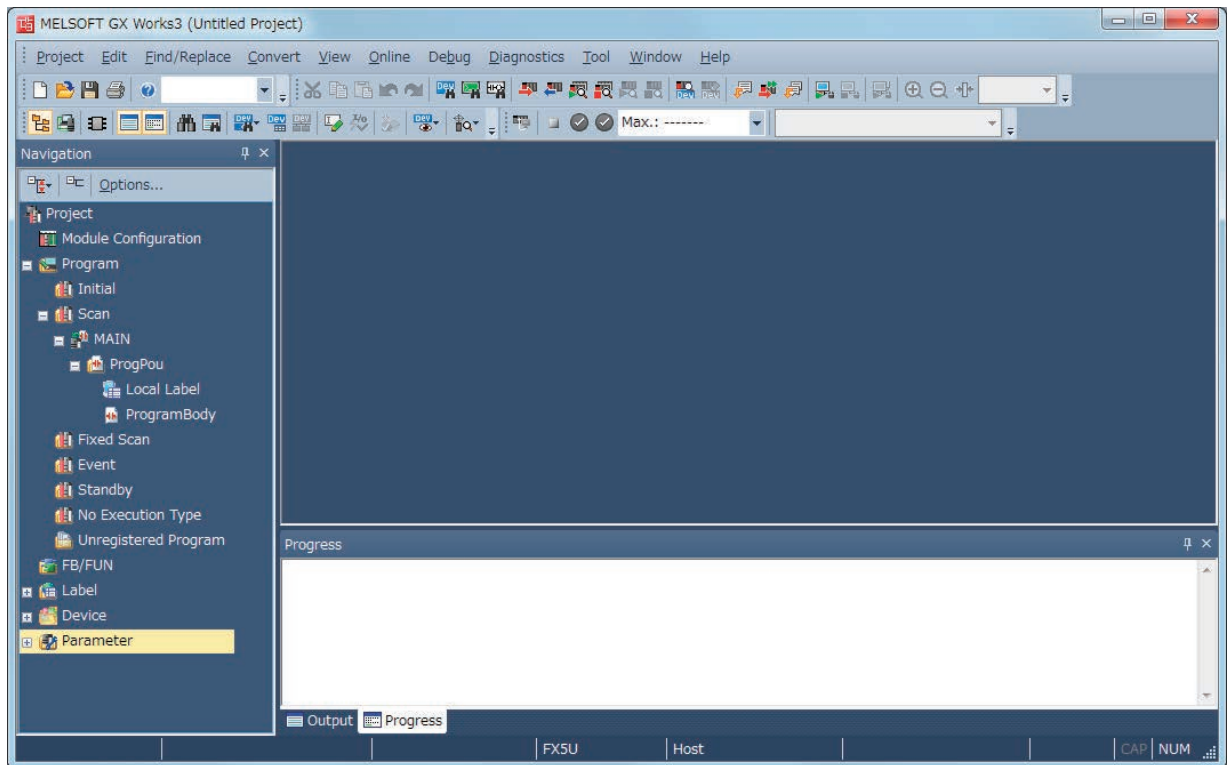


## 3.2 Starting GX Works3 and creating a new project

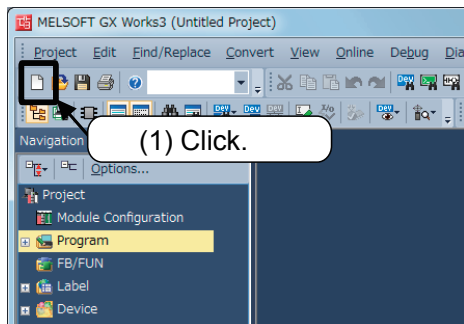
### 3.2.1 Starting GX Works3


Select [MELSOFT] → [GX Works3] → [GX Works3] from the Windows® Start menu\*1.

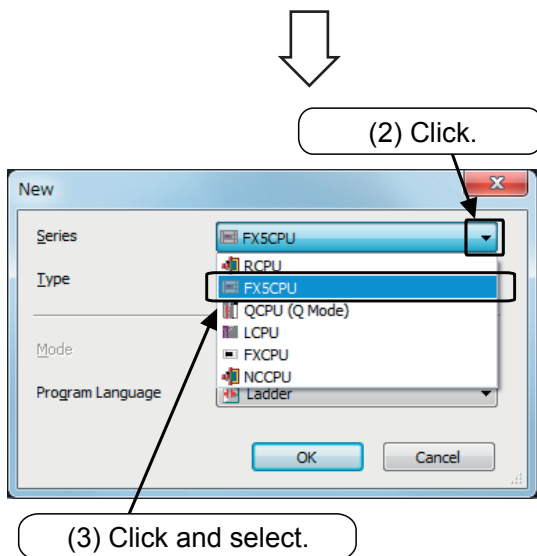
\*1: Select [Start] → [All apps] or [Start] → [All Programs].



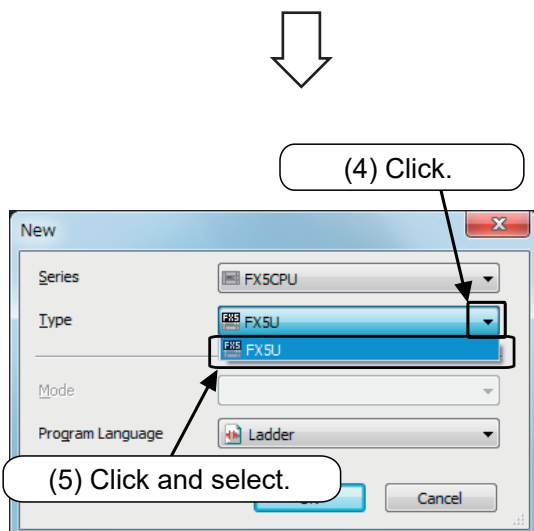
## 3.2.2 Creating a new project



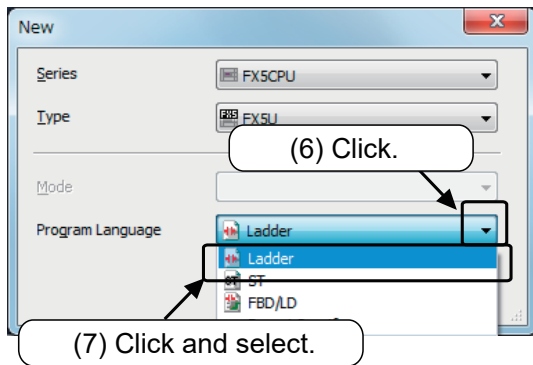
- (1) Click  from the tool bar, or select [Project] → [New project] (Ctrl + N) from the menu bar.



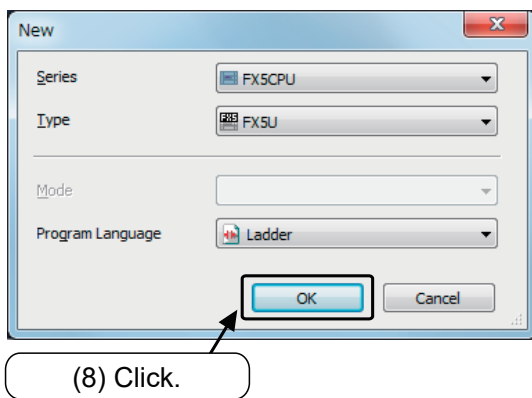
- (2) Click the list button of "Series".  
(3) Click and select "FX5CPU" from the drop-down menu.



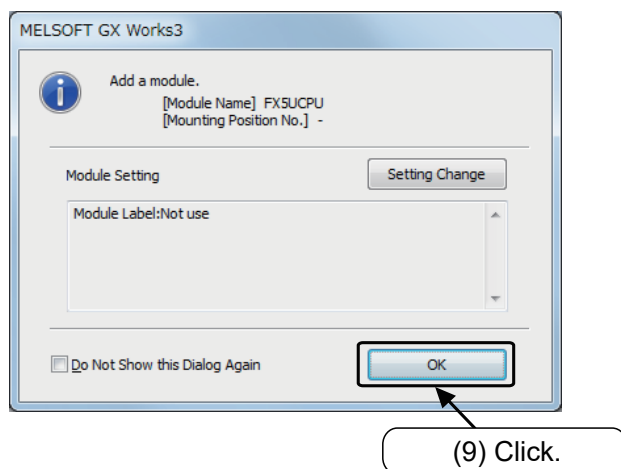
- (4) Click the list button of "Type".  
(5) Click and select "FX5U" from the drop-down menu.



- (6) Click the list button of "Program Language".  
 (7) Click and select "Ladder" from the drop-down menu.



- (8) Click the [OK] button.



- (9) The confirmation window for adding the module label of the selected module type ("FX5U" in this case) appears. Confirm that "Module Label: Not use" is selected, and then click the [OK] button.

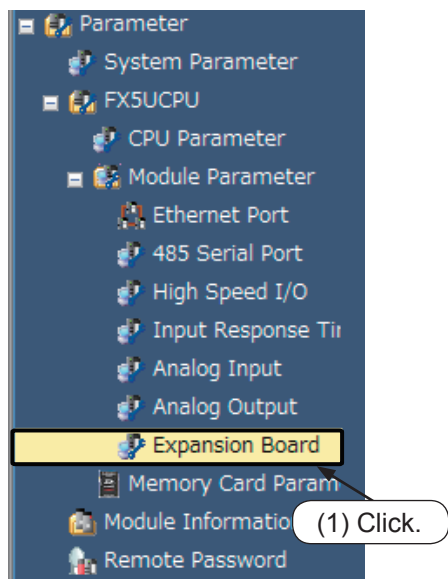
(If this screen does not appear, proceed to the next step.)



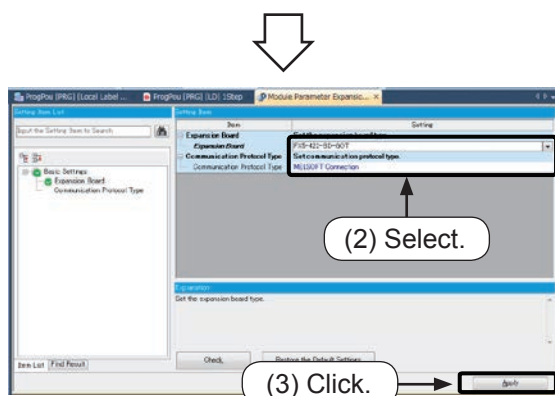


### 3.2.3 Setting the parameters

This chapter explains the parameter settings required to connect the GOT to the FX5-422-BD-GOT.



- (1) Double-click [Parameter] → [FX5UCPU] → [Module Parameters] → [Expansion Board] on the navigation window.



- (2) Select each item as shown below.
- Expansion board: FX5-422-BD-GOT
  - Communication Protocol type
- (3) After the setting is completed, click the [Apply] button.

## Reference

### Communication setting for Demonstration Machine

The Demonstration Machine (FX5U-32MT-SIM) communicates between the FX5U CPU module and PC using the GOT (direct connection) transparent function.

The FX5U CPU module and GOT settings are as shown below.

FX5U CPU module

| Item                              |                 | Description        |
|-----------------------------------|-----------------|--------------------|
| Module Parameter, extension board | Extension board | FX5-422-BD-GOT     |
|                                   | Protocol format | MELSOFT connection |

GOT

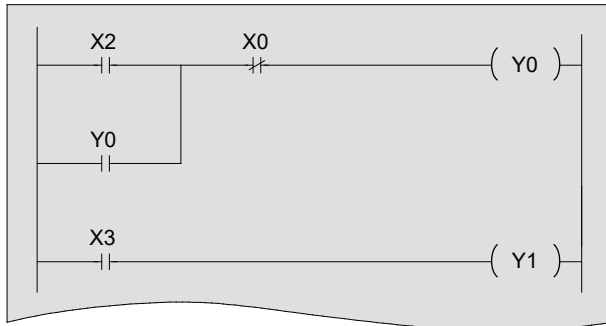
| Item             |        | Description              |
|------------------|--------|--------------------------|
| Connected device | Model  | MELSEC iQ-F              |
|                  | I/F    | Standard I/F (RS422/485) |
|                  | Driver | Serial (MELSEC)          |



## 3.3 Creating a circuit

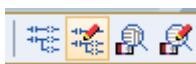
### 3.3.1 Creating a circuit by using the function keys

[The circuit to be created]



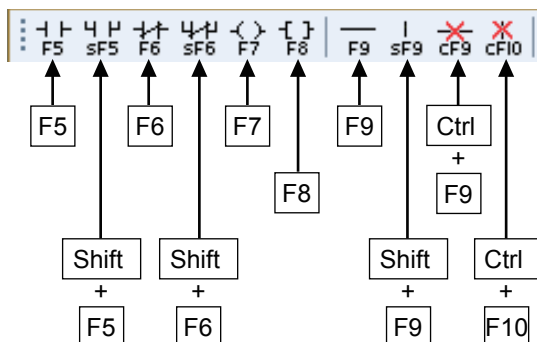
#### Point

- When creating a circuit, make sure to set the mode to "Write Mode".



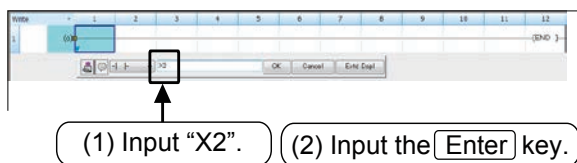
Write Mode (F2)

- The relationship between the function keys and the symbols of the circuit are displayed on the buttons of the tool bar.



Main key operations

- Use only one-byte characters.

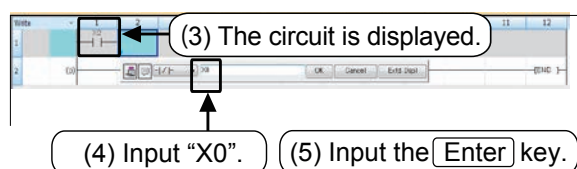


- (1) Press the **F5** ( $\rightarrow$ ) key.  
Input "X2".

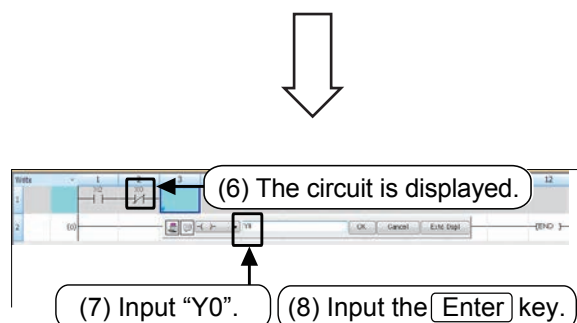


Cancel it by **ESC** or [Cancel].

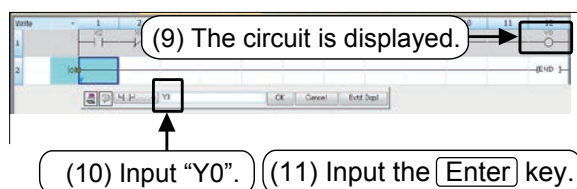
- (2) Confirm by pressing the **Enter** key or [OK].



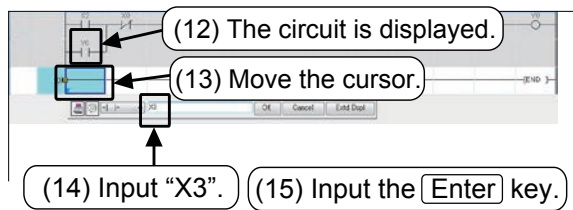
- (3) The circuit input ( $\rightarrow$ ) is displayed.
- (4) Press the **F6** ( $\rightarrow$ ) key.  
Input "X0".
- (5) Confirm by pressing the **Enter** key or [OK].



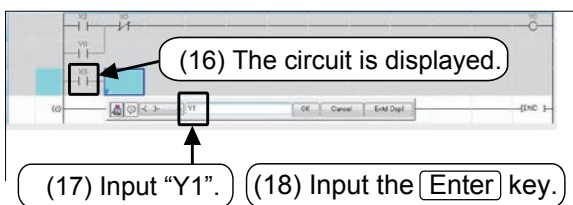
- (6) The circuit input ( $\rightarrow$ ) is displayed.
- (7) Press the **F7** ( $\rightarrow$ ) key.  
Input "Y0".
- (8) Confirm by pressing the **Enter** key or [OK].



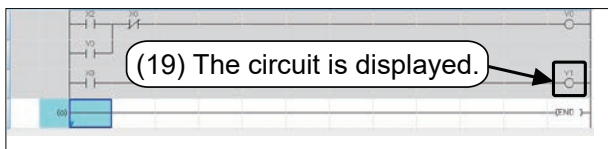
- (9) The circuit input ( $\rightarrow$ ) is displayed.
- (10) Press the **Shift** + **F5** ( $\rightarrow$ ) key.  
Input "Y0".
- (11) Confirm by pressing the **Enter** key or [OK].



- (12) The circuit input ( $\overline{Y0}$ ) is displayed.  
 (13) Move the cursor to the beginning of the next line.  
 (14) Press the **F5** ( $\overline{\text{---}}$ ) key.  
       Input "X3".  
 (15) Confirm by pressing the **[Enter]** key or [OK].



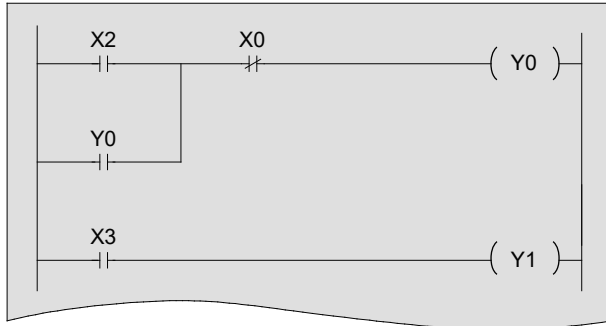
- (16) The circuit input ( $\overline{X3}$ ) is displayed.  
 (17) Press the **F7** ( $\overline{\text{---}}$ ) key.  
       Input "Y1".  
 (18) Confirm by pressing the **[Enter]** key or [OK].



- (19) The circuit input ( $\overline{(Y1)}$ ) is displayed.  
 The circuit is created!!

### 3.3.2 Creating a circuit by using the tool buttons

[The circuit to be created]



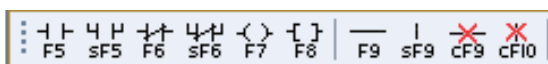
#### Point

- When creating a circuit, make sure to set the mode to "Write Mode".



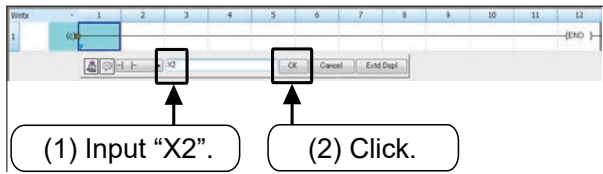
↑  
Write Mode (F2)

- Click the tool buttons to input the symbols of the circuit.

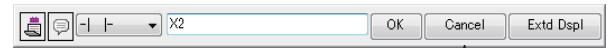


Main tool buttons

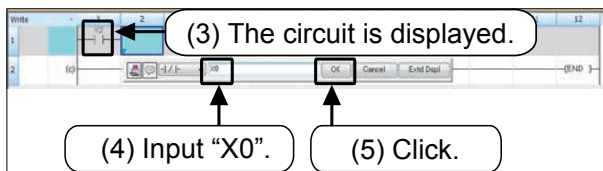
- Use only one-byte characters.



- (1) Click the tool button  $\frac{1}{F5}$ .  
Input "X2".



Cancel it by  $\boxed{\text{ESC}}$  or [Cancel].

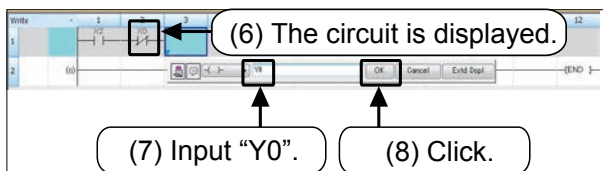


- (2) Confirm by pressing the  $\boxed{\text{Enter}}$  key or [OK].

- (3) The circuit input  $\frac{X2}{1F}$  is displayed.

- (4) Press the tool button  $\frac{1}{F6}$ .  
Input "X0".

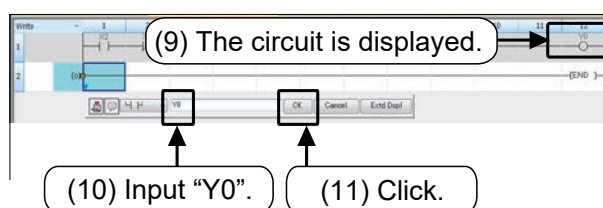
- (5) Confirm by pressing the  $\boxed{\text{Enter}}$  key or [OK].



- (6) The circuit input  $\frac{X0}{1F}$  is displayed.

- (7) Click the tool button  $\frac{1}{F7}$ .  
Input "Y0".

- (8) Confirm by pressing the  $\boxed{\text{Enter}}$  key or [OK].

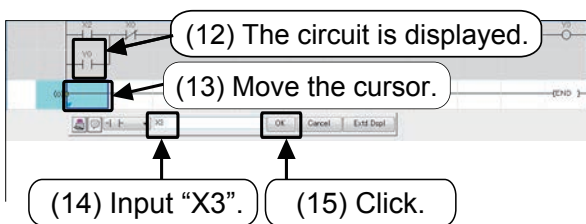


- (9) The circuit input  $\frac{-(Y0)-}{1F}$  is displayed.

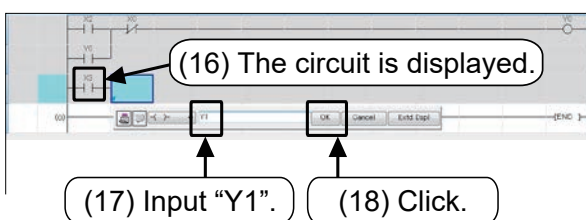
- (10) Click the tool button  $\frac{1}{SF5}$ .  
Input "Y0".

- (11) Confirm by pressing the  $\boxed{\text{Enter}}$  key or [OK].

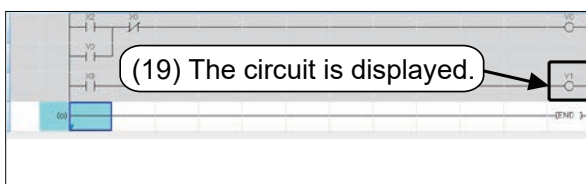




- (12) The circuit input (  $\text{Y0}$  ) is displayed.
- (13) Move the cursor to the beginning of the next line.
- (14) Click the tool button  $\text{F5}$ .  
Input "X3".
- (15) Confirm by pressing the  key or [OK].

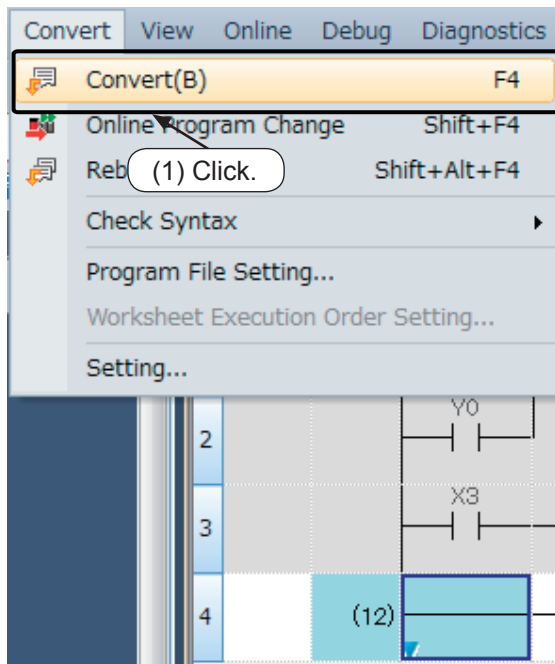


- (16) The circuit input (  $\text{X3}$  ) is displayed.
- (17) Click the tool button  $\text{F7}$ .  
Input "Y1".
- (18) Confirm by pressing the  key or [OK].

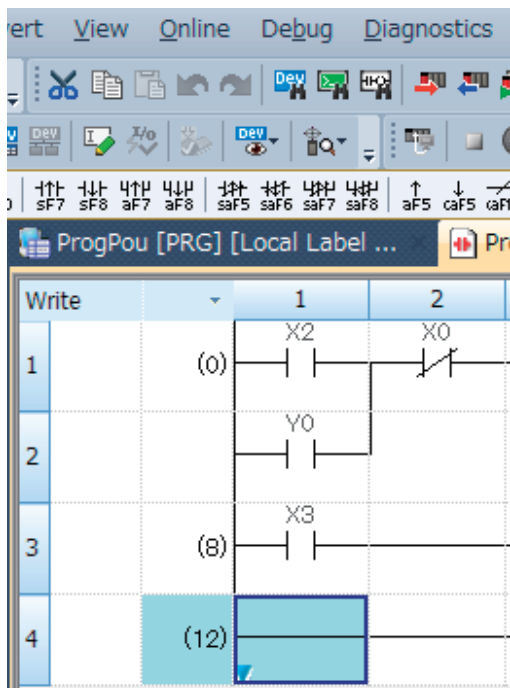


- (19) The circuit input (  $\text{Y1}$  ) is displayed.  
The circuit is created!!

### 3.3.3 Converting a Created Ladder Program (Circuit Conversion)



(1) Click [Convert] → [Convert] from the menu bar.



(2) The ladder program is converted. When the conversion processing is completed and the input ladder blocks are finalized, the color of those ladder blocks changes from gray to white.

When an error has occurred during conversion, the results will appear on the output window. When the error/warning message displayed on the output window is double-clicked, the cursor is moved to the position where the error has occurred. Check the ladder.

## 3.4 Preparations for writing to PLC

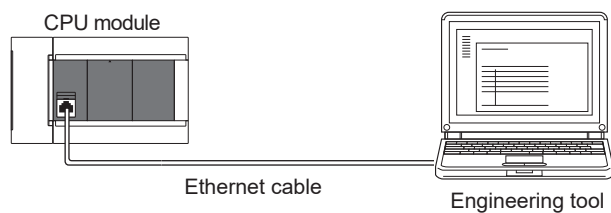
### 3.4.1 Specifying connection destination

#### (1) Ethernet direct connection

The FX5U CPU module and engineering tool (GX Works3) can be easily and directly connected without a hub by using one Ethernet cable.

The IP address and host name do not need to be set when using a direct connection.

A straight cable or cross cable can be used for the Ethernet cable.



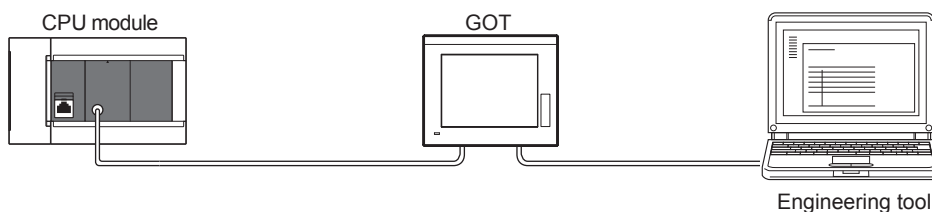
3

#### (2) GOT (direct connection) transparent connection

When the engineering tool (GX Works3) is connected to the GOT directly connected to FX5U CPU module, the FX5U CPU module program can be written, read and monitored via the GOT.

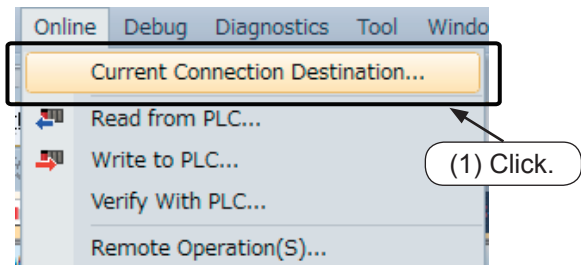
The demonstration model uses the GOT (direct connection) transparent connection.

The following page explains the connection destination settings for this demonstration machine.

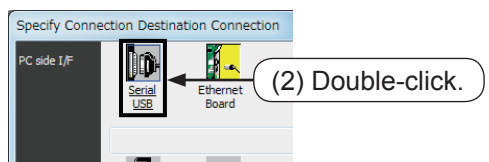





Complete the settings for communicating with the FX5U CPU module using the GOT (direct connection) transparent connection.



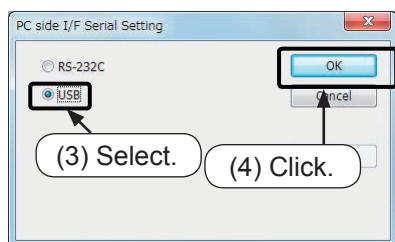
(1) Click [Online] → [Current Connection Destination] on the menu bar.



(2) Double-click .

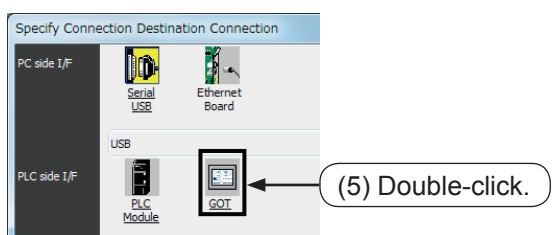
[Supplement]

When the message "Current settings will be lost when new item is selected. OK?" appears, click [Yes], and perform step (2) again.

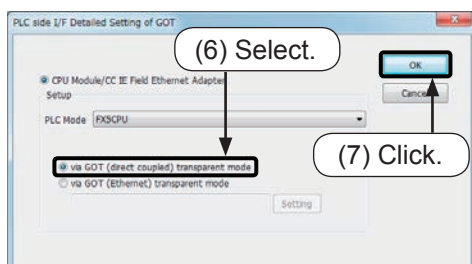


(3) Select the communication port on the PC side.  
(Select [USB] for the demonstration machine.)

(4) Click [Yes].



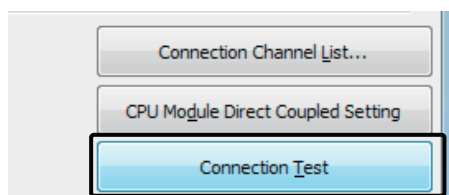
(5) Double-click .



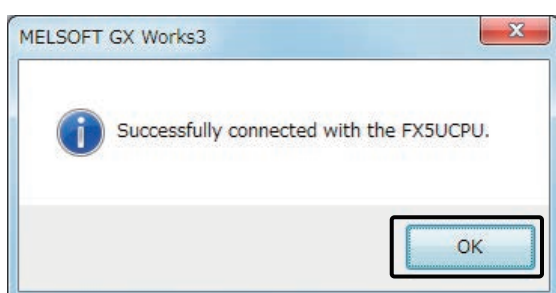
(6) Select [Use GOT (direct connection) transparent function].

(7) Click [OK].

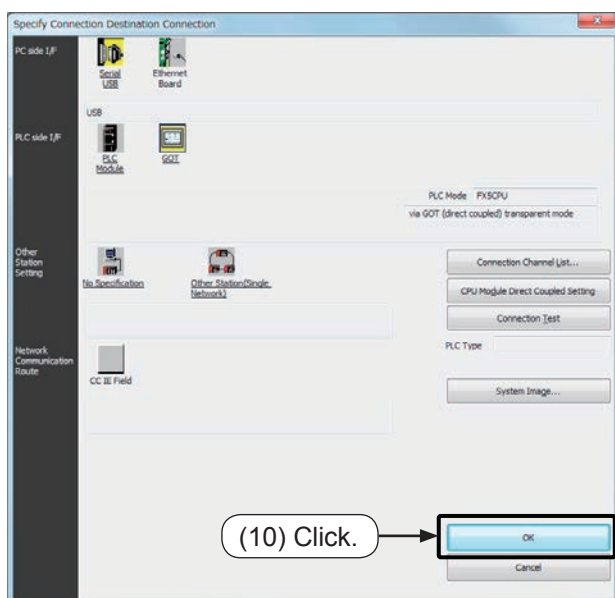




(8) Double-click [Connection Test].



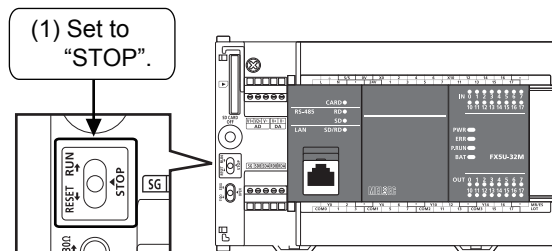
(9) Check that the CPU module is successfully connected, and click [OK].



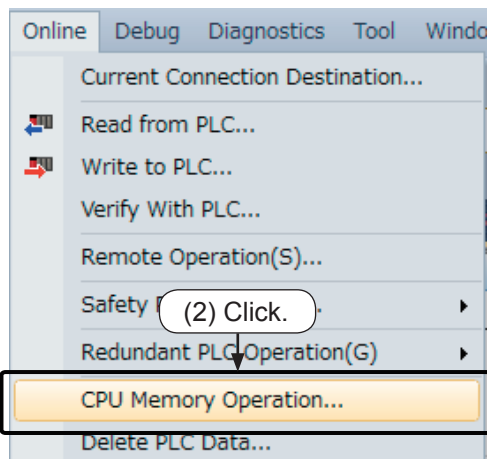
(10) Click [OK].

## 3.4.2 Initializing the PLC

This section explains the methods for initializing the FX5U CPU module memory.



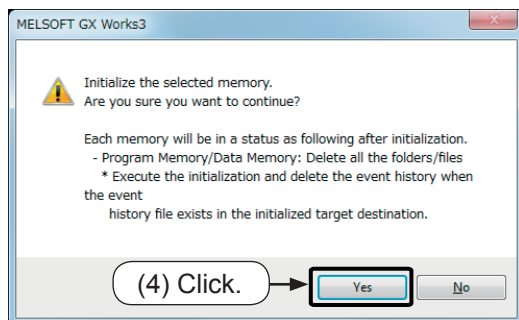
(1) Set the "RUN/STOP/RESET" switch of the CPU module to "STOP".



(2) Click [Online] → [CPU Memory Operation] from the menu bar.



(3) Click the [Initialization] button.



(4) The confirmation dialog box appears. Click the [Yes] button.

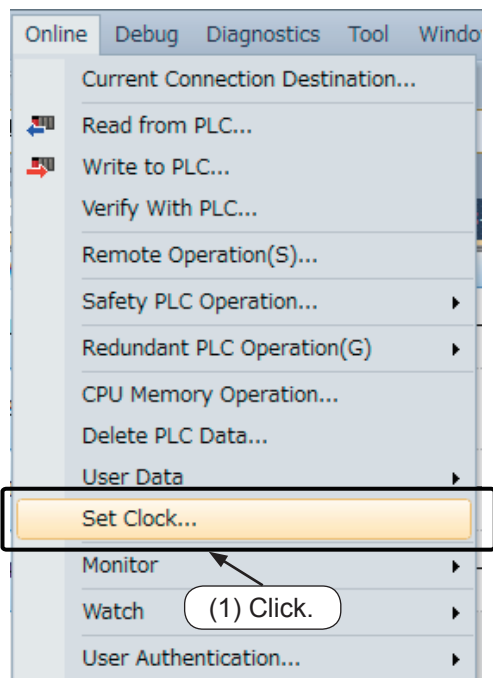


(5) When the initialization is completed, the dialog box shown on the left appears. Click the [OK] button.

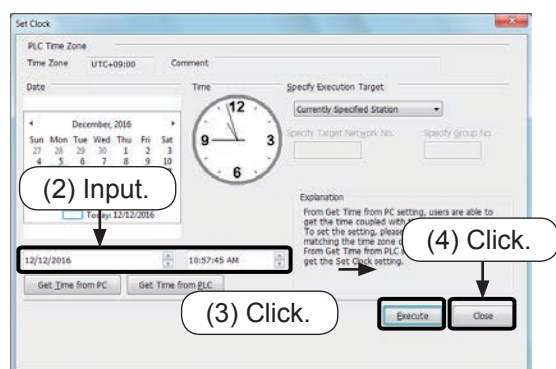
### 3.4.3 Setting the clock of the PLC

The FX5U CPU module has a built-in clock function.

The method of setting the FX5U CPU's built-in clock using GX Works 3 is explained in this section.

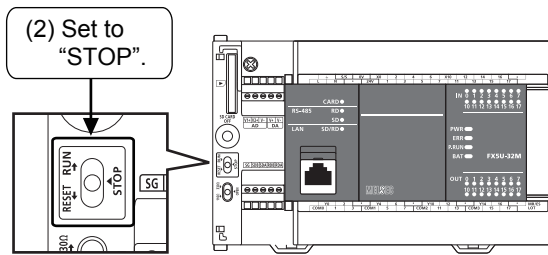


(1) Click [Online] → [Set Clock] from the menu bar.



- (2) Set a year, month, day, hour, minute and second on the "Set Clock" dialog box.
- (3) Click the [Execute] button.
- (4) Click the [Close] button.

## 3.5 Writing programs to the PLC

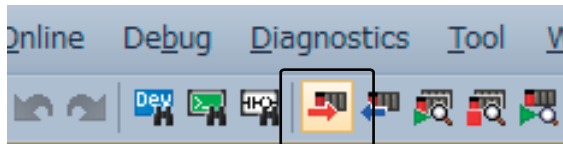



- (1) Prior to this operation, create a ladder program (sequence program) with GX Works3.
- (2) Set the RUN/STOP/RESET switch to the STOP position.

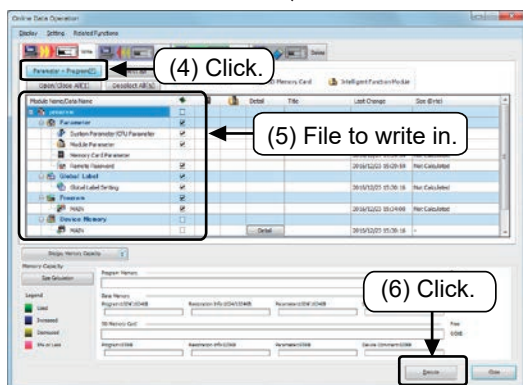
[Supplement: Automatic RUN/STOP function from GX Works3]

If writing is executed while the PLC is running, the message "Execute write to PLC after remote STOP?" will appear after step (6).

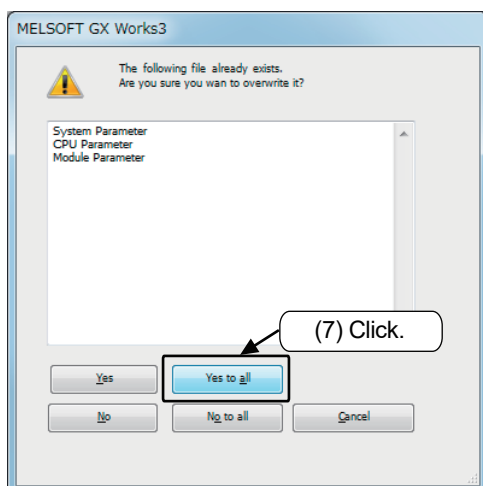
To execute write, click [Yes].



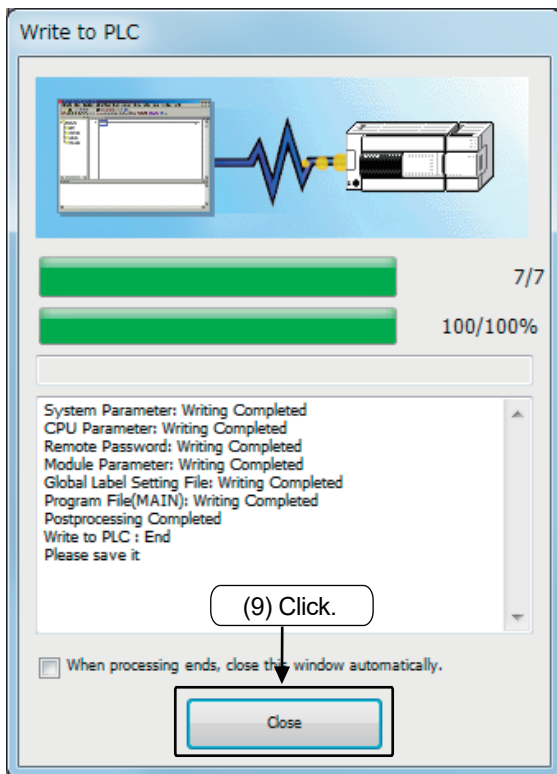
- (3) Click  on the toolbar, or click [Online] → [Write to PLC] from the menu bar.



- (4) Click [Parameter + Program].
  - (5) Confirm that the file to be written is selected.
  - (6) Click [Execute].
- (Also refer to the supplement for step (2).)

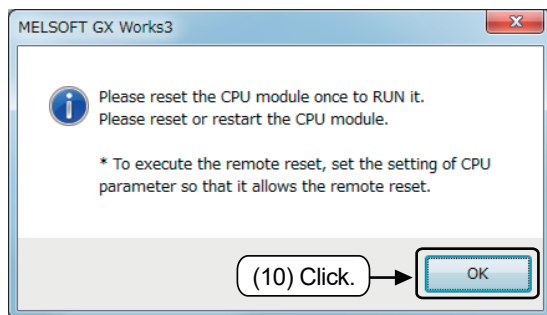


- (7) If parameters or programs already exist in the CPU module, a message asking whether to overwrite will appear. Click [Yes to all].



(8) The dialog box indicating that writing is in progress appears.

(9) When writing the data is completed, the [Close] button is displayed. Click the [Close] button.  
 (This process is not required if "When processing ends, close window automatically." is checked.)



(10) Click [OK].

To run with the project written into the PLC, reset the PLC or turn the power OFF and ON.

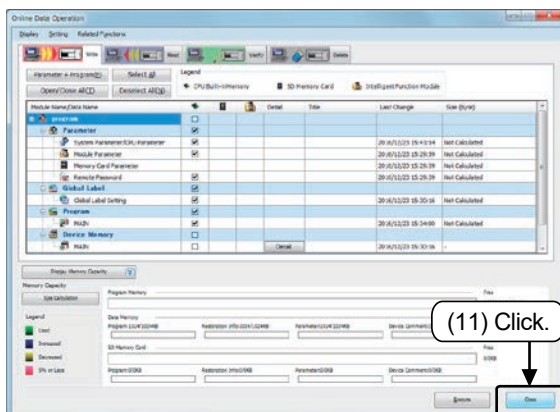
[Supplement: How to reset]

(1) Hold the CPU module RUN/STOP/RESET switch to the RESET side for approx. one second.

(2) Confirm that the ERR LED flashes several times and then turns OFF.

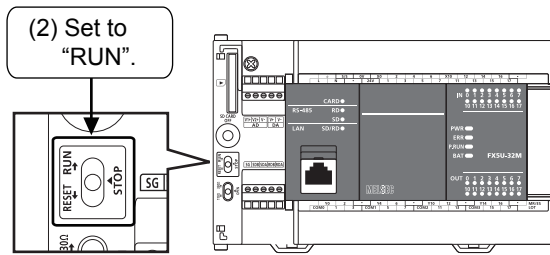
(3) Return the RUN/STOP/RESET to the STOP position.

(11) Click the [Close] button to close the dialog box.

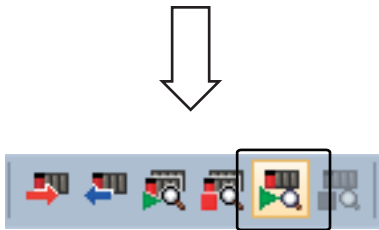



# 3.6 Monitoring the PLC

## 3.6.1 Operation monitor of a program



- (1) It is assumed that the ladder program (sequence program) has been written to the CPU module, and the PLC has been reset or the power turned OFF and ON prior to this operation.  
(Refer to the previous page for details on resetting.)
- (2) Set the RUN/STOP/RESET switch of the CPU module to the "RUN" position.



- (3) Click  on the toolbar, or click [Online] → [Monitor] → [Monitor Mode] from the menu bar.


### Operation check by circuit monitor

| Read Mntr |  | 1    | 2  | 3  | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12     |
|-----------|--|------|----|----|---|---|---|---|---|---|----|----|--------|
| 1         |  | (0)  | X2 | X0 |   |   |   |   |   |   |    |    | Y0     |
| 2         |  |      | Y0 |    |   |   |   |   |   |   |    |    |        |
| 3         |  | (8)  | X3 |    |   |   |   |   |   |   |    |    | Y1     |
| 4         |  | (12) |    |    |   |   |   |   |   |   |    |    | [END ] |

- (1) Set [Switch X2 is "ON"] with the status [Switch X0 is "OFF"], and then check [Output Y0 is "ON"].
- (2) Check [Output Y0 is "ON"] while [Switch X2 is "OFF"].
- (3) Set [Switch X0 is "ON"] and then check [Output Y0 is "OFF"].
- (4) Check [Output Y1 is "ON/OFF"] in accordance with [Switch X3 is "ON/OFF"].

#### Point

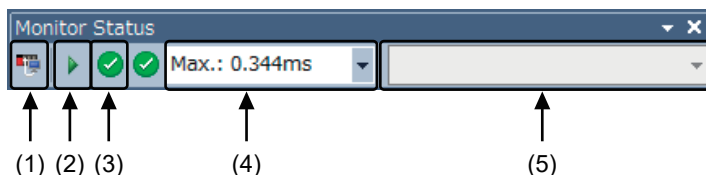
#### Stopping the monitor and editing

- Select the  (Monitor Stop) icon, or [Online] → [Monitor] → [Monitor Stop] to stop the monitor. The circuit can be edited in the write mode.



## Monitoring on the monitor status bar

In the monitor mode, the following "Monitor Status" dialog box appears regardless of whether the operation status is monitoring in progress or not.



### (1) Connection status

The connection status with the CPU module is displayed.

### (2) CPU module operating status

The operating status of the CPU module is displayed. RUN: ►, STOP: ■, PAUSE: II. Remote operations can also be performed from GX Works3.

### (3) ERROR status

The ERROR LED status of the CPU module is displayed.

Clicking the icon opens the "Module Diagnostics" window.

Refer to [Diagnosing the PLC] described later for the details.

### (4) Scan time details

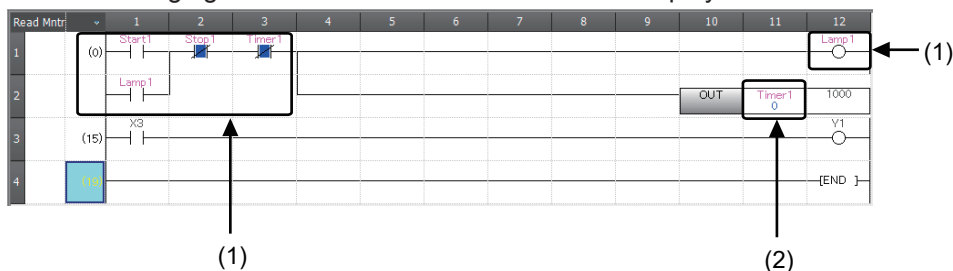
The scan time details are displayed. Select the value to be displayed from the drop-down list (current value, maximum value, or minimum value).

### (5) Monitor target selection

Specify the monitor target FB instance when monitoring a FB program.

## Monitoring on the ladder editor

The following figure shows how the ladder status is displayed on the ladder editor.

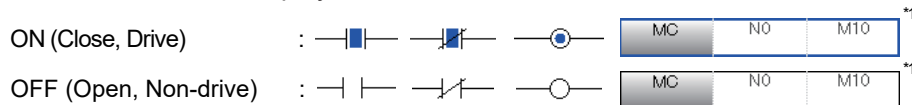


(1) The on/off states of contacts and coils are displayed.

(2) The current value of the word/double word type data is displayed.

### ● On/off state display

The on/off states are displayed on the editor as follows.

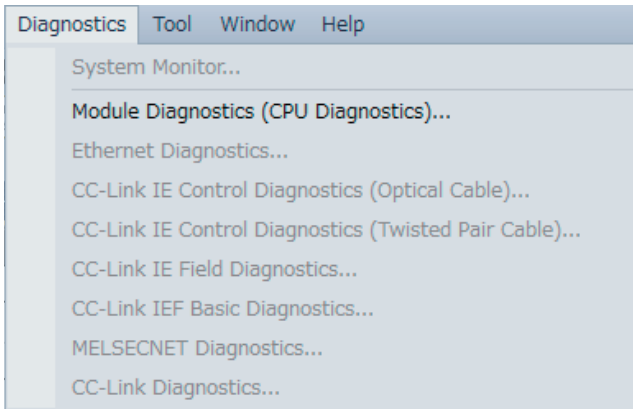


<sup>\*1</sup> Only comparison instructions that are equivalent to contacts and the instructions that are equivalent to coils are supported.

Comparison instructions equivalent to contacts : 16-bit binary data comparison, 32-bit binary data comparison, floating-point data comparison

Instructions equivalent to coils : SET, RST, PLS, PLF, SFT, SFTP, MC, FF

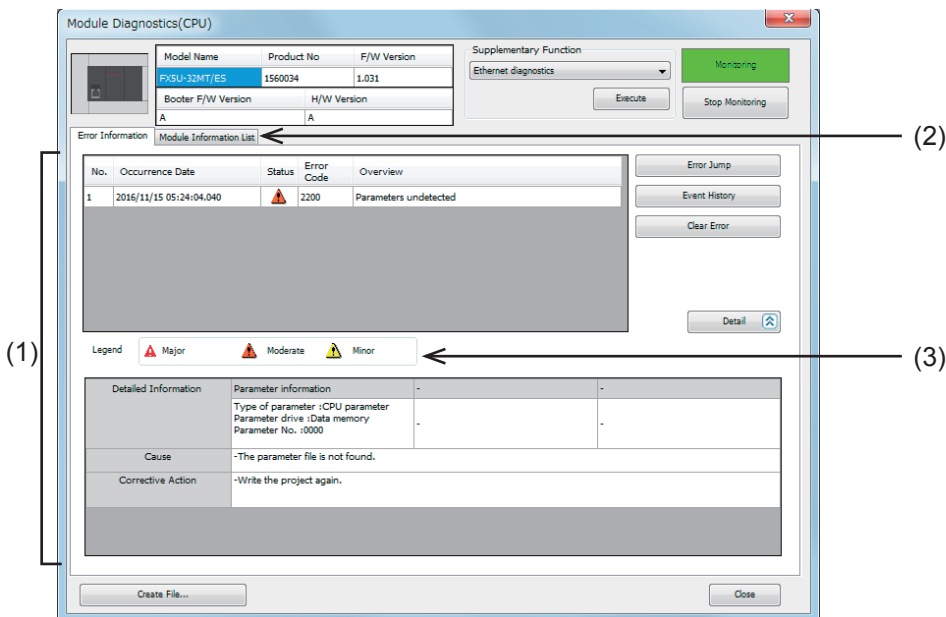
## 3.6.2 Diagnosing the PLC

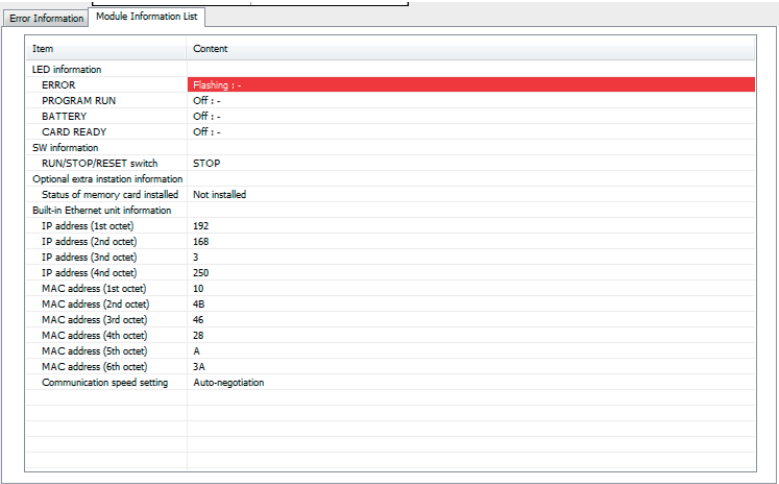


(1) Click [Diagnostics] → [Module Diagnostics (CPU Diagnostics)] from the menu bar.

3

(2) The "Module Diagnostics(CPU)" window appears.



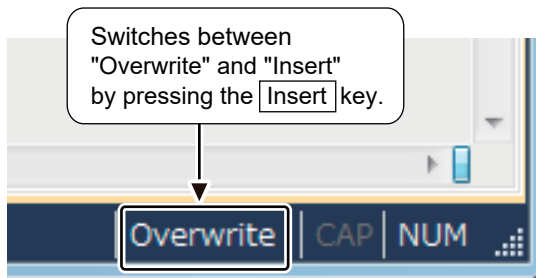
|     | Item                    | Description  |
|-----|-------------------------|--|
| (1) | Error Information       | Select this tab to display the error information of the current CPU module.  |
| (2) | Module Information List | Select this tab to display the status information of the CPU module.<br> |
| (3) | Legend                  | Displays the legend of icons displayed on the window.  |

## 3.7 Editing a circuit

### 3.7.1 Correcting a circuit

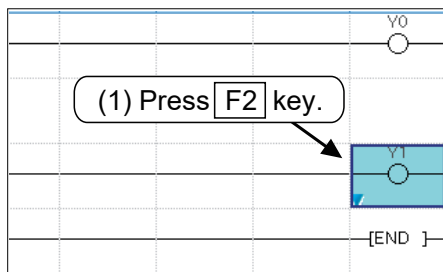
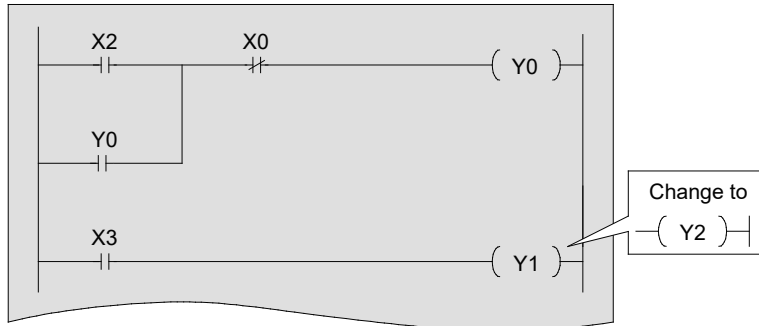
#### Point

- Use only one-byte characters.
- Confirm that the write mode is enabled.
- Switch between "Overwrite" and "Insert"
  - Set to "Overwrite" when correcting and overwriting a circuit diagram.
  - A new circuit will be inserted when the "Insert" mode is on.

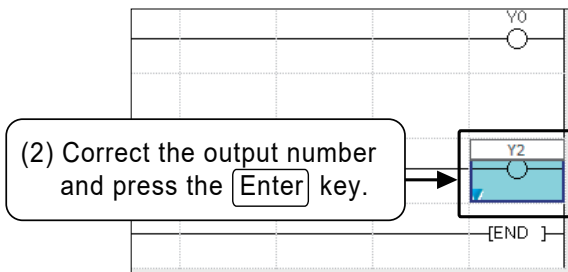


# (1) Changing the OUT coils and numbers of contacts

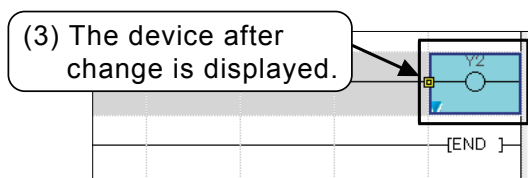
[The circuit to be corrected]



- (1) Click the position to be modified, and press the [F2] key.



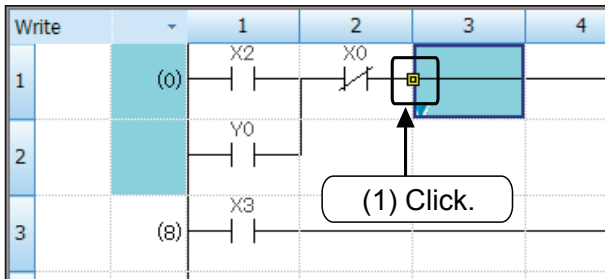
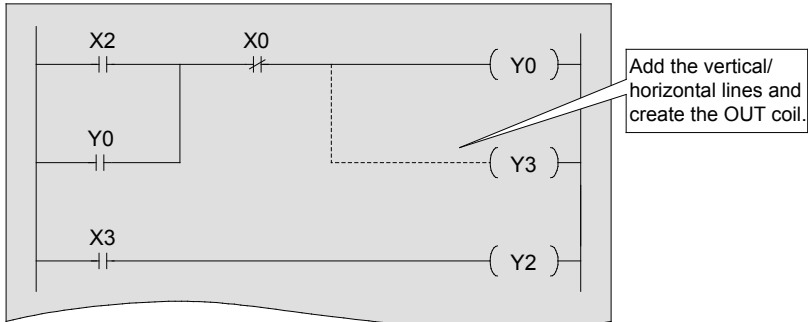
- (2) The device can be modified. Modify the device to "Y2", and press the [Enter] key.



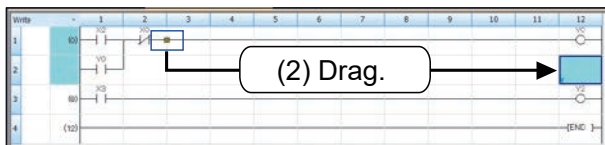
- (3) The ladder program after the modification is displayed.  
To change only the device number, click the [F2] key.
- (4) Confirm the changes by pressing the [F4] (Convert) key.

## (2) Adding a circuit

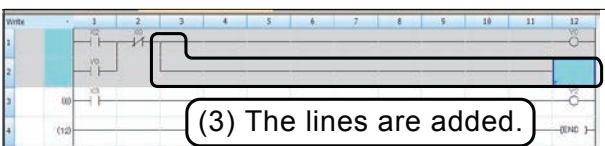
[The circuit where lines are to be added]



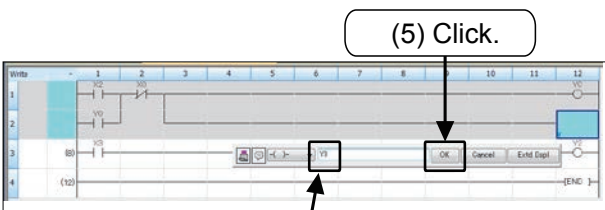
(1) Move the mouse pointer close to the exiting line, and click the displayed icon.





(2) Drag the icon from the position to the end position.  
A vertical line is drawn on the left side of the cursor.



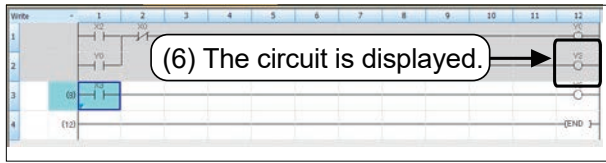
(3) Release the left button of the mouse to create a line.



(4) Click  on the toolbar and enter "Y3".  
(5) Click the [OK] button.

(4) Click  and input Y3.





(6) The added symbol (  $(Y3)$  ) is displayed.

(7) Confirm the changes by pressing the **F4** (Convert) key.

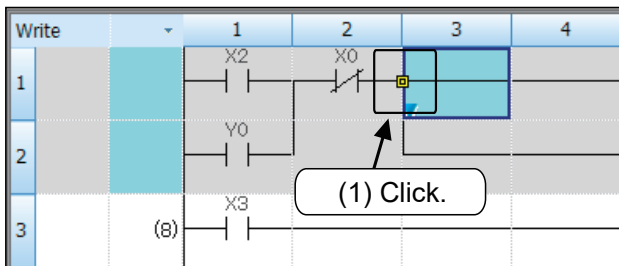
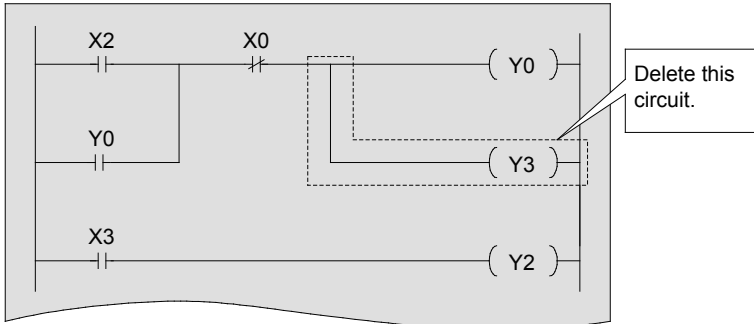
## Reference

### Adding or deleting a line with the key operation

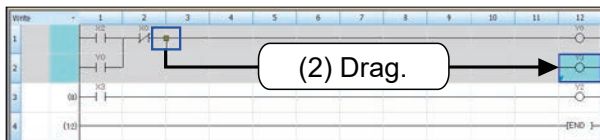
- In GX Works3, lines can be added or deleted with the **Ctrl** key + **→** , **←** , **↑** , or **↓** .

### (3) Deleting lines

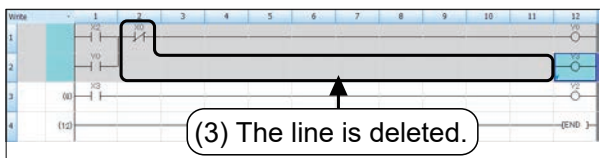
[The circuit where lines are to be deleted]



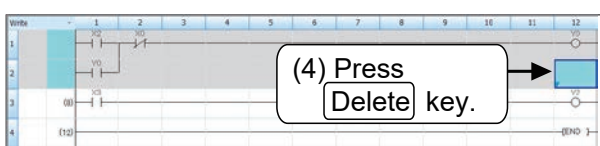
(1) Move the mouse pointer close to the exiting line, and click the displayed icon.



(2) Drag the icon along the line to be deleted.



(3) Release the left button of the mouse to delete the line.  
The line connected to "END" cannot be deleted.



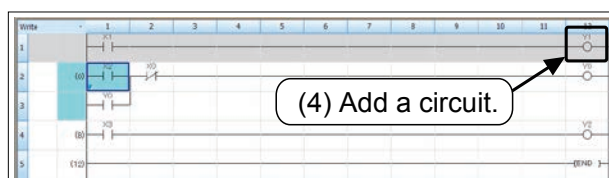
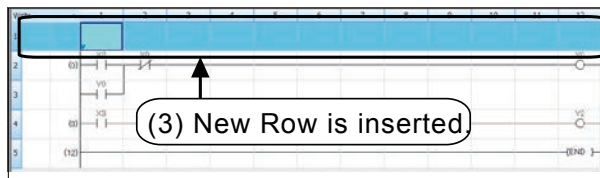
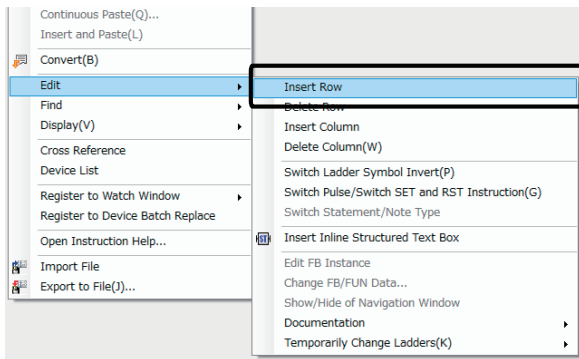
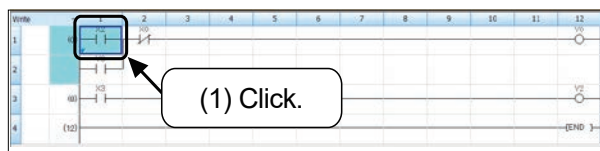
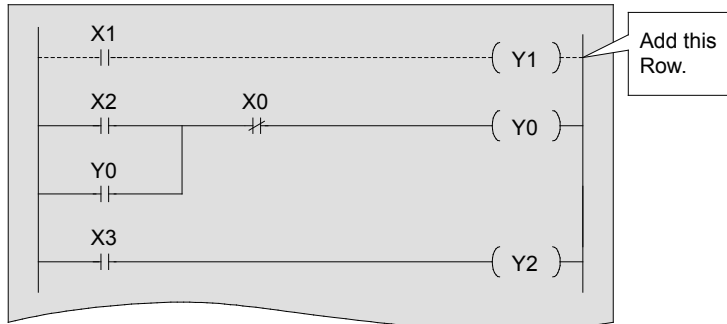
(4) Press the **Delete** key to delete (  $(Y3)$  ).  
(5) Confirm the changes by pressing the **F4** (Convert) key.



## 3.7.2 Inserting and deleting Rows

### (1) Inserting Rows

[The circuit where a Row is to be inserted]



A line is inserted above the Row where the cursor is located

(1) Locate the cursor on the Row below the one to be inserted.

(2) Right click the mouse at any place, and select [Insert Row].

(3) A Row is inserted.

\* Insert is also possible by shift + Insert

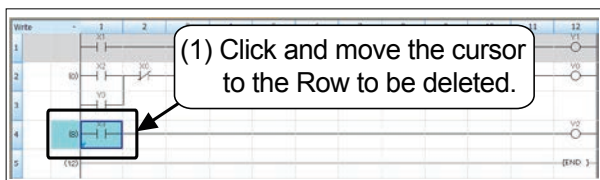
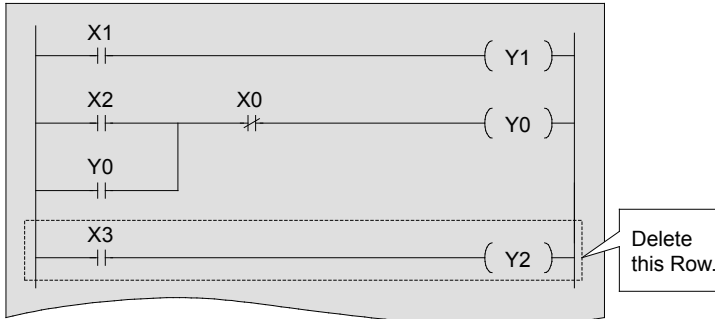
(4) Add a program in the inserted Row.



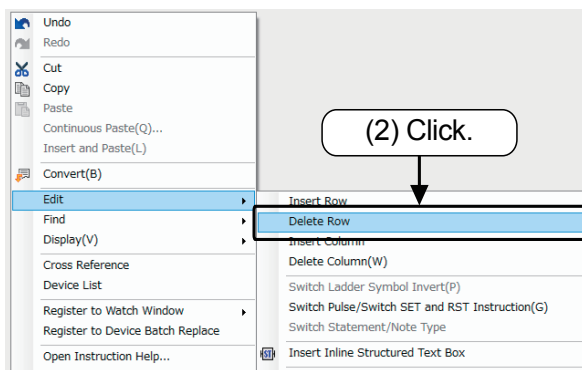
(5) Confirm the changes by pressing the F4 (Convert) key.

## (2) Deleting Rows

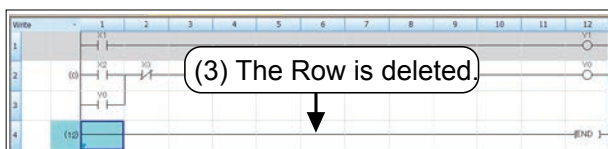
[The circuit where a Row is to be deleted]



(1) Move the cursor to the Row to be deleted.



(2) Right click the mouse at any place, and select [Delete Row.]

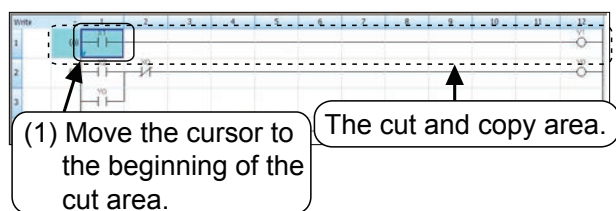
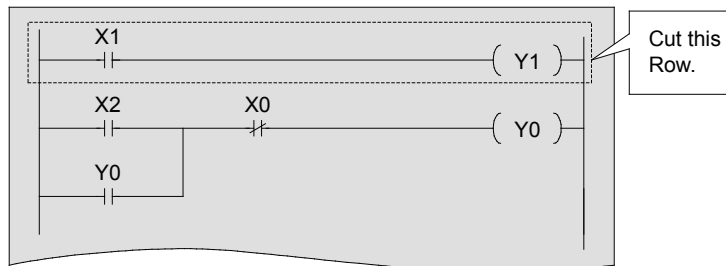


(3) The Row is deleted.  
(4) Confirm the changes by pressing the **F4** (Convert) key.

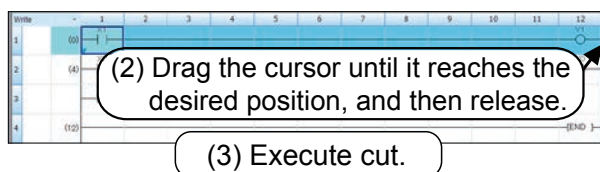
## 3.7.3 Cutting and copying (pasting) a circuit


### (1) Cut

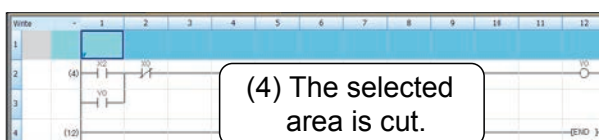
[The circuit to be edited]



- (1) Move the cursor to the beginning of the circuit to be cut.



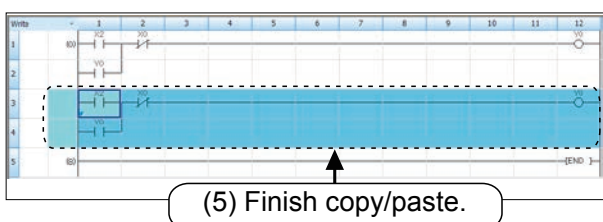
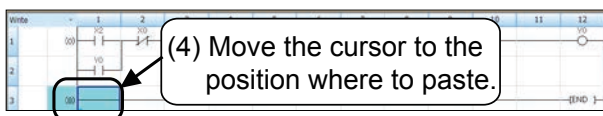
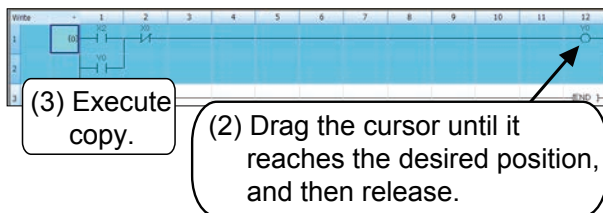
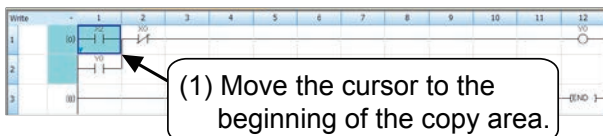
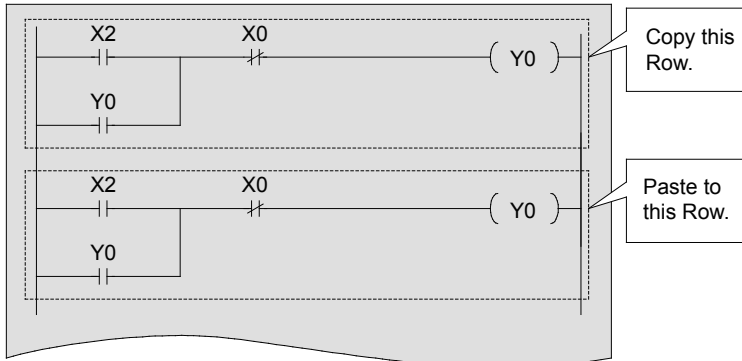
- (2) Drag the cursor until it reaches the desired position, and then release.
- (3) Select  from the tool bar or select [Edit] → [Cut] (Ctrl + X) from the menu bar, and execute the cut.



- (4) The selected area is cut.
- (5) Confirm the changes by pressing the **F4** (Convert) key.

## (2) Copy (paste)


[The circuit to be copied (pasted)]



Continue to edit the circuit with the "cut" operation performed in the previous steps.

(1) Move the cursor to the beginning of the circuit to be copied.

(2) Drag the cursor until it reaches the desired position, and then release.

(3) Select  from the tool bar or select [Edit] → [Copy] (Ctrl + C) from the menu bar.


(4) Move the cursor to the position where to paste.

### Point

Using by the **Insert** key

"Overwrite" mode : Pastes by overwriting data from the cursor position.

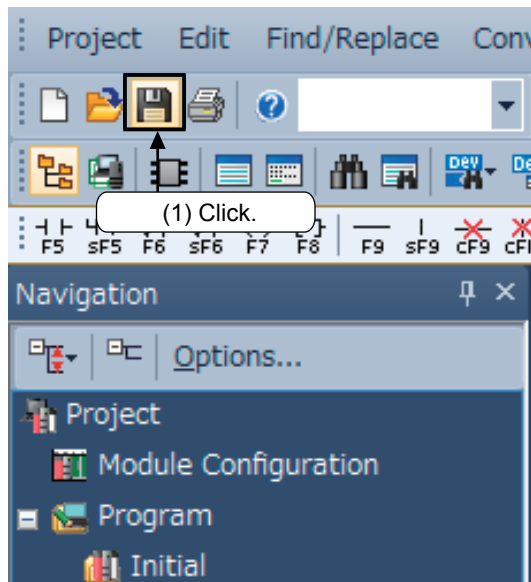
"Insert" mode : Pastes it by inserting data at the cursor position.


(5) Select  from the tool bar or select [Edit] → [Paste] (Ctrl + V) from the menu bar.

(6) Confirm the changes by pressing the **F4** (Convert) key.

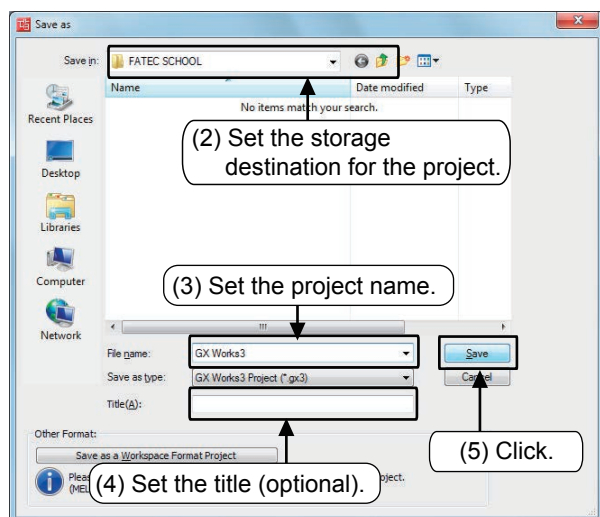
## 3.8 Saving a created circuit

Saving a created project in the single file format.



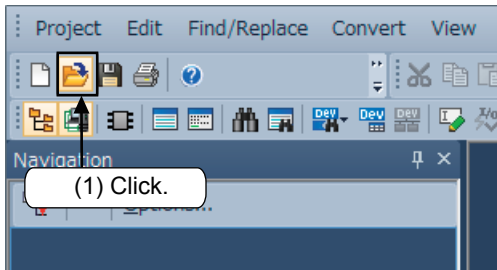
- (1) Select  from the tool bar or select [Project] → [Save] (Ctrl + S) from the menu bar.


If the project is overwritten, the saving operation is completed in this step.



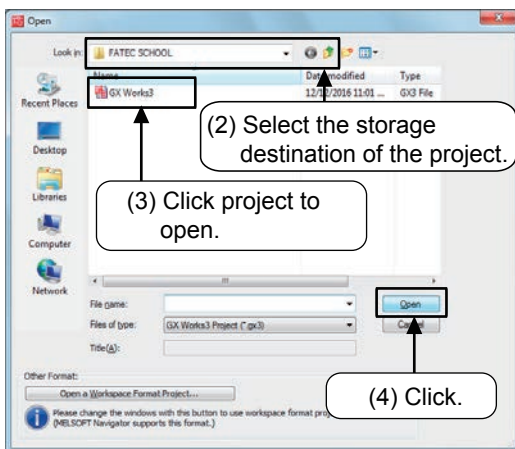
- (2) Select the storage destination of the project.
- (3) Set a project name.
- (4) Set a title as necessary.
- (5) After setting each item, click the [Save] button.  
The saving operation is completed.

# 3.9 Opening a Saved Project



- (1) Select  from the tool bar or select [Project] → [Open project] (Ctrl + O) from the menu bar.

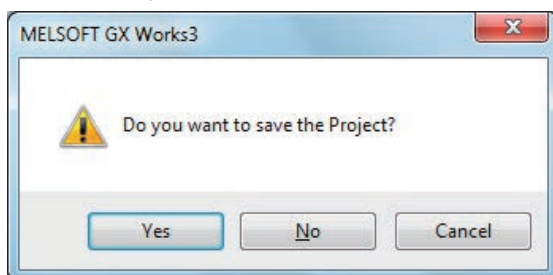
3



- (2) Specify the storage destination for the project.  
 (3) Click the project to open.  
 (4) After setting each item, click the [Open] button.

## Reference

If another project is open and has not been saved, the following dialog box appears.



- [Yes] ..... The project is saved and closed.  
 [No] ..... The project is not saved but closed.  
 [Cancel] ..... The project is not closed.  
                     Reading of the project is paused.

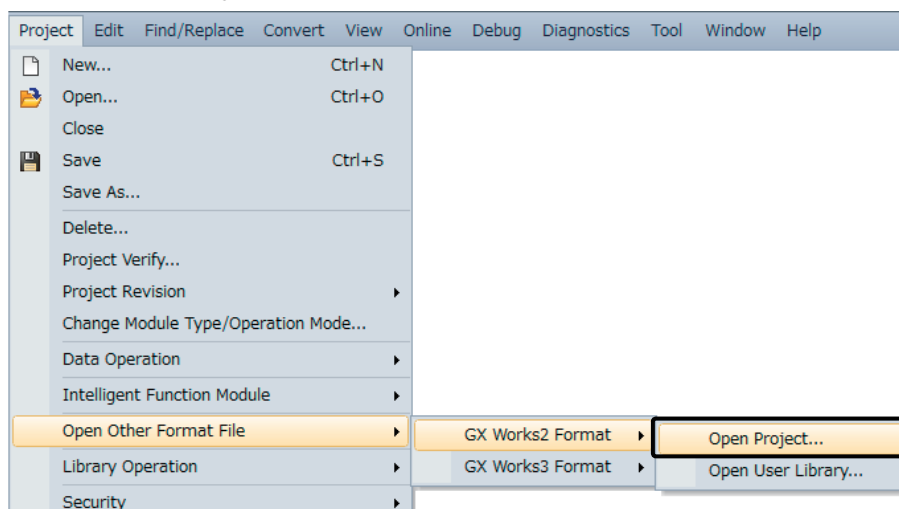
## Reference

### Opening a Project in Another Format

The model of a project created with GX Works2 can be changed with GX Works3.

This function is supported with projects for the FX3U/FX3UC model.

To open a project in another format, open the target project by selecting [Project] → [Open Other Format File] → [GX Works2 Format] → [Open Project...] from the menu bar.



\* Can only be executed in an environment where GX Works2 is installed.


## 3.10 Debugging a program

See the previous section "Writing programs to the PLC" for details on connecting with the FX5U CPU module and on writing a program.

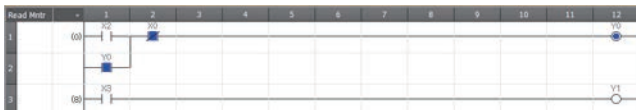
### 3.10.1 Circuit monitor

Display the circuit, and monitor the conduction status of the contacts and the driving status of the coils. (Refer to the previous section "Operation monitor of a program" for details on the display.)




- (1) Select  from the tool bar or select [Online] → [Monitor] → [Monitor mode] from the menu bar.

(1) Click.



- (2) The ON/OFF status of the circuit and the current value of the word device (timer, counter and data register) are displayed in the circuit monitor window.

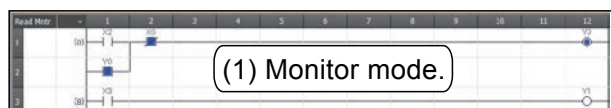
#### Reference

- With GX Works3, select the  (Monitor Stop) icon, or select [Online] → [Monitor] → [Monitor stop] from the menu.

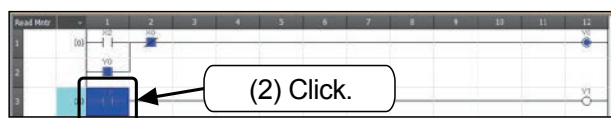


## 3.10.2 Forced ON/OFF of the device

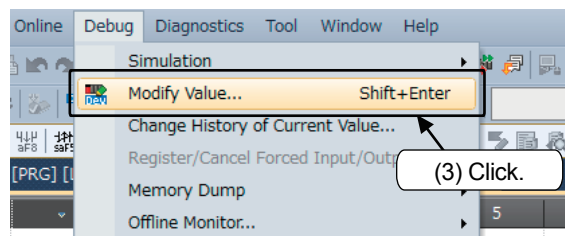
Using the device test screen, forcibly turn ON/OFF the bit devices of the PLC (M,X,Y,T,C and so on).  
To confirm the operation of the output (Y), STOP the PLC.



- (1) Set to the circuit monitor mode. (Refer to the previous section "Circuit monitor".)



- (2) On the Circuit Monitor screen, click and select the bit device to be forcibly turned ON and OFF.



- (3) The ON/OFF state will be highlighted when [Debug] → [Modify Value] are selected from the menu bar.

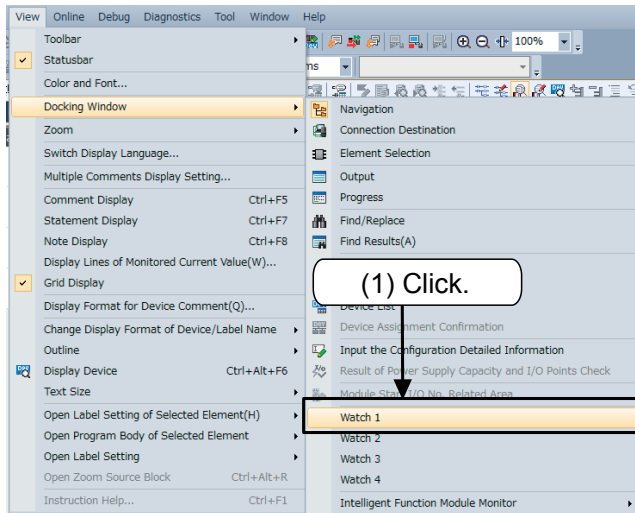
### Reference

#### Forced ON/OFF of the device (Circuit monitor screen)

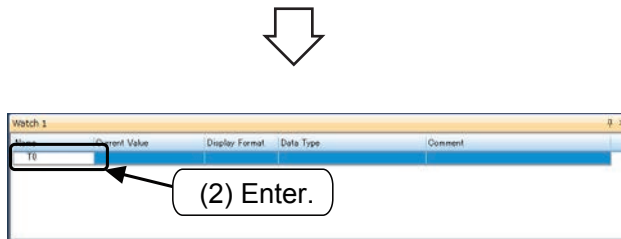
A specified device can be forcibly turned on/off by double-clicking any bit device (contact, coil) in the [Ladder monitor screen] while pressing the [Shift] key.

### 3.10.3 Watch Window

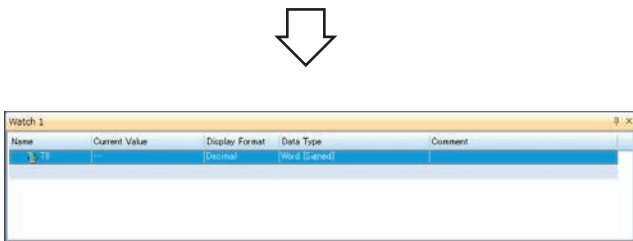
Designate a circuit diagram range on the Circuit Monitor screen, and register the device in this section in the Watch Window.



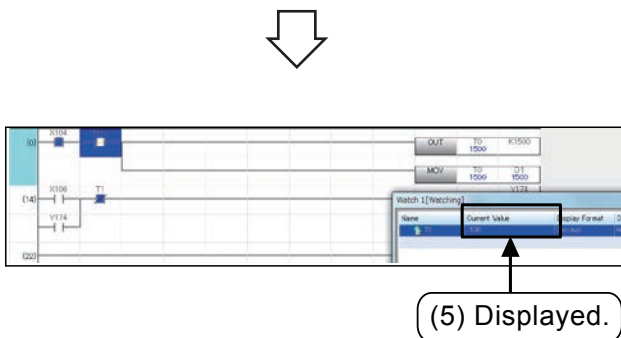
- (1) Click [View] → [Docking Window] → one of [Watch 1] to [Watch 4] from the menu bar.  
\* In this example, select [Watch 1].



- (2) The "Watch 1" window appears. Select a row to be edited, and click "Name" and input "T0".



- (3) The input device or label is registered.

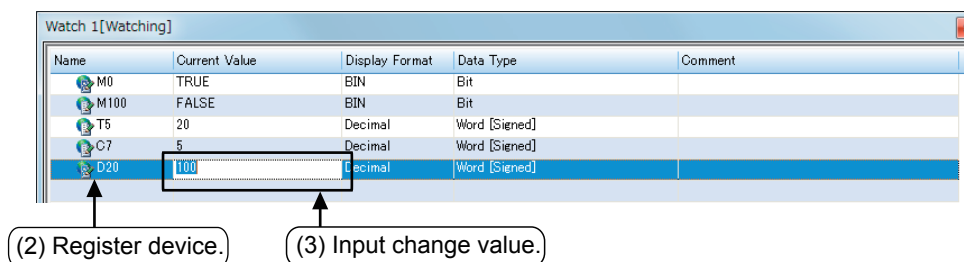


- (4) Click [Online] → [Watch] → [Start Watching] from the menu.  
(5) The current value of the registered device or label is displayed in the window.

## 3.10.4 Forced ON/OFF and current value change using Watch Window

The bit device (M, Y, etc.) can be forcibly turned ON/OFF or the current value for the word device (T, C, D, etc.) can be changed from the Watch Window.

To confirm the operation of the output (Y), STOP the PLC.



(1) Open the Watch Window. Refer to the previous section "Watch Window" for details on opening the window.

(2) Input the device number in the "Name" field, and register it into the Watch Window.

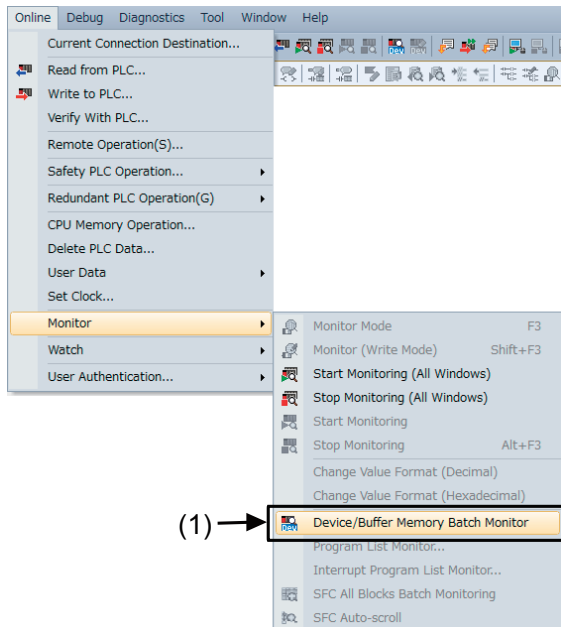
(Note) After registering, select [Online] → [Watch] → [Start Watching] from the menu.

(3) Input the changed value in the "Current Value" field, and press the  key.

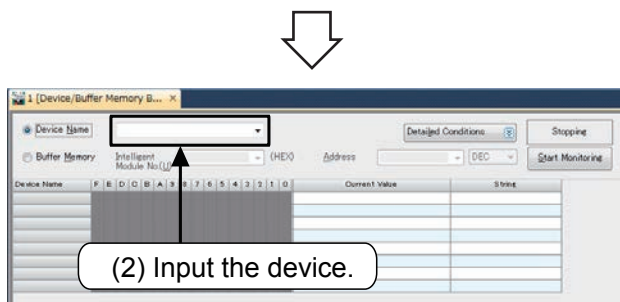
- Bit device (X, Y, etc.) : Input "1" for ON, and "0" for OFF.  
(ON indicates "TRUE", and OFF indicates "FALSE".)
- Word device (T, C, D, etc.) : Input the range of values the device can handle.

## 3.10.5 Device batch monitor

Specify a device and monitor a continuous range of devices that follow it.

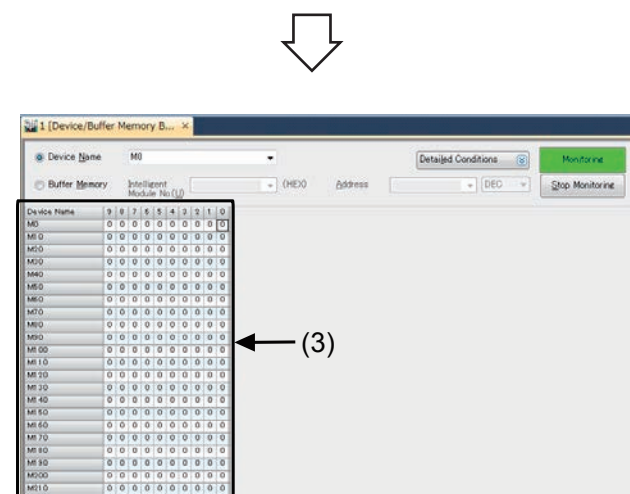


- (1) Select [Online] → [Monitor] from the menu bar.  
Or right click the circuit window and select [Device/Buffer Memory Batch Monitor].



- (2) Input the first number of the devices to be monitored in the "Device/Buffer Memory Batch Monitor" window and then press the  key to begin monitoring.

(Note) When designating a timer or counter, click [Detailed Conditions], and designate the program part [ProgPou] from the program reference destination.



- (3) The operation state corresponding to the device operation will display.
  - Bit device (X, Y, M, S): ON = 1, OFF = 0
  - Timer, counter: Contact/coil ON/OFF state, setting value, current value
  - Data register: Current value

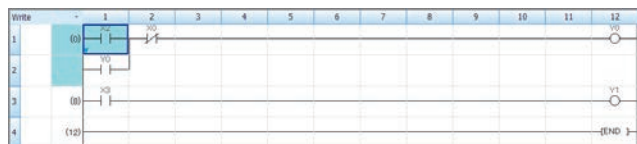
### Changing the display format

The format can be changed with [Display] → [Display Format Detailed Setting] on the menu bar.

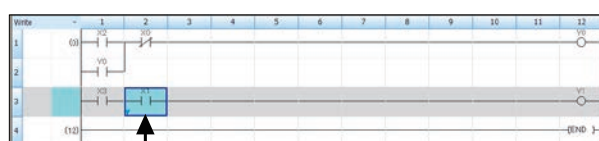
## 3.10.6 Writing a program to the PLC during RUN

Write the corrected part of the circuit to the PLC when the PLC is running.

Less time is needed for writing during RUN since the entire program is not transferred.



- (1) A contact will be added to the circuit on the left as an example.



- (2) Add a contact.  
The circuit block is displayed in gray.

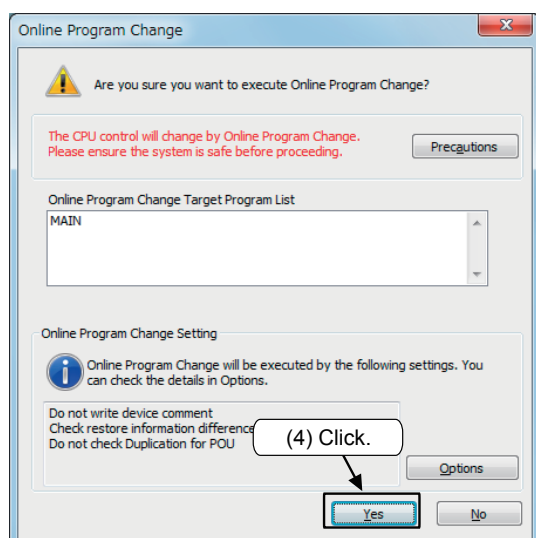
(2) Add a contact.

Write during RUN



[Shift]+[F4]

- (3) Press [Shift] and [F4] together, or select [Convert] → [Online Program Change] from the menu bar.



- (4) Confirm the details in the warning message, such as that there will be no safety risks if the control changes due to changes in the program, and then click [Yes].

### Caution

It is impossible to write the program to the PLC if the program in the PLC is different from the one in GX Works3. Verify in advance, or transfer the program first by using [Write to PLC].

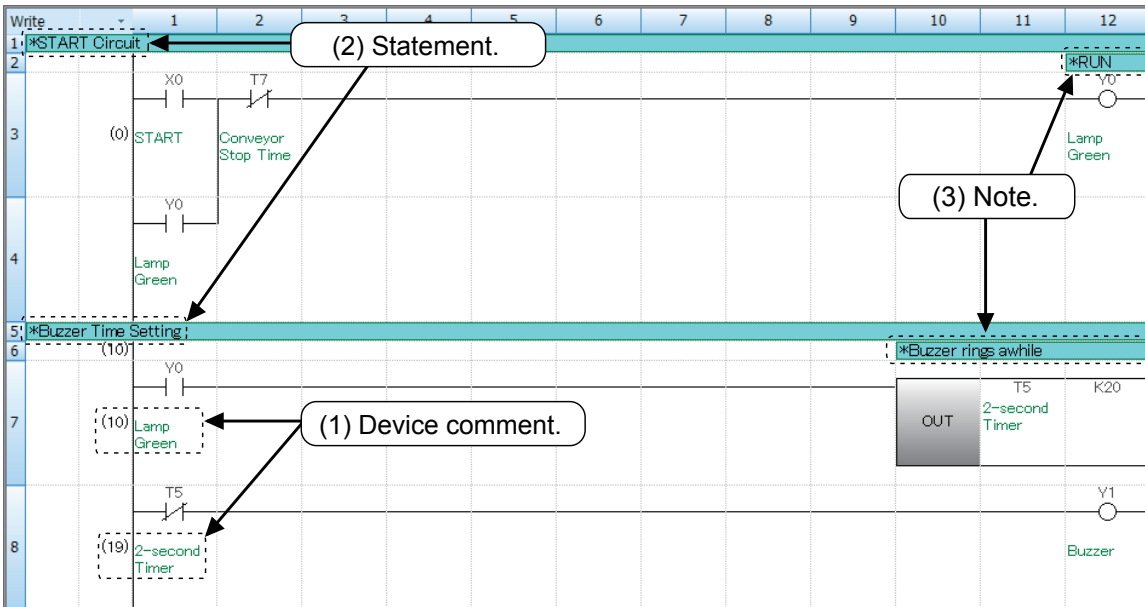
# 3.11 Inputting comments

## 3.11.1 Types of comments

The following 3 types of comments can be input.

| Type               | Purpose   | The number of characters (full-width) |
|--------------------|---|---------------------------------------|
| (1) Device comment | A comment describing the role and function of each device         | 1024                                  |
| (2) Statement      | A comment describing the role and function of circuit blocks      | 5000                                  |
| (3) Note           | A comment describing the role and function of output instructions | 5000                                  |

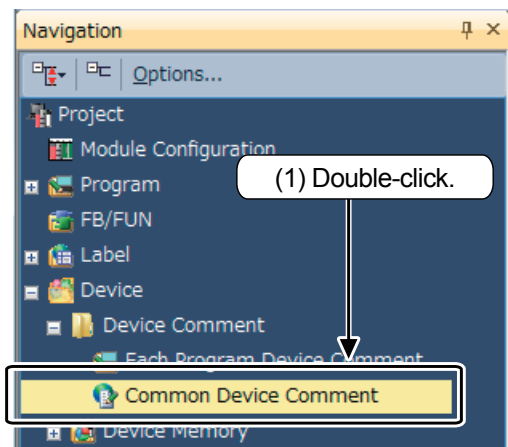
### [Comment Examples]



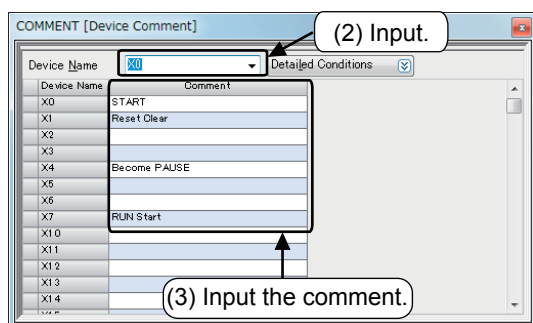
### Point

- Device comments include [Common] and [By Program].
  - [Common Device Comment]: Comments used commonly by several programs.
  - [Comment By Program]: Comments used within the program file having the same name.  
These cannot be written to the PLC.
- Statements include "In PLC" and "In Peripheral".
  - [In PLC Statement/Note]: Stored in the PLC.
  - [In Peripheral Statement/Note]: Cannot be stored in the PLC.

## 3.11.2 Operation for creating device comments



- (1) Double-click [Device] → [Device Comment] → [Common Device Comment] on the navigation window.



- (2) Input the start number of the devices which are to be commented in "Device name", and click .

- (3) Input comments in the "Comment" column.

- When inputting comments for another device, input the device number again following step (2).

### Displaying the comment

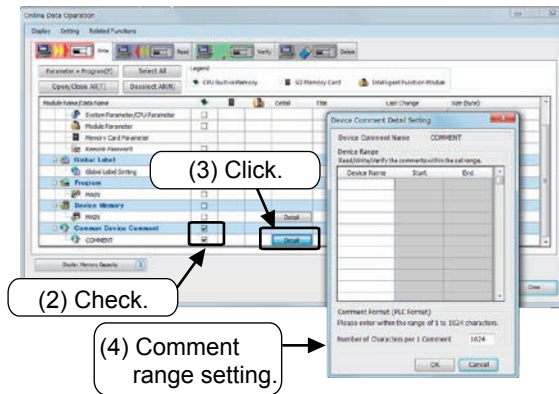
Click on [Display] → [Comment Display] in the menu, and input " ✓ ".

## Point

### Setting for writing the device comments to the PLC

- To write the device comments to the PLC, the writing range must be set.

Detailed setting for device comments



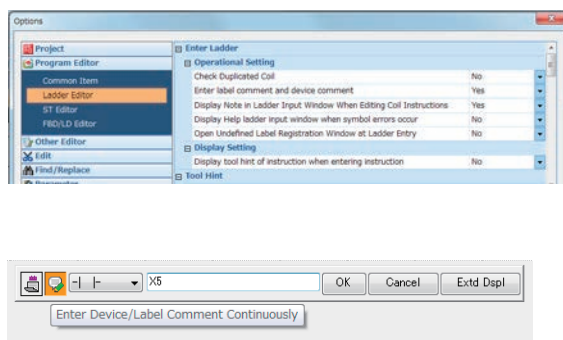
- (1) Select [Online] → [Write to PLC] on the menu.
- (2) Check "Common Device Comment".
- (3) Click [Details].
- (4) On the Device Comment Details Setting dialog, set the type and range of devices written to the PLC, and number of characters (1 to 1024) in one comment.

- All device comments will be write targets if the device comment range is not set.

3

## Reference

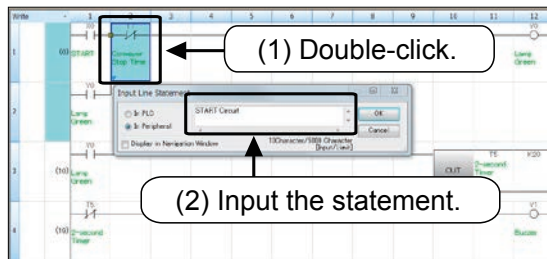
### How to input comments when creating a circuit (Two methods)




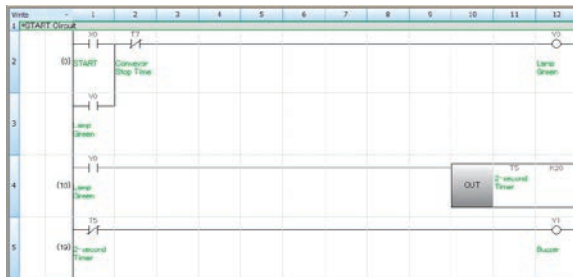
- Select [Tool] → [Options] from the menu, select [Program Editor] → [Ladder Editor] from the setting tree, and select [Yes] for [Enter label comment and device comment].  
When the above setting is made, the [Comment Input] window will open after the circuit input operation during circuit creation.
- When inputting the circuit, click the icon shown on the left to changeover.



### 3.11.3 Operation for creating statements

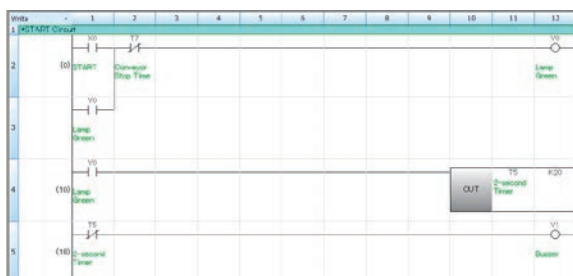



- (1) Click  from the tool bar, and double-click anywhere on the circuit block where the statement is to be written.
- (2) Input the statement in the "Input Line Statement" window and click [OK].



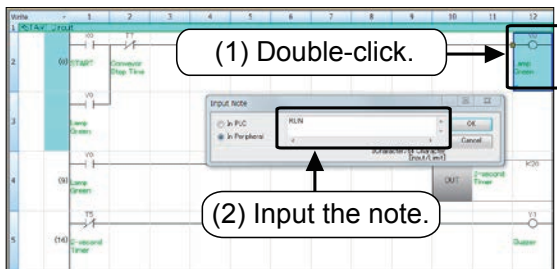
(3) **F4** (Convert)


(3) Set with the **F4** (Convert) key.

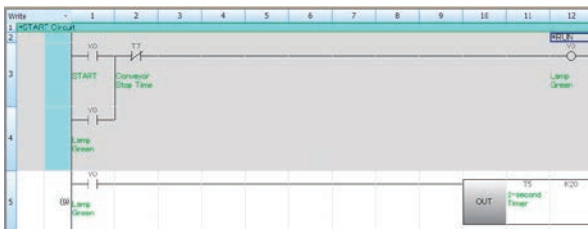


- Click  on the tool bar again to finish the operation.

## 3.11.4 Operation for creating notes

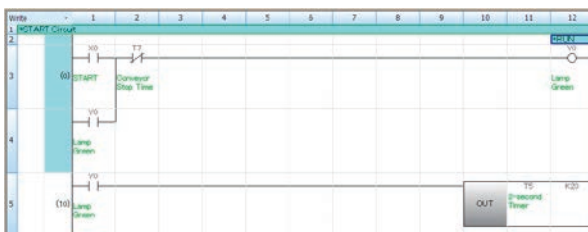



- (1) Click  from the tool bar, and double-click the output instruction symbol where the note is to be written.
- (2) Input the note in the "Input Note" window and click [OK].



- (3) **F4** (Convert)

- (3) Set with the **F4** (Convert) key.



- Click  on the tool bar again to finish the operation.

# MEMO

# Easy to master instructions!

## Chapter 4

# SUMMARY OF PLC INSTRUCTIONS

---

### So far...

It was explained that the PLC is a collection of many relays, timers and counters, and the internal sequence is created with personal computer software, etc.

It was also explained that when creating this sequence program, there are rules according to how the contacts and coils are connected and according to the types of coils. These rules are the instructions.

### In the instructions...

There are some that function with just the instruction word + device, or with just the instruction word. Thus, it is necessary to know how the device number is configured.

### In this chapter...

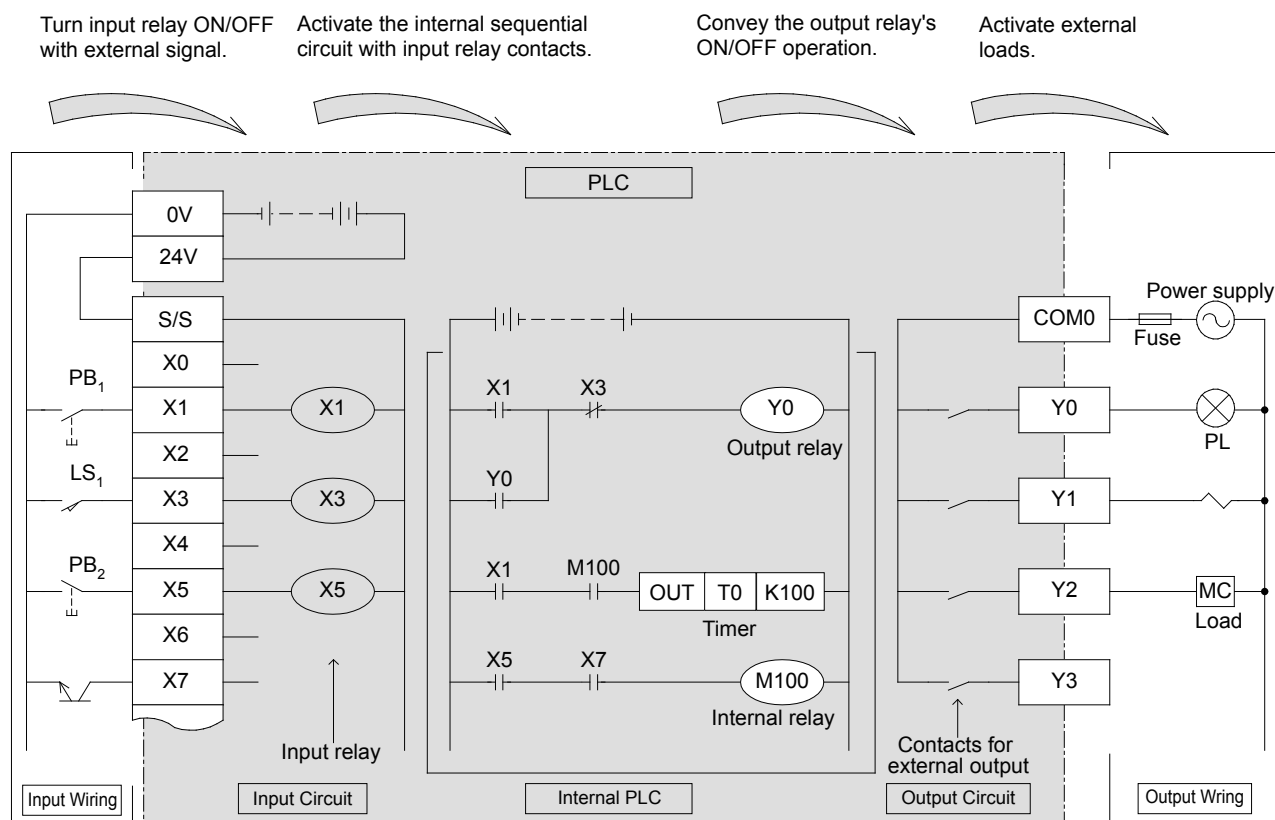
Instructions for the PLC are described. Note that there are also many application instructions which are used to simplify complicated sequential circuit designs.

If you would like to perform the programming training, please learn the basic personal computer operations referenced in Chapter 3 beforehand.

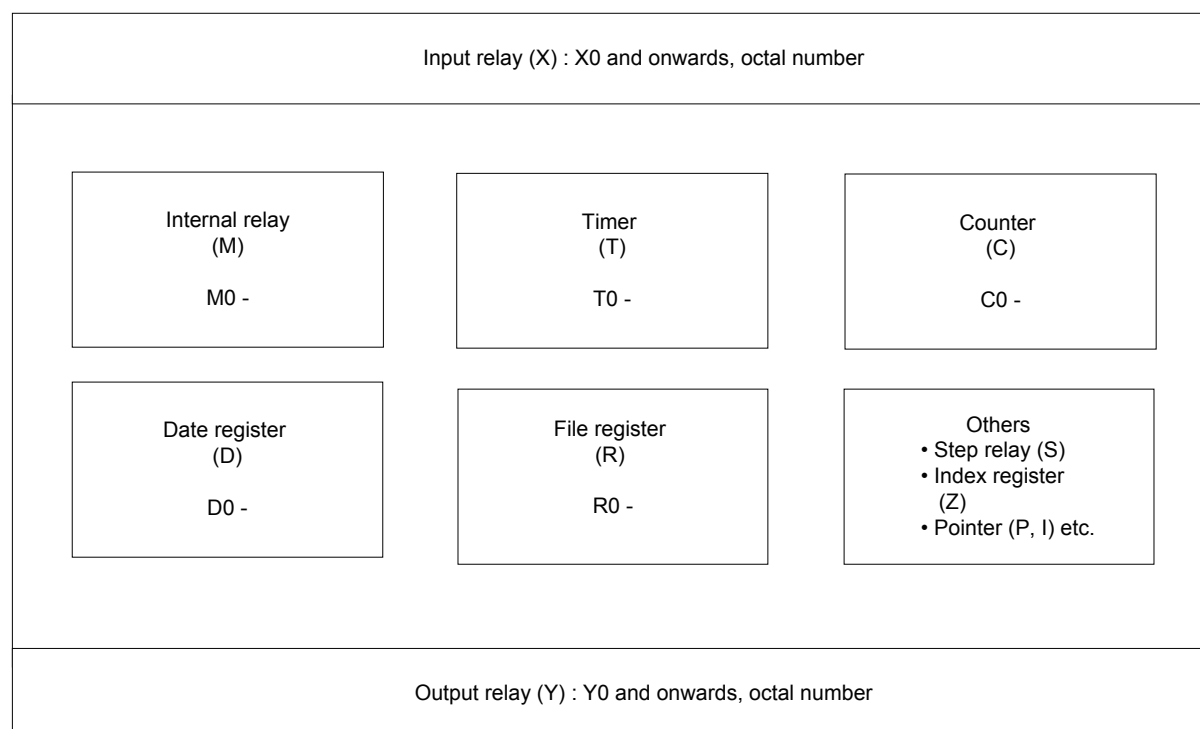
Now, let's understand the contents of instructions.

# 4.1 Devices and device numbers

There are various relay and timer identification numbers.



## (1) Types of PLC devices



## (2) Number of device points for FX5U CPU module main devices

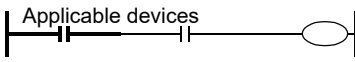
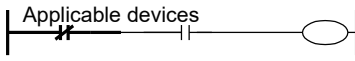
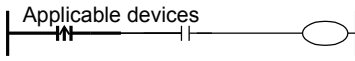
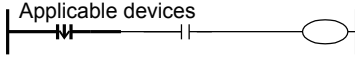
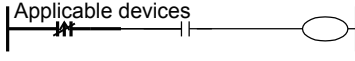
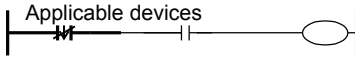
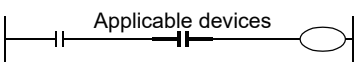
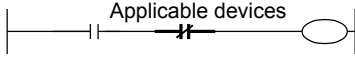
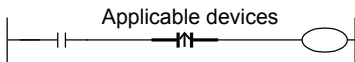
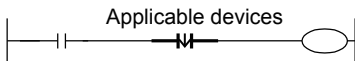
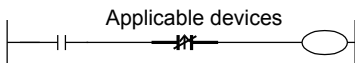
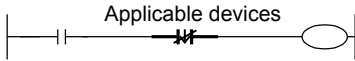
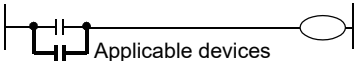
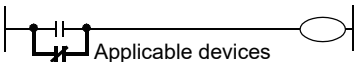
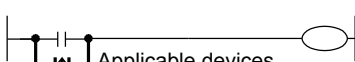
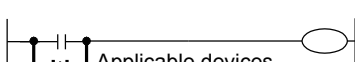
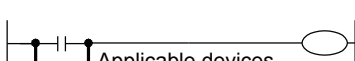
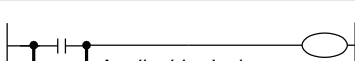
| Item                            |                                    |                      | Base | Maximum number of points  |  |
|---------------------------------|------------------------------------|----------------------|------|---|--|
| Number of user device points    | Input relay (X)                    |                      | 8    | 1024 points or less   | The total of X and Y assigned to the input/output is maximum 256 points. |
|                                 | Output relay (Y)                   |                      | 8    | 1024 points or less   |  |
|                                 | Internal relay (M)                 |                      | 10   | 32768 points (variable with parameters) *1                                      |  |
|                                 | Latch relay (L)                    |                      | 10   | 32768 points (variable with parameters) *1                                      |  |
|                                 | Link relay (B)                     |                      | 16   | 32768 points (variable with parameters) *1                                      |  |
|                                 | Annunciator (F)                    |                      | 10   | 32768 points (variable with parameters) *1                                      |  |
|                                 | Link special relay (SB)            |                      | 16   | 32768 points (variable with parameters) *1                                      |  |
|                                 | Step relay (S)                     |                      | 10   | 4096 points (fixed)   |  |
|                                 | Timer series                       | Timer (T)            | 10   | 1024 points (variable with parameters) *1                                       |  |
|                                 | Retentive timer series             | Retentive timer (ST) | 10   | 1024 points (variable with parameters) *1                                       |  |
|                                 | Counter series                     | Counter (C)          | 10   | 1024 points (variable with parameters) *1                                       |  |
|                                 |                                    | Long counter (LC)    | 10   | 1024 points (variable with parameters) *1                                       |  |
|                                 | Data register (D)                  |                      | 10   | 8000 points (variable with parameters) *1                                       |  |
|                                 | Link register (W)                  |                      | 16   | 32768 points (variable with parameters) *1                                      |  |
|                                 | Link special register (SW)         |                      | 16   | 32768 points (variable with parameters) *1                                      |  |
| Number of system device points  | Special relay (SM)                 |                      | 10   | 10000 points (fixed)  |  |
|                                 | Special register (SD)              |                      | 10   | 12000 points (fixed)  |  |
| Module access device            | Intelligent function module device |                      | 10   | 65536 points (Specified with U□¥G□)   |  |
| Number of index register points | Index register (Z) *2              |                      | 10   | 24 points   |  |
|                                 | Long index register (LZ) *2        |                      | 10   | 12 points   |  |
| Number of file register points  | File register (R)                  |                      | 10   | 32768 points (variable with parameters) *1                                      |  |
| Number of nesting points        | Nesting (N)                        |                      | 10   | 15 points (fixed)   |  |
| Number of pointer points        | Pointer (P)                        |                      | 10   | 4096 points   |  |
|                                 | Interrupt pointer (I)              |                      | 10   | 178 points (fixed)  |  |
| Others                          | Decimal constant (K)               | Signed               | —    | For 16 bits: -32768 to +32767,<br>For 32 bits: -2147483648 to +2147483647       |  |
|                                 |                                    | Unsigned             | —    | For 16 bits: 0 to 65535,<br>For 32 bits: 0 to 4294967295                        |  |
|                                 | Hexadecimal constant (H)           |                      | —    | For 16 bits: 0 to FFFF,<br>For 32 bits: 0 to FFFFFFFF                           |  |
|                                 | Real constant (E)                  | Single precision     | —    | E-3.40282347+38 to E-1.17549435-38, 0,<br>E1.17549435-38 to E3.40282347+38      |  |
|                                 | String                             |                      | —    | Shift-JIS Code maximum half-byte 255 characters (256 characters including NULL) |  |

\*1: Variable with parameters within the range of the CPU module built-in memory's capacity.

\*2: The index register (Z) and long index register (LZ) can be set with a total of 24 words or less.

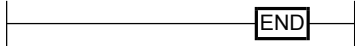
## 4.2 Types of PLC instructions

The following table lists the available PLC instructions for FX5U CPU module programming.

| Mnemonic                   | Name                       | Symbol  | Function  | Applicable Devices <sup>*1</sup>                                  |
|----------------------------|----------------------------|---|---|---|
| <b>Contact Instruction</b> |                            |   |   |   |
| LD                         | Load                       |    | Initial logical operation contact type NO (normally open)   | X,Y,M,L,SM,F,<br>B,SB,S,T,ST,C,<br>LC,DX<br>D,W,SD,SW,R,<br>U□\G□ |
| LDI                        | Load inverse               |    | Initial logical operation contact type NC (normally closed) |   |
| LDP                        | Load pulse                 |    | Initial logical operation of Rising edge pulse              |   |
| LDF                        | Load falling pulse         |    | Initial logical operation of Falling/trailing edge pulse    |   |
| LDPI                       | Load pulse inverse         |    | Start of Rising edge pulse NOT operation                    |   |
| LDFI                       | Load falling pulse inverse |    | Start of Falling edge pulse NOT operation                   |   |
| AND                        | AND                        |   | Serial connection of NO (normally open) contacts            |   |
| ANI                        | AND inverse                |  | Serial connection of NC (normally closed) contacts          |   |
| ANDP                       | AND pulse                  |  | Serial connection of Rising edge pulse                      |   |
| ANDF                       | AND falling pulse          |  | Serial connection of Falling/trailing edge pulse            |   |
| ANDPI                      | AND pulse inverse          |  | Serial connection of Rising edge pulse negate               |   |
| ANDFI                      | AND falling pulse inverse  |  | Serial connection of Falling edge pulse negate              |   |
| OR                         | OR                         |  | Parallel connection of NO (normally open) contacts          |   |
| ORI                        | OR inverse                 |  | Parallel connection of NC (normally closed) contacts        |   |
| ORP                        | OR pulse                   |  | Parallel connection of Rising edge pulse                    |   |
| ORF                        | OR falling pulse           |  | Parallel connection of Falling/trailing edge pulse          |   |
| ORPI                       | OR pulse inverse           |  | Parallel connection of Rising edge pulse negate             |   |
| ORFI                       | OR falling pulse inverse   |  | Parallel connection of Falling edge pulse negate            |   |

| Mnemonic                          | Name                 | Symbol | Function   | Applicable Devices <sup>*1</sup>                                 |
|-----------------------------------|----------------------|--------|--|--|
| <b>Connection Instruction</b>     |                      |        |  |  |
| ANB                               | AND Block            |        | Serial connection of multiple parallel circuits          | —  |
| ORB                               | OR Block             |        | Parallel connection of multiple contact circuits         | —  |
| MPS                               | Memory Point Store   |        | Stores the current result of the internal PLC operations | —  |
| MRD                               | Memory Read          |        | Reads the current result of the internal PLC operations  |  |
| MPP                               | Memory POP           |        | Pops (recalls and removes) the currently stored result   |  |
| INV                               | Inverse              |        | Invert the current result of the internal PLC operations | —  |
| MEP                               | MEP                  |        | Conversion of operation result to leading edge pulse     | —  |
| MEF                               | MEF                  |        | Conversion of operation result to trailing edge pulse    | —  |
| <b>Out Instruction</b>            |                      |        |  |  |
| OUT                               | OUT                  |        | Final logical operation type coil drive                  | X,Y,M,L,SM,F,B,SB,S,DY<br>D,W,SD,SW,R,U□\G□                      |
| SET                               | SET                  |        | SET Bit device latch ON                                  | X,Y,M,L,SM,F,B,<br>SB,S,T,ST,C,LC,DY<br>D,W,SD,SW,R,U□\G□        |
| RST                               | Reset                |        | RESET Bit device OFF                                     | X,Y,M,L,SM,F,B,<br>SB,S,DY<br>ST,C,D,W,SD,SW,<br>R,U□\G□,Z,LC,LZ |
| PLS                               | Pulse                |        | Rising edge pulse  | X,Y,M,L,SM,F,B,SB,S,DY<br>D,W,SD,SW,R,U□\G□                      |
| PLF                               | Pulse Falling        |        | Falling/trailing edge pulse                              |  |
| ALT                               | Alternate            |        | Output reversal  | X,Y,M,L,SM,F,B,SB,S,DY<br>D,W,SD,SW,R,U□\G□                      |
| <b>Master Control Instruction</b> |                      |        |  |  |
| MC                                | Master Control       |        | Denotes the start of a master control block              | X,Y,M,L,SM,F,B,SB,S,<br>D,W,SD,SW,R                              |
| MCR                               | Master Control Reset |        | Denotes the end of a master control block                | —  |

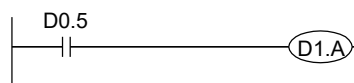


| Mnemonic        | Name | Symbol  | Function  | Applicable Devices <sup>*1</sup> |
|-----------------|------|---|---|----------------------------------|
| End Instruction |      |   |   |                                  |
| END             | END  |  | End program, and return to input/output process and 0 step. | —                                |

\*1: When the device No. is specified, the word device (D,W,SD,SW,R,U□\G□) can handle the bit data for the specified bit No.

The bit No. can be specified with a hexadecimal in the range of 0 to F.

For example, the D0 bit 5 (b5) is specified as "D0.5", and the D1 bit 10 (b10) is specified as "D1.A".

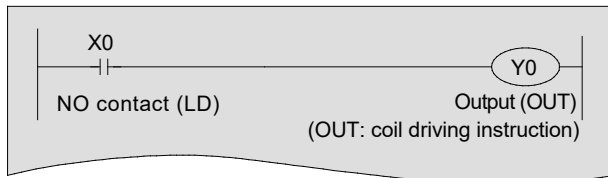


## 4.3 Let's master PLC instructions

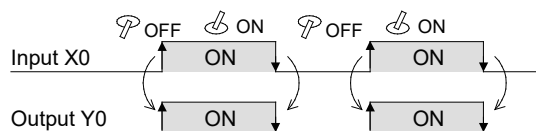
### 4.3.1 Contact instruction and out instruction

#### (1) [ Program of NO contact ] Normally open instructions

Ladder display



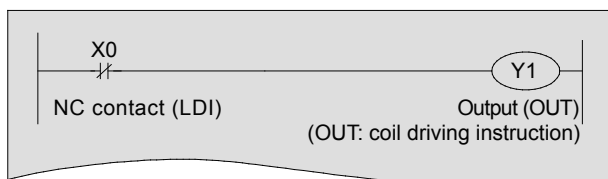
#### <<Operation>>



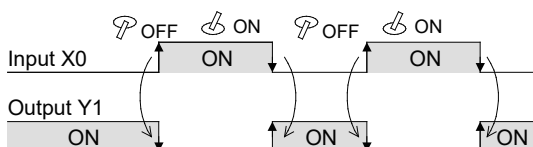
- If the input condition X0 is "ON", Y0 is "ON".
- If X0 is "OFF", Y0 is "OFF".

#### (2) [Program of NC contact] Normally closed instructions

Ladder display



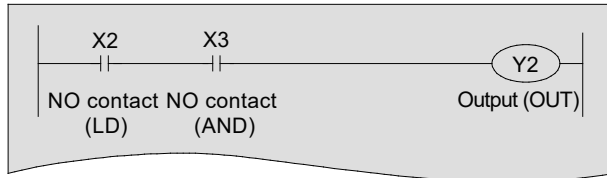
#### <<Action>>



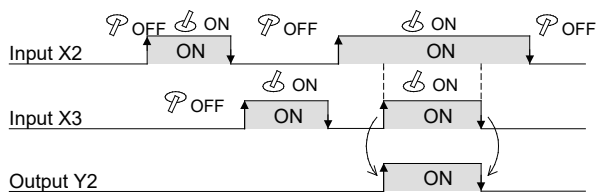
- If the input condition X0 is "OFF", Y1 is "ON".
- If X0 is "ON", Y1 is "OFF".

### (3) [Program of a serial circuit (1)]

Ladder display



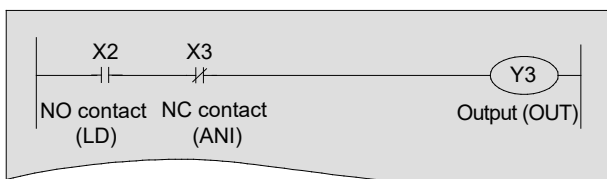
#### <<Action>>



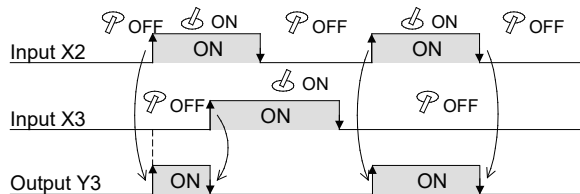
- If the input condition X2 and X3 are both "ON", Y2 is "ON".
- If X2 or X3 is "OFF", Y2 is "OFF".

### [Program of a serial circuit (2)]

Ladder display



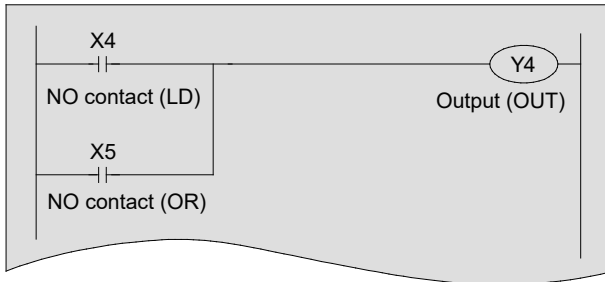
#### <<Action>>



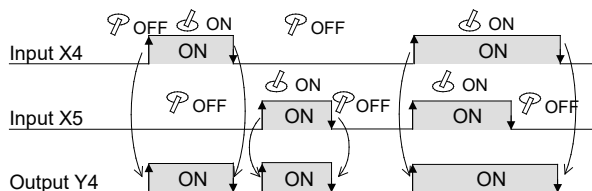
- If the input condition X2 is "ON" and X3 is "OFF", Y3 is "ON".
- If X2 is "OFF" or X3 is "ON", Y3 is "OFF".

## (4) [Program of a parallel circuit (1)]

Ladder display



### <<Action>>



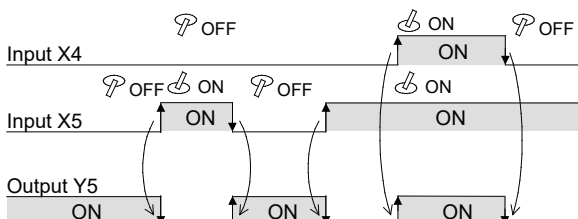
- If the input condition X4 or X5 is "ON", Y4 is "ON".
- If X4 and X5 are both "OFF", Y4 is "OFF".

## [Program of a parallel circuit (2)]

Ladder display



### <<Action>>

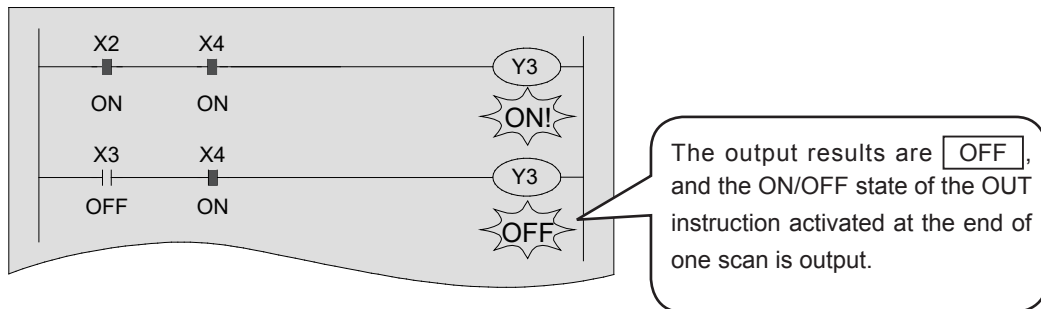


- If the input condition X4 is "ON" or X5 is "OFF", Y5 is "ON".
- If X4 is "OFF" and X5 is "ON", Y5 is "OFF".

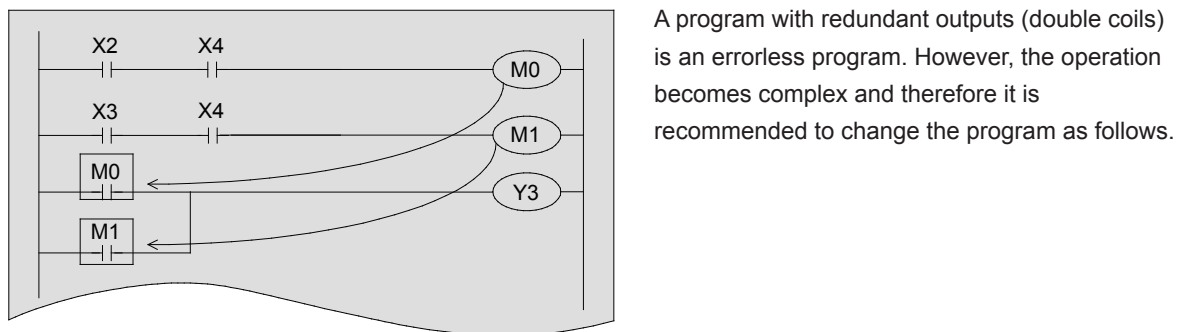
## Important point

### Prohibition of double output (double coil), and countermeasures

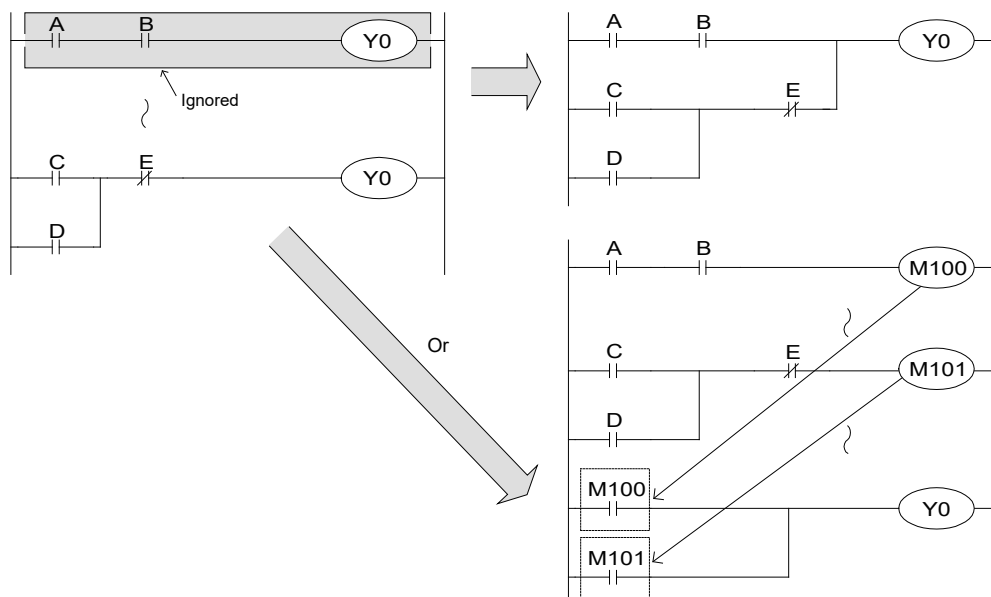
- Note that it is prohibited to specify multiple OUT instructions to a single coil.



Change it like this.



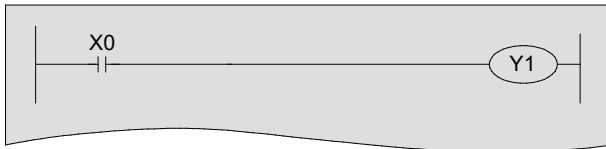
### Another changing example



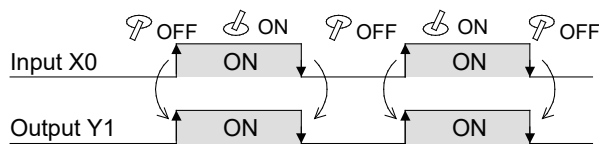
## 4.3.2 Difference between OUT instruction and SET/RST

### (1) [OUT instruction] OUT (Coil driving instruction)

Ladder display



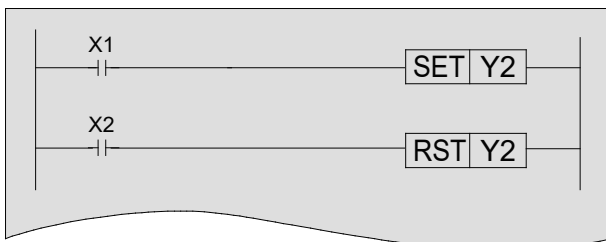
#### <<Action>>



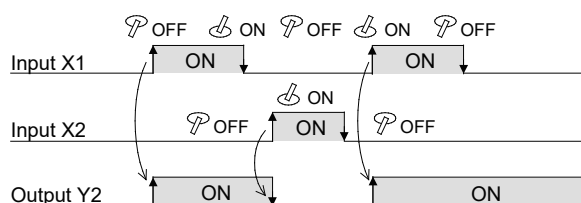
- If the input condition is "ON", the OUT instruction will turn on the specified device.
- If the input condition is "OFF", the specified device will also be turned "OFF".

### (2) [SET/RST instruction] SET (Instruction to maintain the energized status), Reset (Instruction to reset the energized status)

Ladder display



#### <<Action>>



- If the input condition is "ON", the SET instruction will turn on the specified device and keep it "ON" even after the input condition turns "OFF".
- In order to turn "OFF" the set device, use the RST instruction.

## 4.3.3 Clocking of timers

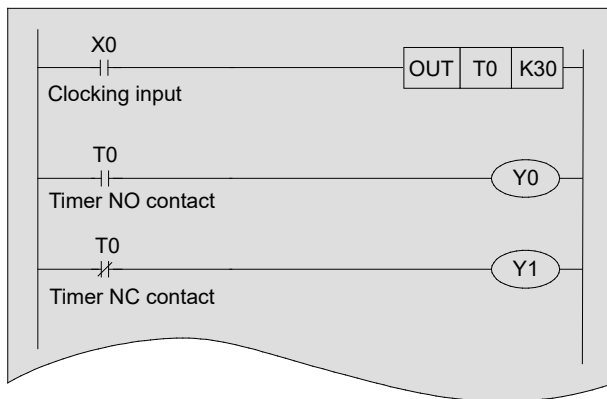
Timers count with clock pulses of 1 ms, 10 ms, 100 ms and so on. When they reach their set value, the output contact turns on. (On-delay timer)

The set value may be a constant (K) or indirectly specified by a value in a data register (D).

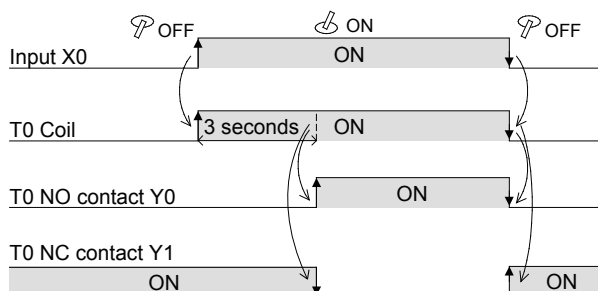
The timers include the Timer (T) for which the current value is set to 0 when the timer coil turns OFF, and the retentive timer (ST) that holds the current value even if the coil turns OFF.

### (1) Timer

Ladder display



### <<Action>>



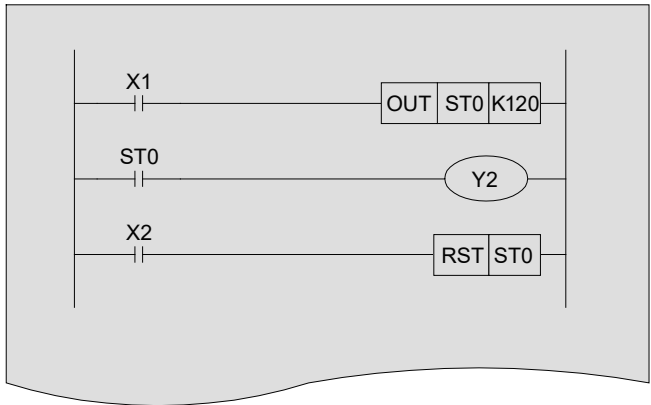
- If the input condition is "ON", the timer T0 begins clocking, and the T0 contact turns "ON" after the specified period (T0: 100 ms base × 30 = 3 seconds).
- If X0 is "OFF", the clocking of the timer is reset and the contact T0 turns "OFF".

### Reference

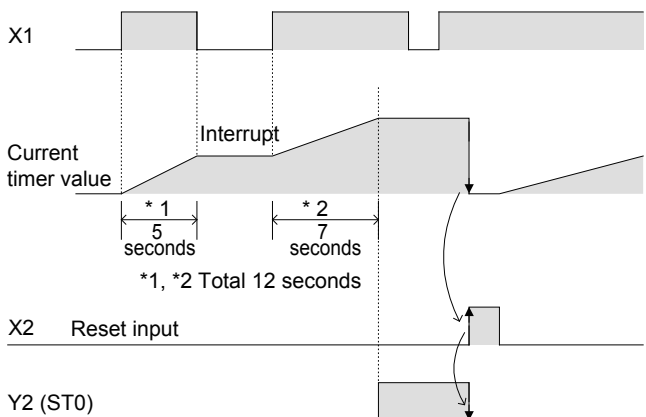
- The values of timers and counters can also be set with a data register (D). (Indirect specification of the value)

## (2) Retentive timer

Ladder display



### <<Action>>



- The timer operates only when the clock input X1 is "ON". The clock is interrupted when the input turns "OFF".
- The output contact of the timer operates when the total "ON" time of the input X1 reaches the predetermined value.
- If the reset input X2 is "ON", the current value of the timer will become 0 and the output contact will be "OFF".

### Reference

#### Types of timers

|                         |  |
|-------------------------|--|
| Timer module:           | The timer is a low-speed timer, timer, or high-speed timer according to the timer designation (how the instruction is written). For example, the same T0 can be a low-speed timer (100 ms) if specified as OUT T0, can be a timer (10 ms) if specified as OUTH T0, and a high-speed timer (1 ms) if specified as OUTHS T0. This also applies to the retentive timer. |
| Set value of the timer: | The constant K is an integer from 1 to 32,767. If the constant is K120, it is 12 seconds for low-speed timers based on 100 ms, and 0.12 seconds for high-speed timers based on 1 ms.   |
| Latched function:       | Even if the power is turned off during clocking, the current value of the timer will be saved and the timer will operate according to the total driving time before and after the power is off.  |



## 4.3.4 Counting of counters

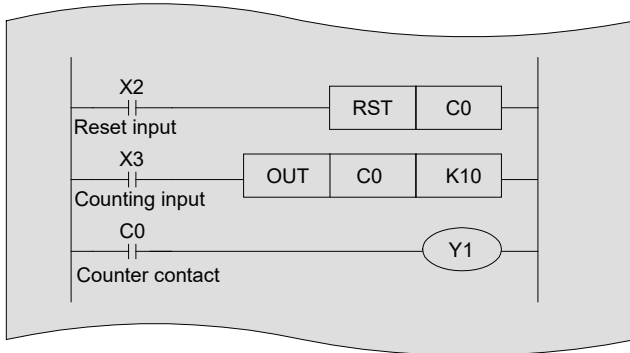
This section describes the counter (C) and long counter (LC).

### Features of the counter

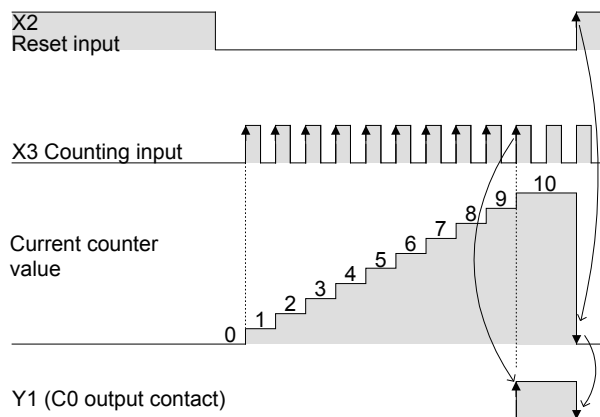
The features of the counter (C) and long counter (LC) are described below. They can be used according to the count range.

| Item                           | Counter (C)  | Long counter (LC)  |
|--------------------------------|--|--|
| Counting direction             | Up-counting  | Same as the left.  |
| Current value register         | 16 bits  | 32 bits  |
| Set value                      | 1 to 32767   | 1 to 4294967295  |
| Specification of the set value | By the constant K or data register   | Same as the left. However, the data registers are used in pair form (2 registers). |
| Change of the current value    | No changes after counting up   | Same as the left.  |
| Output contact                 | Latched after counting up  | Same as the left.  |
| Reset operation                | The current value of the counter will become 0 and the output contact will be restored when the RST instruction is executed. |  |

### Ladder display



### <<Action>>



- The counter's current value increments each time the count input X3 changes from "OFF" to "ON". When this value reaches the set value, the output contact activates.
- After reaching the predetermined value, the current value and the output contact keep their status.
- When reset input X2 turns "ON", the counter's current value changes to 0, and the output contact is restored.

### Reference

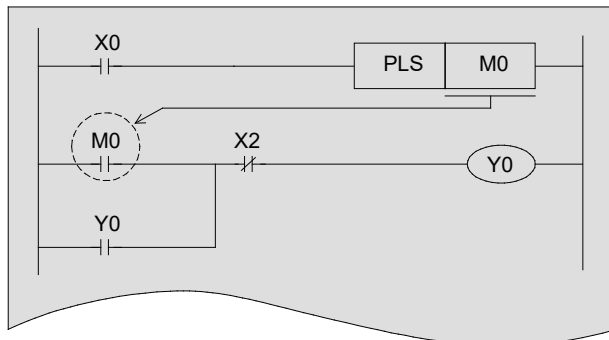
#### High speed inputs can be counted with high speed counters

If a high speed counter is used, inputs will not be missed and high speed signals can be counted.  
For details on high speed counters, see Chapter 10.

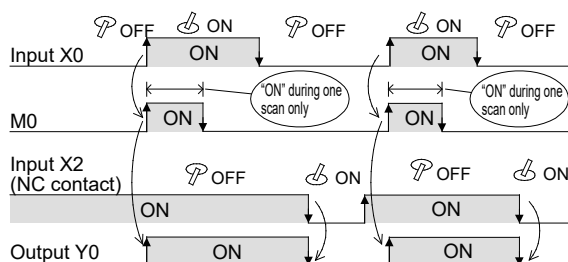
## 4.3.5 PLS/PLF instruction

### (1) [PLS instruction] Pulse (Rising edge pulse output)

Ladder display



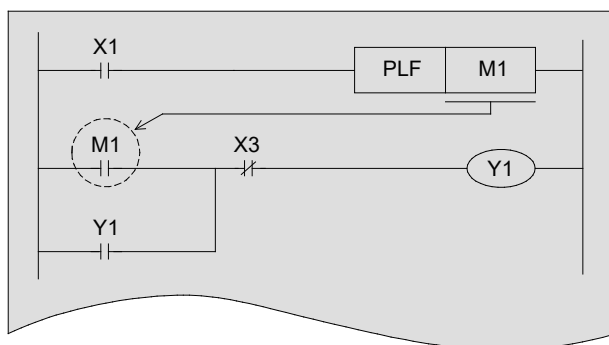
#### <<Action>>



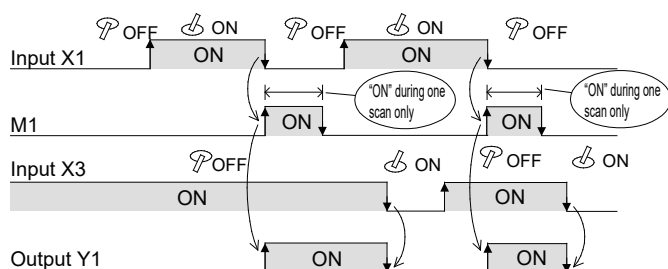
- When the input condition X0 turns "ON", the specified device turns "ON" for just one scan (1 operation cycle) at the rising edge.

### (2) [PLF instruction] Pulse falling (Falling edge pulse output)

Ladder display



#### <<Action>>



- When the input conditions X1 changes from "ON" to "OFF", the specified scan turns "ON" for just one scan (1 operation cycle) at the falling edge.

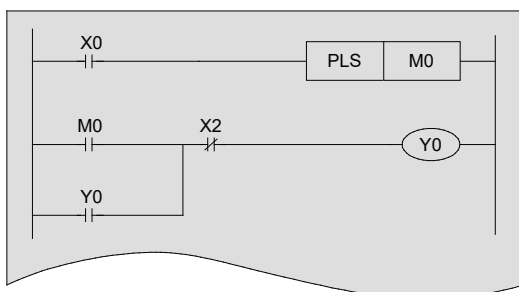
## Reference

### Simplification by using the rising/falling edge pulse contact instructions

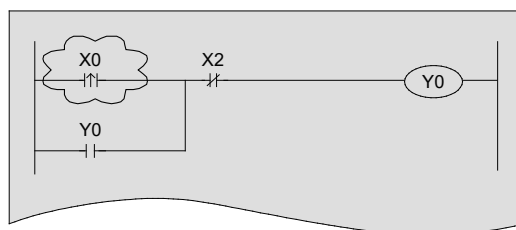
If the rising edge pulse contact  $\text{—}\uparrow\text{—}$  and the falling edge pulse contact  $\text{—}\downarrow\text{—}$  are used, the operation of the previously described PLS/PLF instruction can be written more simply.

They can be used according to the content and function of the following programs.

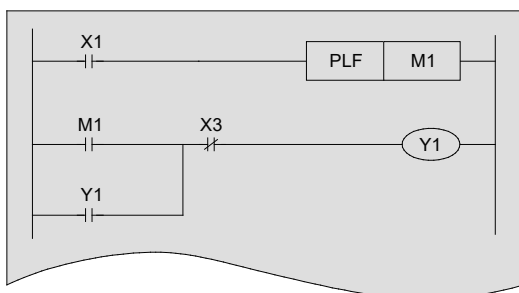
[When the PLS instruction is used]



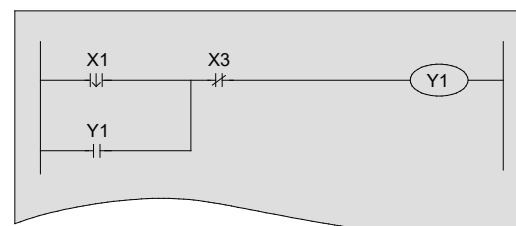
[When the rising edge pulse contact instruction is used]



[When the PLF instruction is used]



[When the falling edge pulse contact instruction is used]

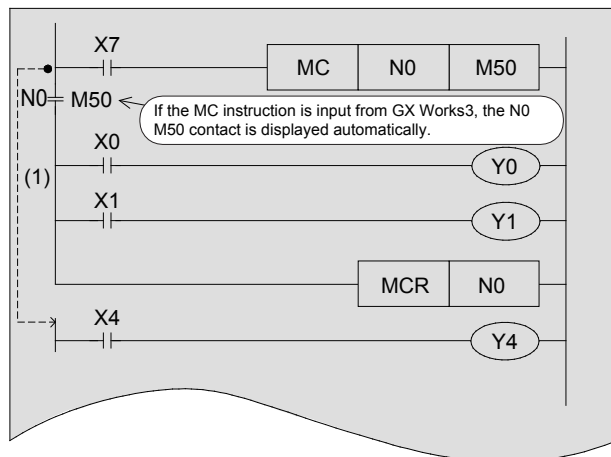


## 4.3.6 MC/MCR instruction

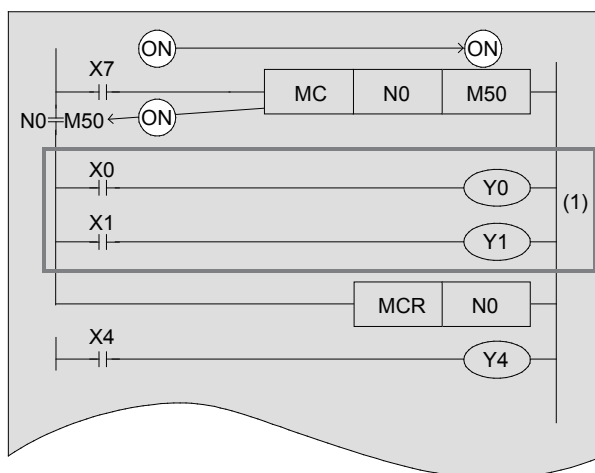
**[MC instruction] Master Control** (Denotes the start of a master control block)

**[MCR instruction] Master Control Reset** (Denotes the end of a master control block)

Ladder display



### <<Action>>



- While the input condition X7 is "ON", the circuit indicated by (1) becomes valid, [Y0 is "ON" if X0 is "ON"], and [Y1 is "ON" if X1 is "ON"].
- When X7 is "OFF", Y0/Y1 does not operate.
- Since Y4 is not subject to MC/MCR, it turns "ON and OFF" independently according to the operation of X4.

### Point

#### Status of MC/MCR block devices when MC does not operate

- Held with the current status: Devices driven by retentive timer values, counter values and SET/RST.
- OFF: Devices driven by non-retentive timers and devices driven by OUT instructions. With a regular timer, the current value is also set to 0.

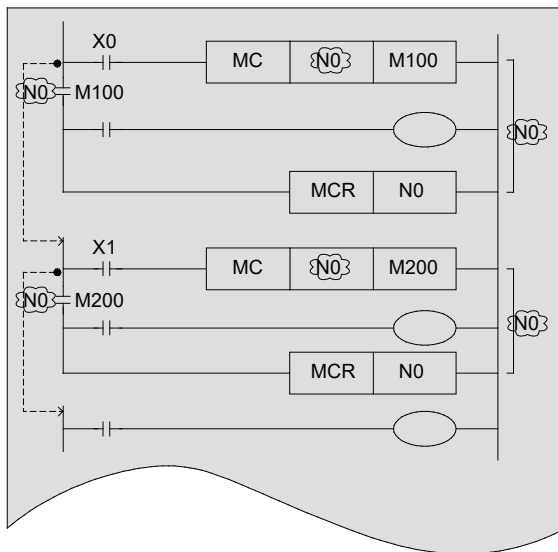
## Reference

### Nesting with MC/MCR

[No nest structure]

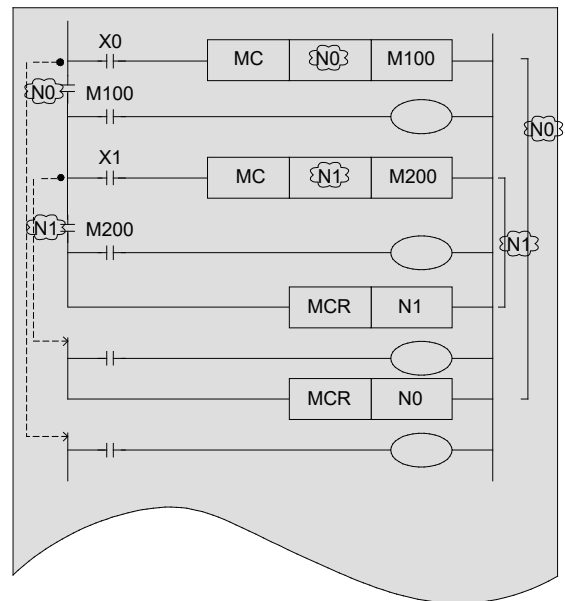
The nesting number N0 is consecutively used to program.

(No limitation on the number of use)



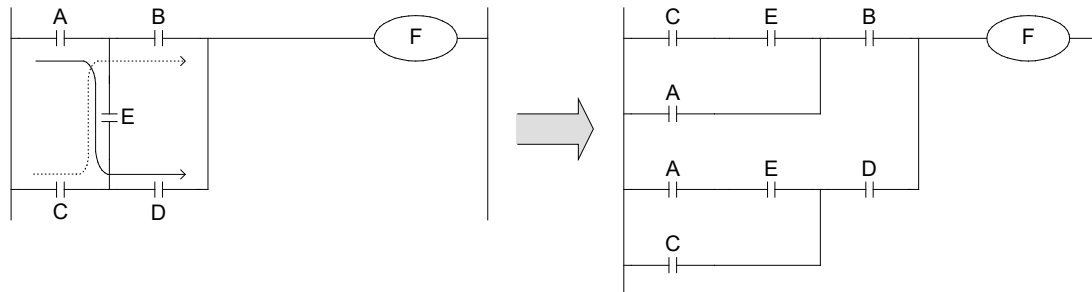
[Nest structured]

Nesting numbers N0 to N14 are sequentially used from the small number to big one to program. (Max. 15 layers)



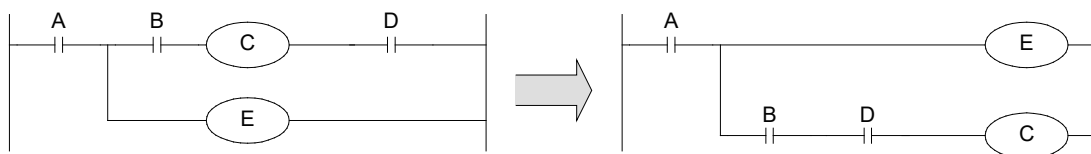
## 4.3.7 Non-programmable circuits and solutions

### (1) Bridge Circuit



A circuit in which current flows in both directions must be rewritten as shown above. (The circuit when having no D, and the circuit when having no B, in parallel. It was connected.)

### (2) Location of Coil

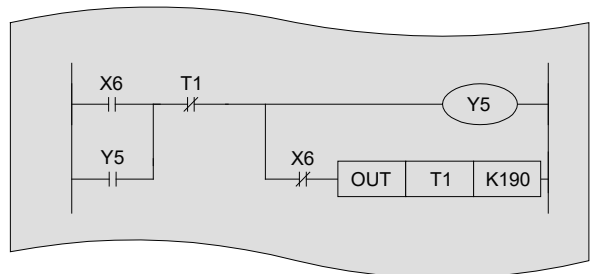


- Contacts cannot be located on the right side of coils.
- It is recommended that coils internally used between contacts be programmed prior to the output.

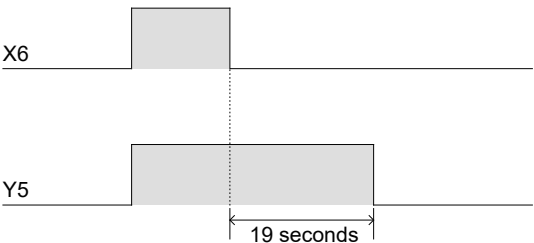
# 4.4 Circuit examples with PLC instructions

## (1) Off delay timer

Ladder display



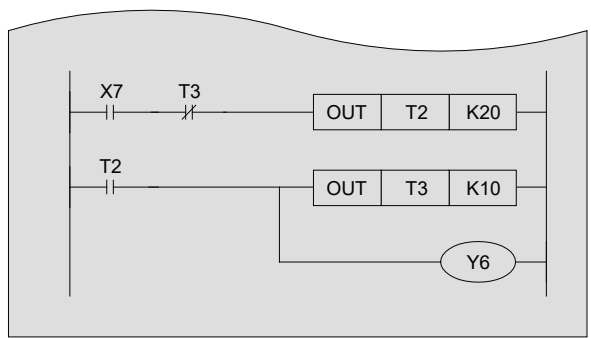
<<Action>>



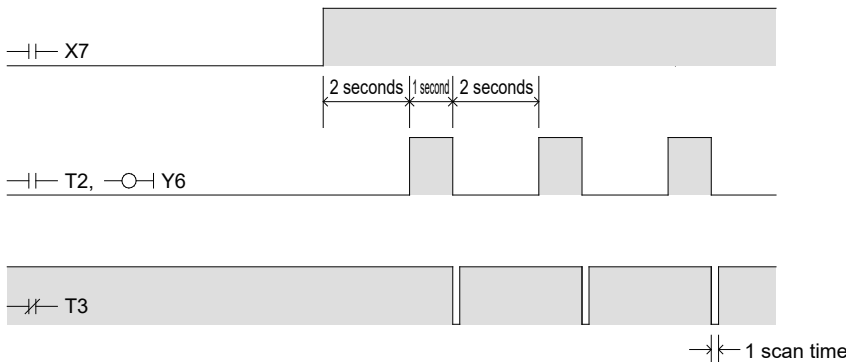
- Y5 will turn OFF 19 seconds after X6 turns OFF.  
A timer, which turns the input contact on or off with a certain time delay if the input contact is OFF, is referred to as off delay timer.

## (2) Flickering (Flashing)

Ladder display



<<Action>>

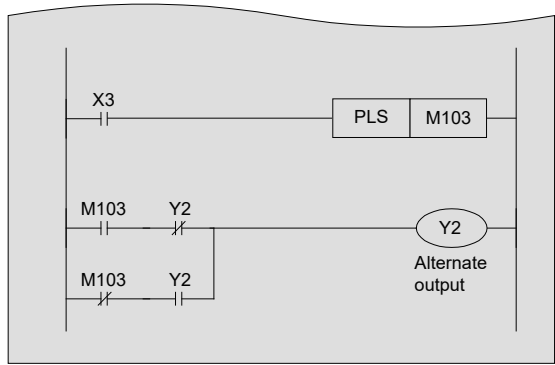


- Two seconds after X7 turns ON, a flashing operation is repeated in which Y6 turns ON for one second and then turns OFF for two seconds.

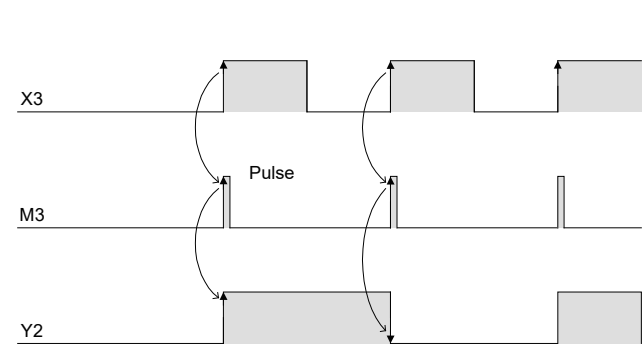


### (3) Alternate Circuit with pulse output circuit (Alternating operation circuit)

Ladder display



#### <<Action>>



- Once X3 is ON, Y2 is ON. If X3 is ON again, Y2 is, in turn, OFF. (Alternating operation)

Reference

- If the circuit is written with a different instruction, the circuit can be simplified as follows:
  - **Alternate circuit**

X3

ALT P

Y2

This circuit is equivalent to the above relay ladder circuit.

- Although relay ladder circuits can represent many controls, PLC instructions have the ability to greatly simplify the relay ladder circuits.

# Let's program!

## Chapter 5

### INTRODUCTION EXAMPLES AND PROGRAM OPERATION

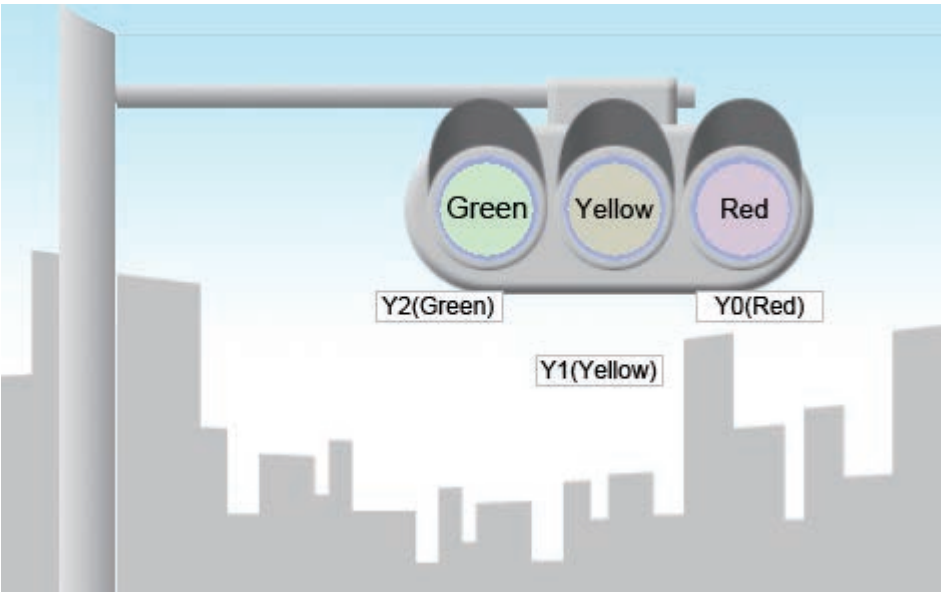
---

#### Let's practice...

Through monitoring the program examples outlined in this chapter, the user can master sequence programming.

In this chapter, you will practice programming using the universal simulation module FX5U-32MT-SIM and with a personal computer simulating the engineering tool. For the operation of the GX Works3, see Chapter 3.

# 5.1 Introduction example <<1>> [Traffic light control]



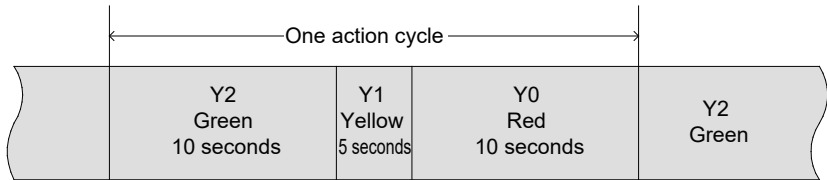
## <<Assignment of I/O>>

| Input |               |
|-------|---------------|
| X0    | Control start |
| X1    | Repeated stop |

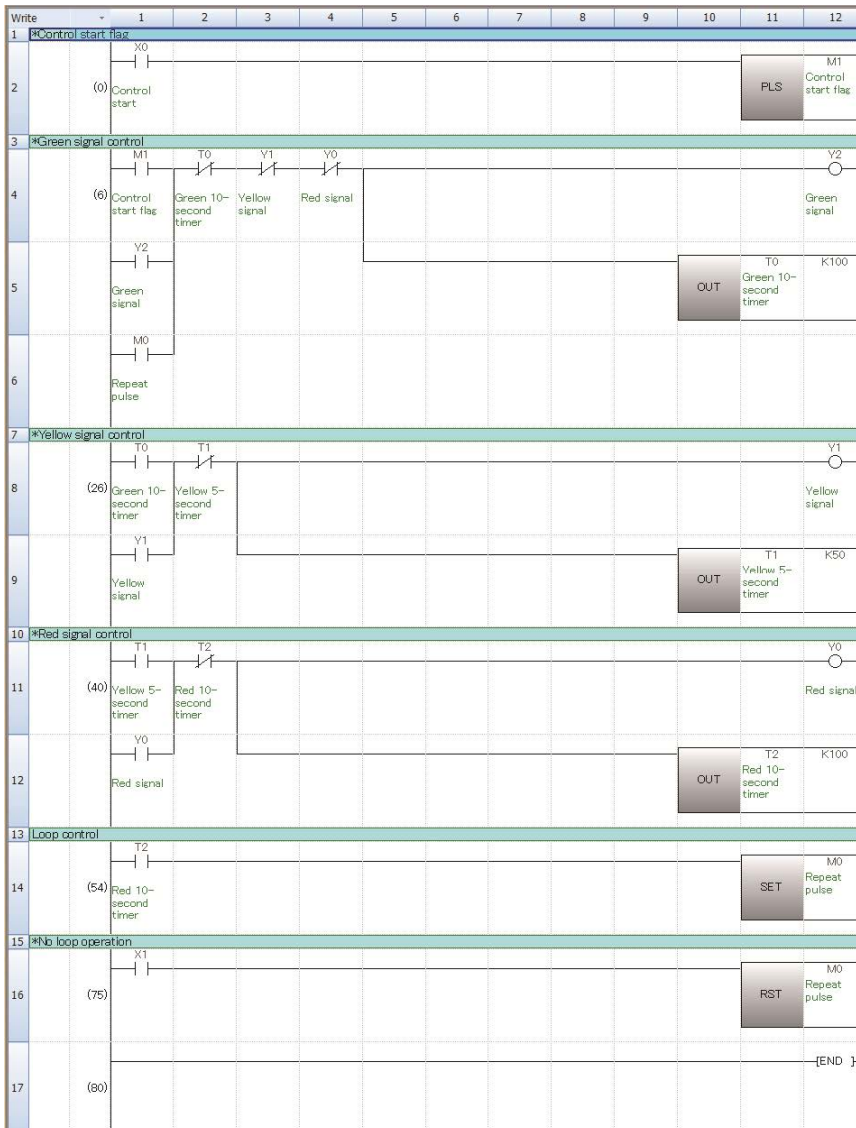
| Output |               |
|--------|---------------|
| Y0     | Red signal    |
| Y1     | Yellow signal |
| Y2     | Green signal  |

## <<Control specification>>

If the PLC is running, the lamps of the traffic light are operated in the following order.  
The operations are repeated after one action cycle. However, when X1 is ON, the operation will stop after one cycle.



## <<Example of sequence program with comments>>



If X0 turns ON, M1 will turn ON for one scan cycle.

If M1 turns ON for one scan cycle, Y2 (Green signal) will turn ON for 10 seconds.

If Y2 (Green signal) turns OFF, Y1 (Yellow signal) will turn ON for 5 seconds.

If Y1 (Yellow signal) turns OFF, Y0 (Red signal) will turn ON for 10 seconds.

If Y0 (Red signal) turns OFF, the program is repeated from the control of the green signal.

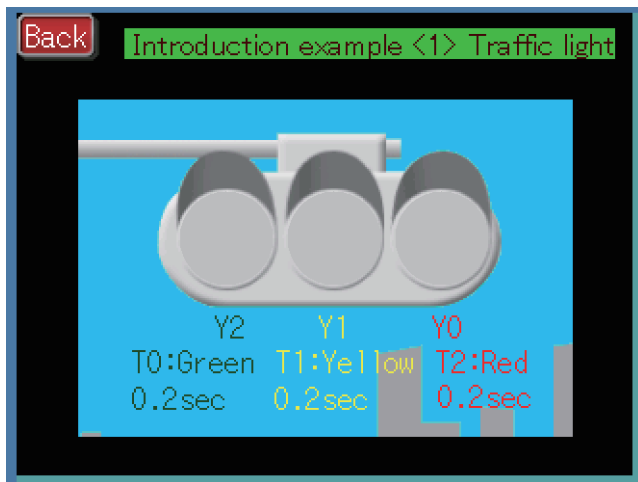
When X1 input is ON, repeated control is prohibited.

## <<Operation check>>

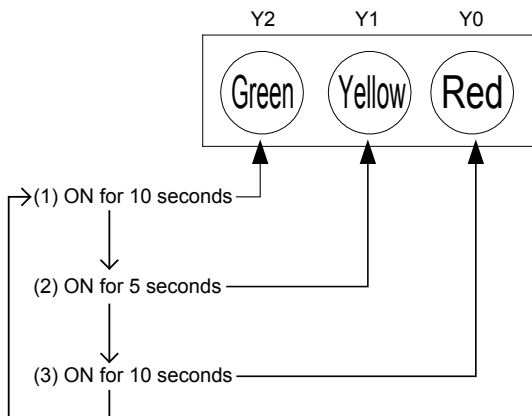
Use GX Works3 to monitor the circuit.

### Training Machine Screen

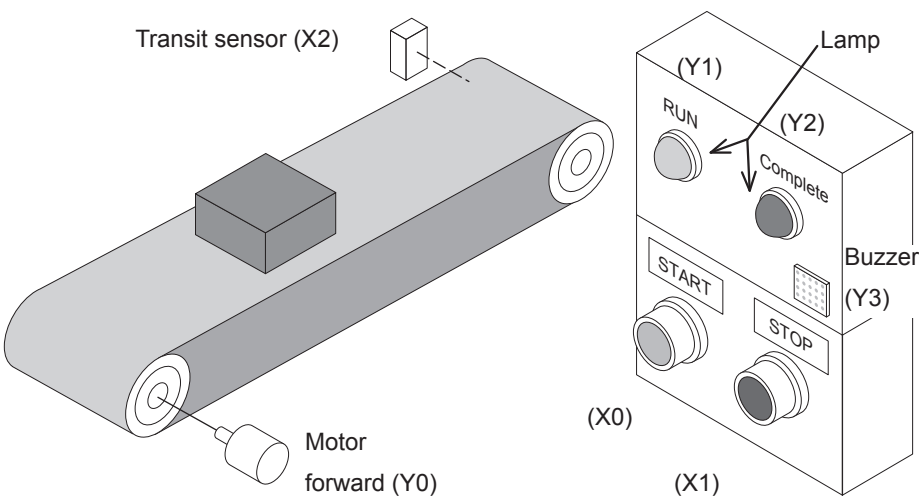
[Basics: MELSEC iQ-F Programming (GX Works3 Version)]



- If X0 turns ON, the signals will turn on in the following order.



## 5.2 Introduction example <<2>> [Conveyor control]



5

### <<Assignment of I/O>>

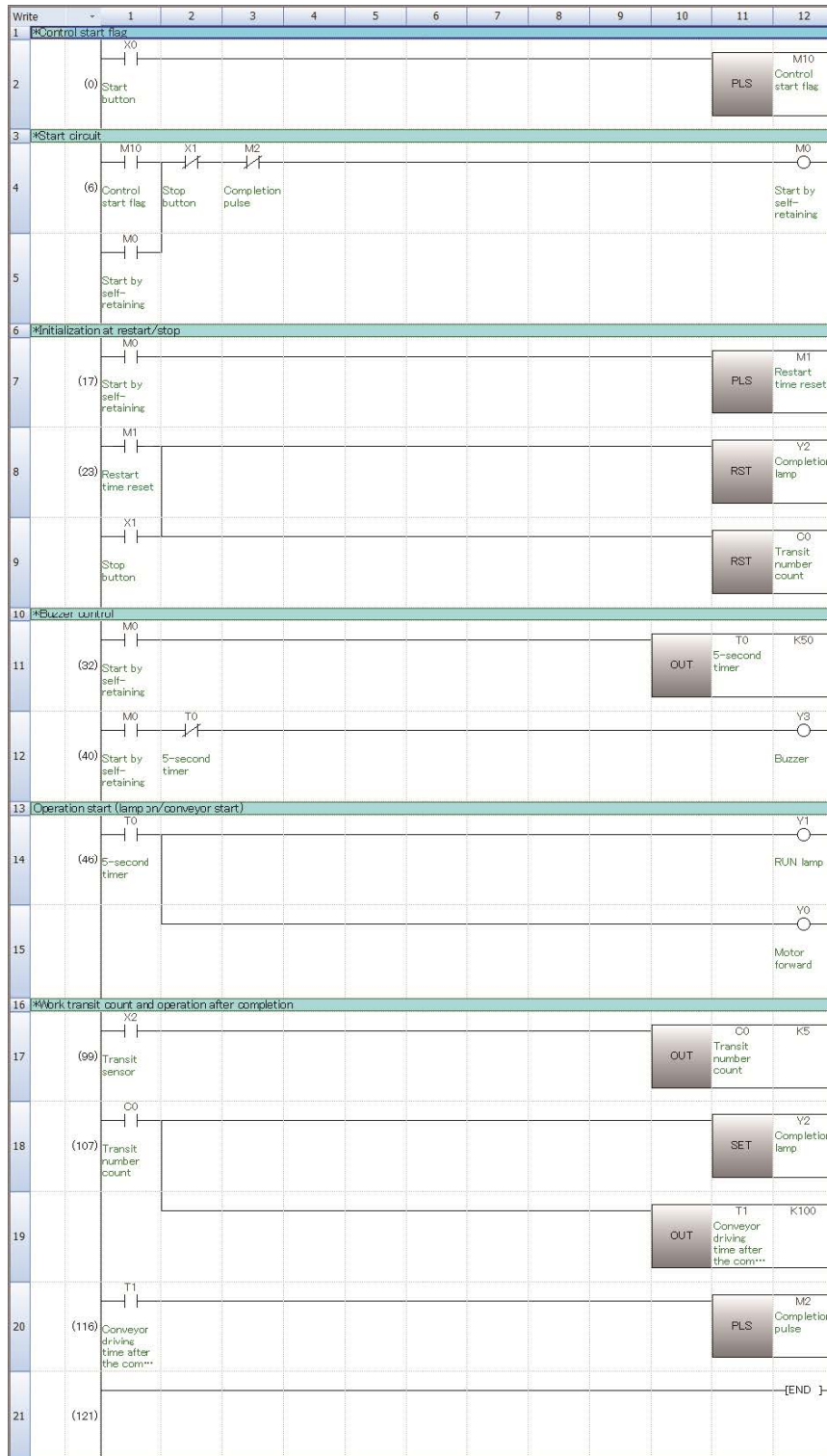
| Input |                |
|-------|----------------|
| X0    | Start button   |
| X1    | Stop button    |
| X2    | Transit sensor |

| Output |               |
|--------|---------------|
| Y0     | Motor forward |
| Y1     | RUN lamp      |
| Y2     | Complete lamp |
| Y3     | Buzzer        |

### <<Control specification>>

- (1) If [Start button (X0)] is pressed, [Buzzer (Y3)] sounds for 5 seconds.
- (2) After that, [Motor forward (Y0)] is activated, and the conveyor begins operating. [RUN lamp (Y1)] is on when the motor is rotating in the forward direction.
- (3) If [Transit sensor (X2)] detects 5 workpieces, [Complete lamp (Y2)] is turned on and the conveyor stops in 10 seconds.
- (4) Stop the control by [Stop button (X1)]. Turn on [Start button (X0)] to restart.

## <<Example of sequence program with comments>>



If X0 turns ON, M10 will turn ON for one scan cycle.

If M10 turns ON for one scan cycle, M0 is self-retained.

Before the operation, the pulse signal M1 is transmitted to initialize the status of the lamp and the current value of the counter.

Buzzer (Y3) sounds for 5 seconds.

RUN lamp (Y1) and motor forward (Y0) turn on after the buzzer (Y3) stops.

The counter (C0) counts the number of times the transit sensor (X2) turns on.

The completion lamp (Y2) will turn ON after the completion of the count.

The conveyor continues operating for 10 seconds by the timer (T1) after the completion of the count.

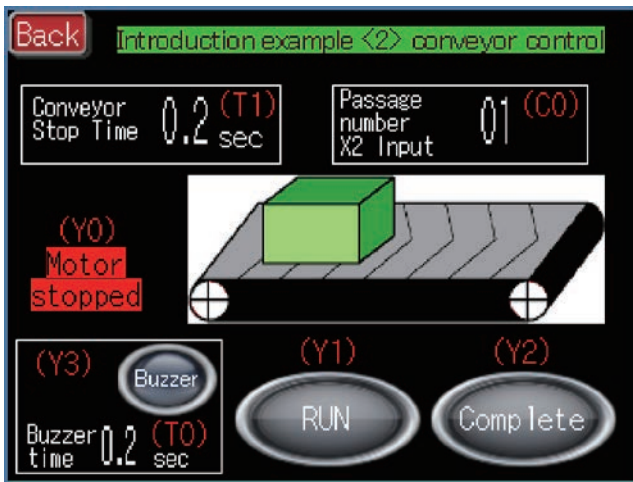
The pulse to stop the operation will be ON after the conveyor stops.

## <<Operation check>>

Use GX Works3 to monitor the circuit.

### Training Machine Screen

[Basics: MELSEC iQ-F Programming (GX Works3 Version)]



5

- (1) X0 (Start button) is turned ON.  $\Rightarrow$  Y3 (Buzzer) is turned on for 5 seconds.
- (2) 5 seconds later  $\Rightarrow$  Y1 (RUN lamp) is turned on, and Y0 (Motor forward) will be ON.
- (3) X2 (Transit sensor) is turned on for 5 times.  $\Rightarrow$  Y2 (Completion lamp) is turned on after the fifth ON signal is detected.
- (4) 10 seconds later  $\Rightarrow$  Y1 (RUN lamp) and Y0 (Motor forward) will be OFF, and the conveyor stops.



# MEMO

# Let's handle numeric values!

## Chapter 6

### EXPRESSING NUMERIC VALUES (DATA)

---

It is wasteful to use PLC as a simple relay board...

The PLC is not only used as a substitute for the relay board.

In recent times, the PLC has become a powerful machine with higher added value.

In order to master this machine, it is necessary to learn the instructions that handle numeric values described in this textbook.

6

In order to learn numeric data handling ...

This chapter describes the basics of the values handled by the PLC and the numeric data storage destination, etc.

Simple introductions for easy understanding...

To begin, let's examine applied instructions without a complicated environment. This approach will be valuable for using applied instructions in the future.

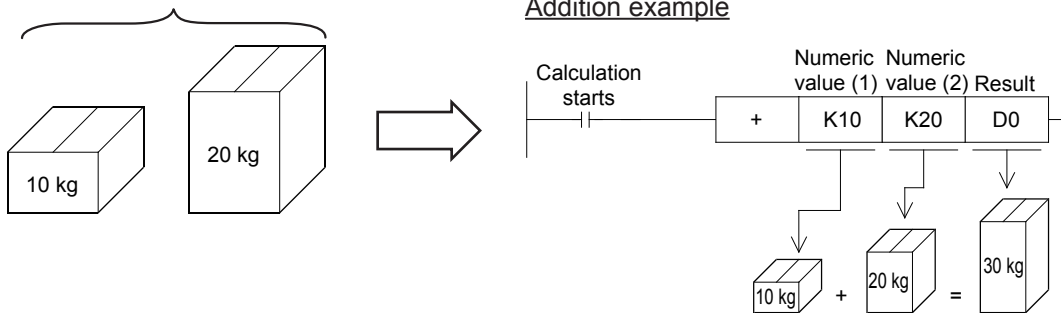
# 6.1 Numeric values

Along with the instructions for simple ON/OFF control as just described, instructions can be used for simple numeric data operation.

Operations for simple addition and comparison are described below.

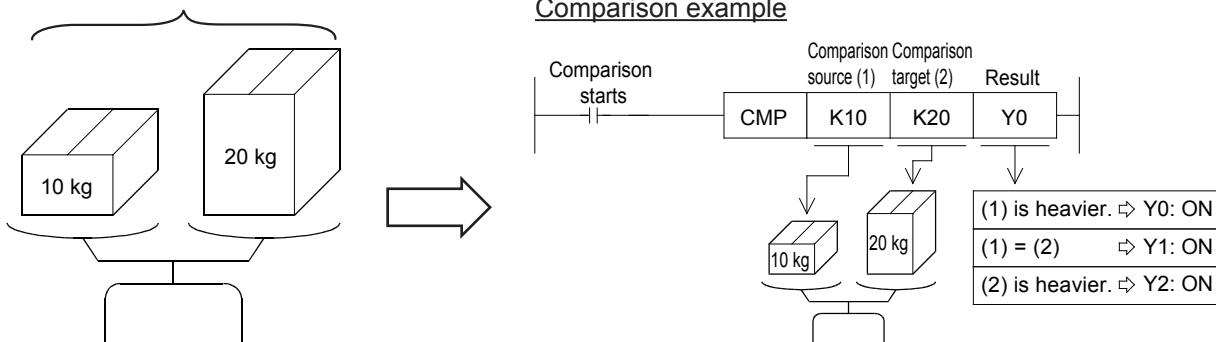
## <<Arithmetic operation>>

Summing two products



## <<Comparison>>

Which is heavier?



### Reference

### Types of instructions

These are types of instructions.

- (1) Dealing with numeric data regarding comparison, and arithmetic operations.
- (2) Controlling program flow, executing jumps, subroutines, loops, interrupts and so on.
- (3) Executing data communications with various devices using FROM/TO instructions and other dedicated instructions.
- (4) Target-oriented instructions such as those to cut down the number of I/Os, those to execute high-speed processing, and instructions similar to the ALT instruction described before.

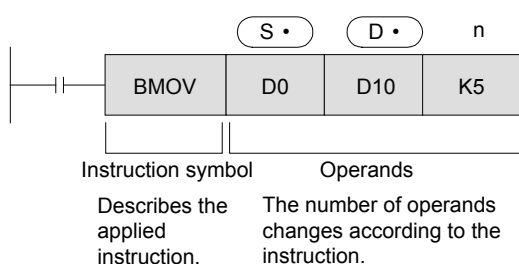
To use many instructions, it is necessary to know what "numeric data" means for a PLC and where "numeric data" is stored in a PLC.

This will be described in the latter half of this chapter.

## Point

### Understanding instructions and how to input them using GX Works3

- Each instruction in the PLC includes a mnemonic to describe the instruction. Following the instruction symbol, operands are used to define the devices and numeric values for processing.



**S •** : The so-called source is the operand which does not change according to the execution of the instructions.

**D •** : The so-called destination is the operand which changes according to the execution of the instructions.

**m, n**: Operands that specify the number of devices, number of transfers, number of data items, and number of strings, etc.  
Operands that can be indexed are indicated with "." (indexing is described later).

Example **S •** **D •**

- The input method of GX Works3



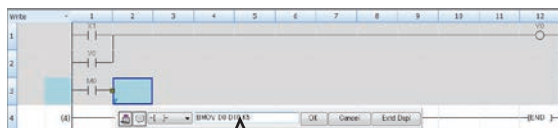
- The applied instructions are turned on by using contacts similar to the OUT instructions and SET instructions. (Some applied instructions do not need contacts.)

**F8** (F8)

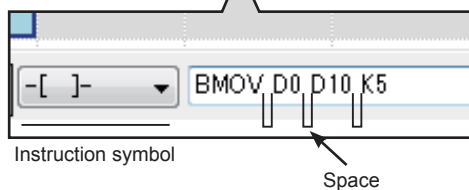


- Press **F8** or **F8** key.

\* If the mnemonic has been directly input, the above operation can be omitted.



- After the mnemonic, input necessary operands and separate each of them with a space.



- Press **Enter** key or click [OK].

# <<Let's try inputting>>

We will study about the command functions and operations, so let's try inputting a ladder with GX Works3. Refer to the "Point" on the previous page for details on inputting.

| Write |  | 1          | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9    | 10  | 11   | 12     |
|-------|--|------------|---|---|---|---|---|---|---|------|-----|------|--------|
| 1     |  | X0<br>(0)  |   |   |   |   |   |   |   |      |     | ALTP | Y0     |
| 2     |  | X1<br>(5)  |   |   |   |   |   |   |   | +    | K10 | K20  | D0     |
| 3     |  | X2<br>(12) |   |   |   |   |   |   |   | CMP  | K10 | K20  | Y0     |
| 4     |  | X3<br>(19) |   |   |   |   |   |   |   | BMOV | D0  | D10  | K5     |
| 5     |  | X4<br>(26) |   |   |   |   |   |   |   |      | MOV | K50  | D1     |
| 6     |  | (32)       |   |   |   |   |   |   |   |      |     |      | [END ] |

## 6.2 Numeric values used in a PLC

### 6.2.1 Decimal numbers

In our daily lives, we use decimals.

The micro PLC uses decimals for the following applications.

(1) PLC device No. (excluding input relay (X) and output relay (Y))

**[Typical examples]**

|                    |    |     |     |     |    |     |      |      |     |
|--------------------|----|-----|-----|-----|----|-----|------|------|-----|
| Internal relay (M) | M0 | ,M1 | ,M2 | ... | M8 | ,M9 | ,M10 | ,M11 | ... |
| Timer (T)          | T0 | ,T1 | ,T2 | ... | T8 | ,T9 | ,T10 | ,T11 | ... |
| Counter (C)        | C0 | ,C1 | ,C2 | ... | C8 | ,C9 | ,C10 | ,C11 | ... |
| Data register (D)  | D0 | ,D1 | ,D2 | ... | D8 | ,D9 | ,D10 | ,D11 | ... |

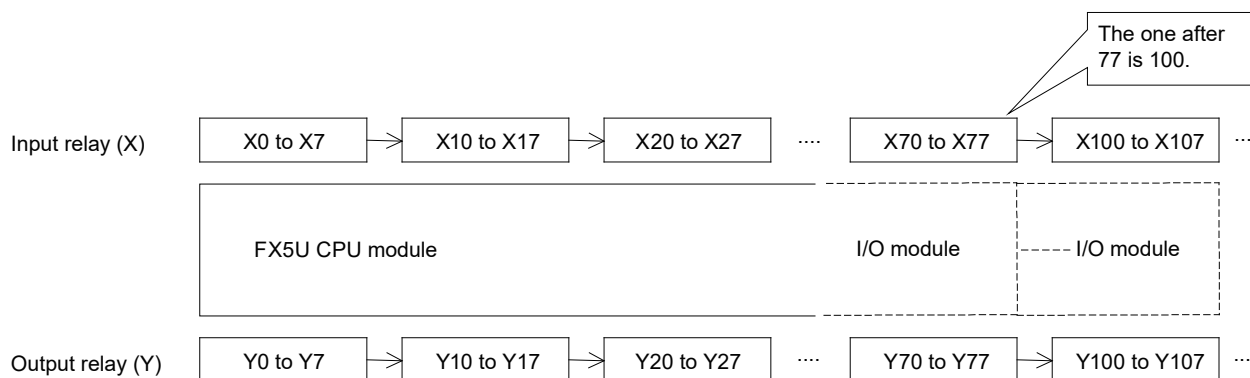
(2) When constants (K) are used for timers, counters, or numeric values in applied instructions, a decimal number is used with "K," such as "K20" to represent the constant.

### 6.2.2 Octal numbers

Octal numbers are base octal numbers, which use eight unique digits from 0 through 7 as follows: 0 to 7, 10 to 17, 20 to 27...

The micro PLC uses octal numbers as device numbers for input relays (X) and output relays (Y).

- The micro PLC I/O numbers are represented with octal numbers



For information on how to assign I/O numbers according to the structure of the system, see "2.5.4 micro PLC I/O number assignment".

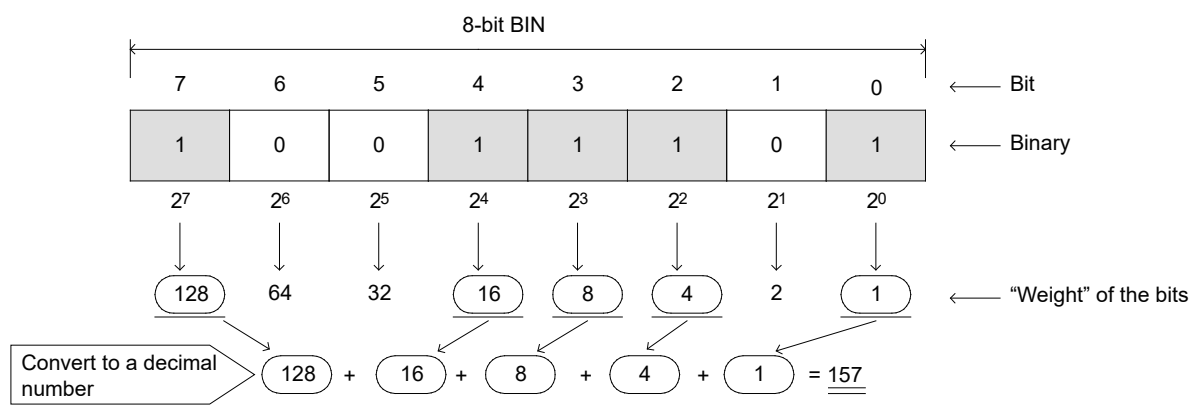
# 6.2.3 Binary numbers

The numbers most people are familiar with are decimal numbers, which use a base 10 representation. Computers and PLCs, however, use binary numbers, which utilize a base 2 system. For example, it is convenient to use the binary number 0 or 1 to correspond to the ON/OFF status of memory locations and relays. Let's spend some time to learn the difference between binary and decimal numbers.

[Comparison of binary and decimal]

|          | Decimal                                      |  | Binary                     |      |
|----------|--|--|----------------------------|------|
|          |  |  |                            |      |
|          | 0  |  | 0000                       | 0000 |
|          | 1  |  | 0000                       | 0001 |
|          | 2  |  | 0000                       | 0010 |
|          | 3  |  | 0000                       | 0011 |
|          | 4  |  | 0000                       | 0100 |
|          | 5  |  | 0000                       | 0101 |
|          | 6  |  | 0000                       | 0110 |
|          | 7  |  | 0000                       | 0111 |
|          | 8  |  | 0000                       | 1000 |
|          | 9  |  | 0000                       | 1001 |
|          | 10   |  | 0000                       | 1010 |
|          | 11   |  | 0000                       | 1011 |
|          | 12   |  | 0000                       | 1100 |
|          | ⋮  |  | ⋮                          | ⋮    |
| Main use | Constant K, internal device No. (M, D, etc.) |  | Internal processing of PLC |      |

- What is the value of the binary number "10011101" if represented in decimal?  
The "weight" of each bit is described below. Sum the "weights" that have a binary number of "1". The result is a decimal value.



The value of binary number "10011101" is "157" in decimal format.

## 6.2.4 Hexadecimal numbers

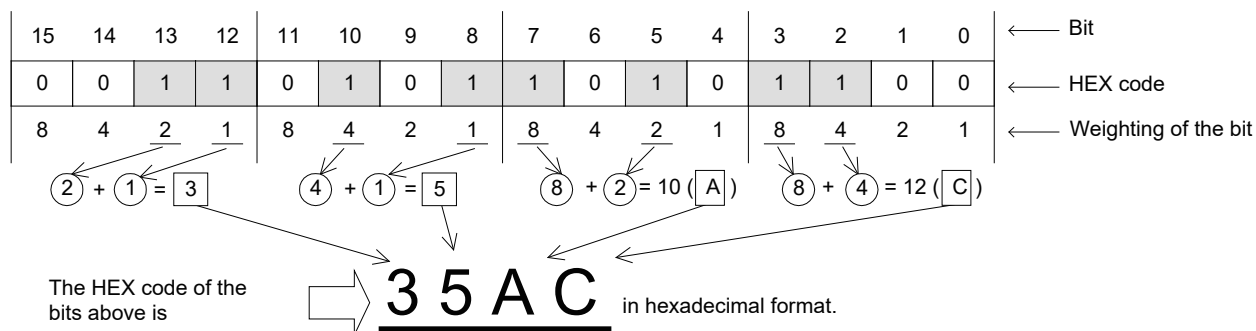
There are 4 bits for each digit of a hexadecimal number, and each digit of a hexadecimal number is represented by 0 to 9, A (10), B (11), C (12), D (13), E (14), F (15).

Hexadecimal numbers are base 16 numbers, and the 16th value is F.

### [Comparison of decimal and hexadecimal]

|          | Decimal                                      | Hexadecimal          | Binary                     |      |
|----------|--|----------------------|----------------------------|------|
|          | 0  | 00                   | 0000                       | 0000 |
|          | 1  | 01                   | 0000                       | 0001 |
|          | 2  | 02                   | 0000                       | 0010 |
|          | 3  | 03                   | 0000                       | 0011 |
|          | 4  | 04                   | 0000                       | 0100 |
|          | 5  | 05                   | 0000                       | 0101 |
|          | 6  | 06                   | 0000                       | 0110 |
|          | 7  | 07                   | 0000                       | 0111 |
|          | 8  | 08                   | 0000                       | 1000 |
|          | 9  | 09                   | 0000                       | 1001 |
|          | 10   | 0A                   | 0000                       | 1010 |
|          | 11   | 0B                   | 0000                       | 1011 |
|          | 12   | 0C                   | 0000                       | 1100 |
|          | 13   | 0D                   | 0000                       | 1101 |
|          | 14   | 0E                   | 0000                       | 1110 |
|          | 15   | 0F                   | 0000                       | 1111 |
|          | 16   | 10                   | 0001                       | 0000 |
|          | ⋮  | ⋮                    | ⋮                          | ⋮    |
| Main use | Constant K, internal device No. (M, D, etc.) | Constant H and so on | Internal processing of PLC |      |

- With the micro PLC, there are cases when a hexadecimal is used for the operation setting (buffer memory setting), etc., when using an intelligent function module.



In order to make it clear, [H] is added to the hexadecimal numbers such as "H35AC" or "35ACH".



## 6.2.5 Binary-coded decimal numbers (BCD code)

The decimal values 0 to 9 of each digit can be represented in binary numbers of 4 bits by BCD code.

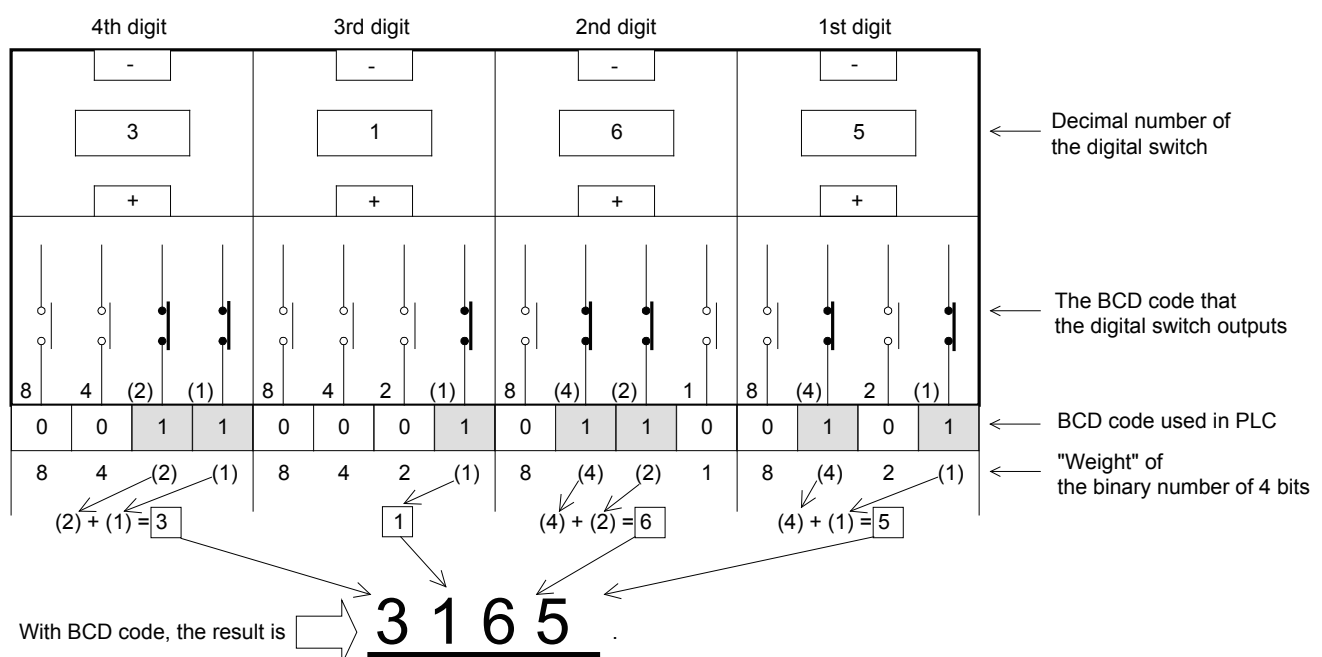
BCD code is used for the output signal of a digital switch, the control signal of a 7-segment display module, or for the signals of various measuring instruments.

[Comparison of decimal and BCD code]

|          | BCD   |  |
|----------|---|--|
|          | Decimal   | BCD  |
|          | 0   | 0000   |
|          | 1   | 0001   |
|          | 2   | 0010   |
|          | 3   | 0011   |
|          | 4   | 0100   |
|          | 5   | 0101   |
|          | 6   | 0110   |
|          | 7   | 0111   |
|          | 8   | 1000   |
|          | 9   | 1001   |
|          | 10  | 0001   |
|          | 11  | 0001   |
|          | 12  | 0010   |
|          | ⋮   | ⋮  |
| Main use | Constant K, internal device<br>No. (M, D, etc.) | BCD digital switch, 7-segment display module |

- BCD code uses binary numbers of 4 bits to represent one digit 0 to 9 of a decimal number.

[Example of 4-digit BCD code (decimal "3165") output by digital switch]



## Reference

### Numeric values used in the micro PLC

Comparison of decimal and other numeric values

| Decimal | Octal | Hexadecimal | Binary |      | BCD  |      |
|---------|-------|-------------|--------|------|------|------|
| 0       | 0     | 00          | 0000   | 0000 | 0000 | 0000 |
| 1       | 1     | 01          | 0000   | 0001 | 0000 | 0001 |
| 2       | 2     | 02          | 0000   | 0010 | 0000 | 0010 |
| 3       | 3     | 03          | 0000   | 0011 | 0000 | 0011 |
| 4       | 4     | 04          | 0000   | 0100 | 0000 | 0100 |
| 5       | 5     | 05          | 0000   | 0101 | 0000 | 0101 |
| 6       | 6     | 06          | 0000   | 0110 | 0000 | 0110 |
| 7       | 7     | 07          | 0000   | 0111 | 0000 | 0111 |
| 8       | 10    | 08          | 0000   | 1000 | 0000 | 1000 |
| 9       | 11    | 09          | 0000   | 1001 | 0000 | 1001 |
| 10      | 12    | 0A          | 0000   | 1010 | 0001 | 0000 |
| 11      | 13    | 0B          | 0000   | 1011 | 0001 | 0001 |
| 12      | 14    | 0C          | 0000   | 1100 | 0001 | 0010 |
| 13      | 15    | 0D          | 0000   | 1101 | 0001 | 0011 |
| 14      | 16    | 0E          | 0000   | 1110 | 0001 | 0100 |
| 15      | 17    | 0F          | 0000   | 1111 | 0001 | 0101 |
| 16      | 20    | 10          | 0001   | 0000 | 0001 | 0110 |
| ⋮       | ⋮     | ⋮           | ⋮      | ⋮    | ⋮    | ⋮    |
| 99      | 143   | 63          | 0110   | 0011 | 1001 | 1001 |
| ⋮       | ⋮     | ⋮           | ⋮      | ⋮    | ⋮    | ⋮    |

Main use

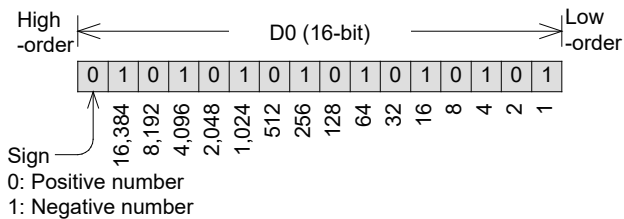
| Decimal   | Octal   | Hexadecimal | Binary                     | BCD   |
|---|---|-------------|----------------------------|---|
| Constant K, internal device<br>No. (M, D, etc.) | The device numbers of the<br>input relays and output relays | Constant H  | Internal processing of PLC | BCD digital switch,<br>7-segment display module |

## 6.3 Storing numeric data

### 6.3.1 Operating word devices

A word device is a register used to store 16-bit and 32-bit numeric data. Word device types include the following:

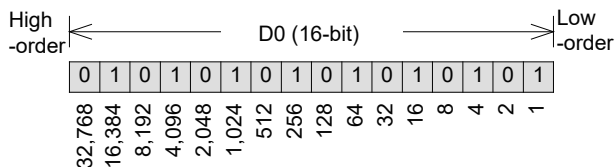
#### <<Signed 16-bit data>>



A signed 16-bit data register can represent numeric values from -32,768 to +32,767.

- Example
- (1) When all 16-bit data are "0", the numeric value is 0.
  - (2) When only the most significant bit is "0", and the others are "1", it is +32,767.
  - (3) When all the 16-bit data are "1", it is -1.

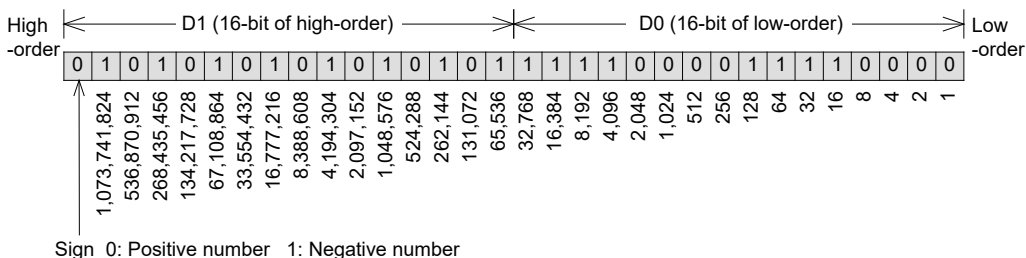
#### <<Unsigned 16-bit data>>



An unsigned 16-bit data register can represent numeric values from 0 to +65,535.

- Example
- (1) When all 16-bit data are "0", the numeric value is 0.
  - (2) When all the 16-bit data are "1", it is +65,535.

#### <<Signed 32-bit data>>

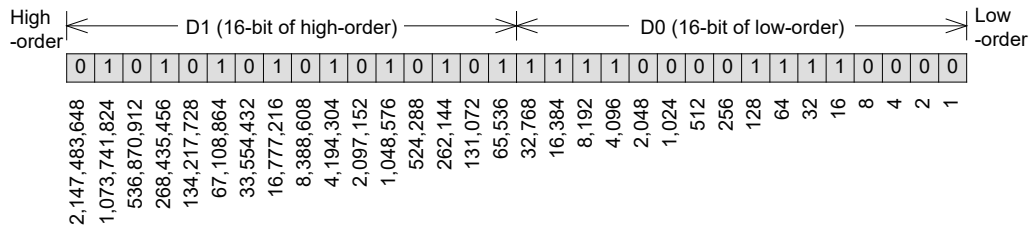


32-bit data is represented by a group of data registers with adjacent numbers. (The high-order bits are larger numbers and the low-order bits are small numbers.)

A signed 32-bit data register can represent numeric values from -2,147,483,648 to +2,147,483,647.

- Example
- (1) When all 32-bit data are "0", the numeric value is 0.
  - (2) When only the most significant bit is "0", and the others are "1", it is +2,147,483,647.
  - (3) When all the 32-bit data are "1", it is -1.

## <<Unsigned 32-bit data>>



32-bit data is represented by a group of data registers with adjacent numbers. (The high-order bits are larger numbers and the low-order bits are small numbers.)

An unsigned 32-bit data register can represent numeric values from 0 to +4,294,967,295.

- Example
- (1) When all 32-bit data are "0", the numeric value is 0.
  - (2) When all the 32-bit data are "1", it is +4,294,967,295.

### Point

- For 32-bit data, the device number on the low-order side can be either even or odd. However, in order to avoid confusion, normally the even numbers are used for the low-order side.

### Data registers

- Data register  
D0 to D7999 (8,000 points)
- File register  
R0 to R32767 (32,768 points)
- Special type  
SD0 to SD10899 (10,900 points)

- In all of the data registers below, 16 bits are used for one point. 32-bit data can be stored by combining two data registers.

### The current value register for timers

- Timer  
T0 to T511 (512 points)
- Retentive timer  
ST0 to ST15 (16 points)

- Each is a 16-bit register, but as a timer, the highest order bit is always "0", and an integer between 0 and 32,767 is handled. (An out-of-range number will lead to an error and the counter will not work.)
- For the timer, the instruction is written with a 100 ms, 10 ms, or 1 ms module. Refer to the previous section "Clocking of timers" for details.

### The current value register for counters

- C0 to C255 (256 points)

- Each is a 16-bit register, but when using as a counter, the highest order bit is always "0", and an integer between 0 and 32,767 is handled. (An out-of-range number will lead to an error and the counter will not work.)

### The current value register for long counters

- LC0 to LC63 (64 points)

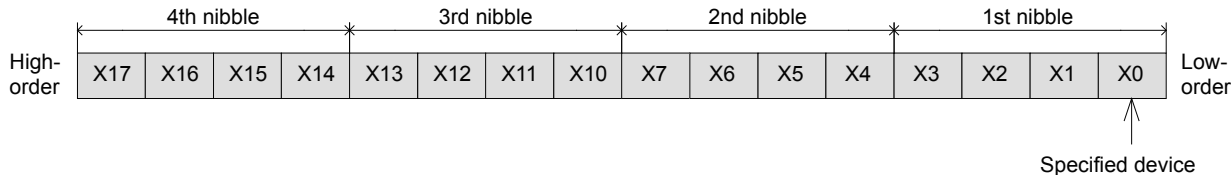
- Each is an unsigned 32-bit register, but when using as a counter, an integer between 0 and 4,294,967,295 is handled. (An out-of-range number will lead to an error and the counter will not work.)
- When timer registers or counter registers are needed for storing 32-bit data, join the two devices with adjacent numbers, as described above.

- The number of device points above is the default parameter setting. The number of device points can be changed with the parameter.

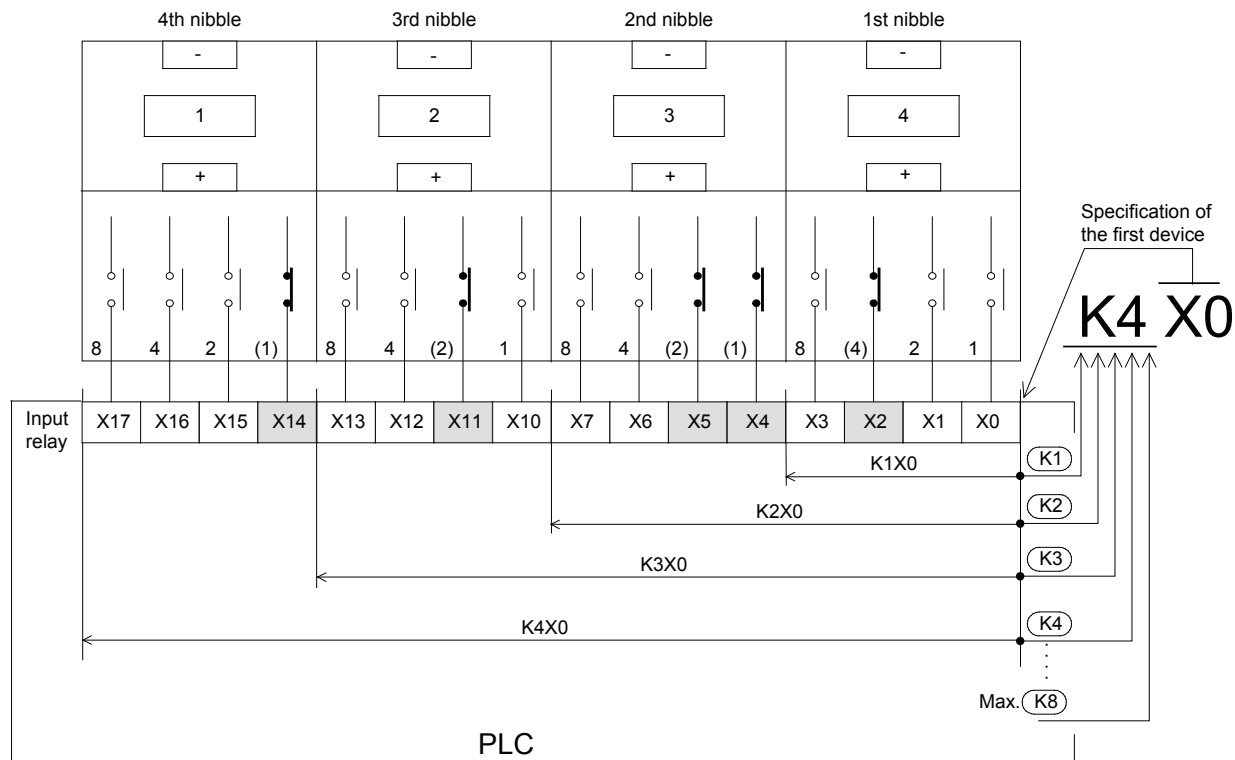
# 6.3.2 Operating bit devices as word devices (The method to specify the digits)

Bit devices are only used for the ON/OFF operation of input relays X, output relays Y, Internal relays M, state relays S and so no. However, bit devices can handle up to 32-bit values by combining 4 points into one nibble and using up to 8 nibbles together.

## <<Example of K4X0>>



- Specifying the 4 digits of a digital switch with 4-bit module



**K** (1)    **4** (2)    **X** (3)    **0** (4)

- (1) Make sure to use K to specify the nibbles.
- (2) Up to 4 nibbles (K1 to K4) can be specified for a 16-bit operation while up to 8 nibbles can be specified for a 32-bit operation.
- (3) The device symbols X, Y, M, S can be specified. (Bit device)
- (4) Always specify the device number of the least significant bit.

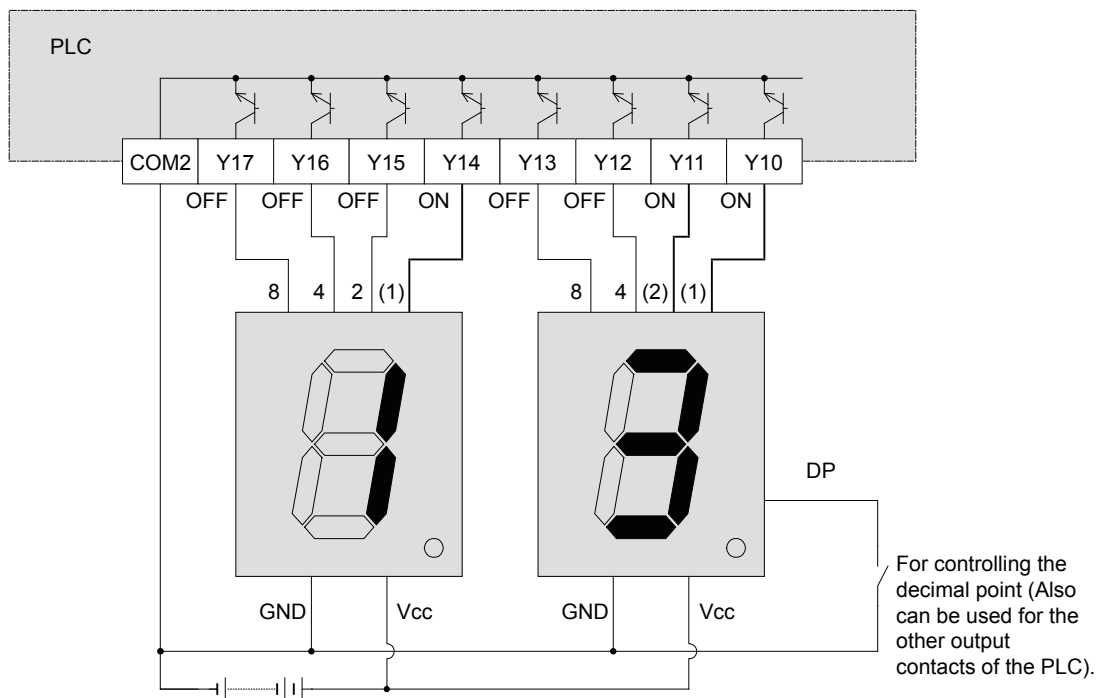
Device numbers can be specified arbitrarily. (Example: K4M13). However, generally, the least significant digit is recommended to be set to 0 such as K1X0, K2Y10, K3M20 and K8S130. (Multiples of 8 are ideal for M and S, but in order to avoid confusion, 0 is recommended to be used.)

## Reference

### 7-Segment driver

To display numbers on a 7-segment display, a PLC outputs BCD of two digits from Y17 to Y10. If the inputs 1, 2, 4, 8 of the 7-segment driver are driven by a PLC, 0 to 9 will be indicated according to the total value of the numbers input.

The digit is specified to "K2Y10" in the following example.



# Data transfer is the basis for PLC!

## Chapter 7

### TRANSFER INSTRUCTIONS FOR NUMERIC VALUES

---

#### Storing and reading numeric values...

As an extension of the previous chapter, this chapter helps to describe how instructions are used for storing and reading numeric data. The most basic of these instructions are the simple transfer instructions, which are used to read numeric values from storage sources S (transfer sources) and transfer them to storage destinations D (transfer destinations).

#### The concept of transferring data is easy...

From simple to complicated applications, data transfer and data manipulation are regarded as common tasks.

PLC data transfer instructions provide an easy way to transfer a variety of data between devices. Also, by indirectly specifying transfer devices through indexing, data transfer instructions become much more flexible for moving ranges of data.



# 7.1 Data transfer instruction (MOV)

The data transfer instruction is the instruction to transfer bit data or numeric data from a transfer source to a transfer destination. It is a typical instruction that must be used for temporary data retention and storage.

The transfer instructions include instructions for simple data transfer and instructions (such as BCD and BIN) for converting data during transfer.

## <<Operation outline>>

### ● Flow of data

If the transfer instruction input is ON, the data in the transfer source is written to the transfer destination.

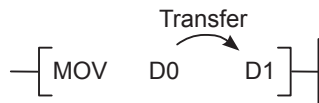
In this situation, the data in the transfer source does not change.

When the transfer instruction input is OFF, data is not transferred, and the transfer destination data does not change.

### ● The data is transferred in BIN.

#### (1) Transferring between two [word devices (16 bits)]

Example

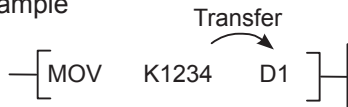


- Transfers data from D0 (16 bits) to D1 (16 bits).

|    | b15 | b14 | b13 | b12 | b11 | b10 | b9 | b8 | b7 | b6 | b5 | b4 | b3 | b2 | b1 | b0 |
|----|-----|-----|-----|-----|-----|-----|----|----|----|----|----|----|----|----|----|----|
| D0 | 0   | 0   | 1   | 0   | 1   | 0   | 0  | 1  | 0  | 0  | 1  | 1  | 0  | 0  | 0  | 1  |
|    | ↓   |     |     |     |     |     |    |    |    |    |    |    |    |    |    |    |
| D1 | 0   | 0   | 1   | 0   | 1   | 0   | 0  | 1  | 0  | 0  | 1  | 1  | 0  | 0  | 0  | 1  |

#### (2) Transferring a [constant K (decimal)] to a [word device]

Example

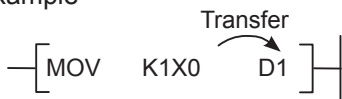


- The PLC treats K1234 as a BIN value and transfers it to D1 (16 bits).

|       | K1234 (decimal) |     |     |     |     |     |    |    |    |    |    |    |    |    |    |    |
|-------|-----------------|-----|-----|-----|-----|-----|----|----|----|----|----|----|----|----|----|----|
|       | b15             | b14 | b13 | b12 | b11 | b10 | b9 | b8 | b7 | b6 | b5 | b4 | b3 | b2 | b1 | b0 |
| K1234 | 0               | 0   | 0   | 0   | 0   | 1   | 0  | 0  | 1  | 1  | 0  | 1  | 0  | 0  | 1  | 0  |
|       | ↓               |     |     |     |     |     |    |    |    |    |    |    |    |    |    |    |
| D1    | 0               | 0   | 0   | 0   | 0   | 1   | 0  | 0  | 1  | 1  | 0  | 1  | 0  | 0  | 1  | 0  |

#### (3) Transferring from a [bit device] to a [word device]

Example

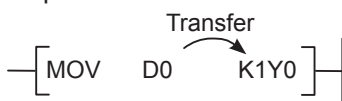


- When the transfer source does not include high-order bits (the data is not 16-bit data), the values in the high-order bits will not be transferred (e.g. the transfer source data is K1X0 to K3X0).

|      | K1X0          |     |     |     |     |     |    |    |    |    |    |    |    |    |    |    |
|------|---------------|-----|-----|-----|-----|-----|----|----|----|----|----|----|----|----|----|----|
|      | b15           | b14 | b13 | b12 | b11 | b10 | b9 | b8 | b7 | b6 | b5 | b4 | b3 | b2 | b1 | b0 |
| K1X0 | 0             | 0   | 1   | 1   | 0   | 1   | 1  | 0  | 1  | 1  | 1  | 0  | 0  | 0  | 0  | 1  |
|      | ↓             |     |     |     |     |     |    |    |    |    |    |    |    |    |    |    |
| D1   | 0             | 0   | 0   | 0   | 0   | 0   | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  |
|      | All become 0. |     |     |     |     |     |    |    |    |    |    |    |    |    |    |    |

#### (4) Transferring from a [word device] to a [bit device]

Example

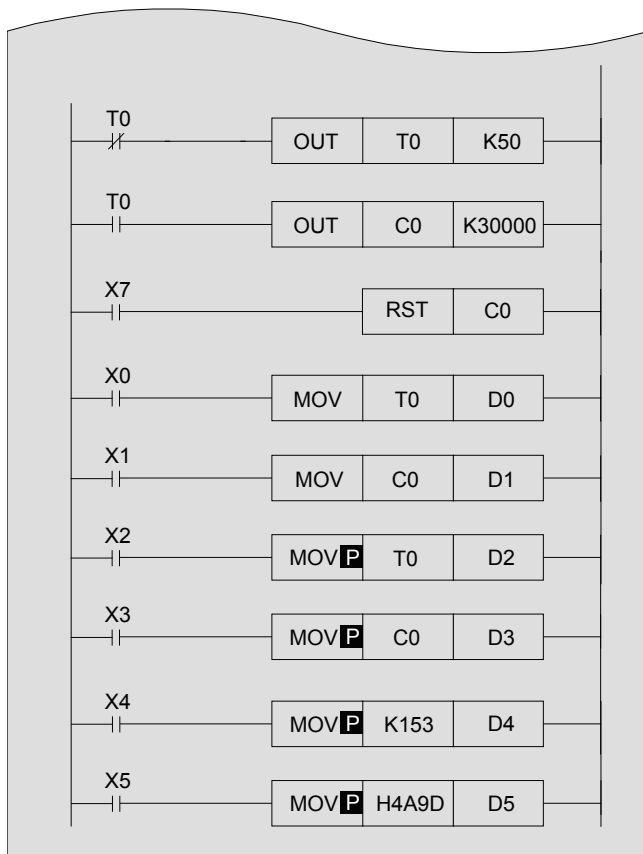


- When the transfer destination does not include high-order bits (the data is not 16-bit data), the values in the high-order bits will not be transferred (e.g. the transfer source data is K1Y0 to K3Y0).

|      | b15  | b14 | b13 | b12 | b11 | b10 | b9 | b8 | b7 | b6 | b5 | b4 | b3 | b2 | b1 | b0 |
|------|--|-----|-----|-----|-----|-----|----|----|----|----|----|----|----|----|----|----|
| D0   | 0  | 0   | 1   | 1   | 0   | 1   | 1  | 1  | 1  | 0  | 0  | 1  | 0  | 1  | 1  | 0  |
|      | ↓  |     |     |     |     |     |    |    |    |    |    |    |    |    |    |    |
| K1Y0 | 0  | 0   | 0   | 0   | 0   | 0   | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 1  | 0  |
|      | There are no changes because the upper bits are not transferred. |     |     |     |     |     |    |    |    |    |    |    |    |    |    |    |

## <<Instruction operation>>

Let's check the operation of the MOV instruction.

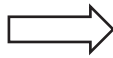
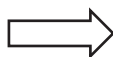
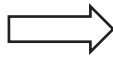
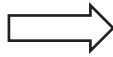
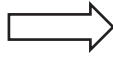
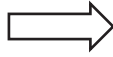


- The current value of timer T0 repeatedly changes from 0 to 50.
- The current value of counter C0 increases every 5 seconds.

- (1) Constantly transfer current value of timer T0 to D0
- (2) Constantly transfer current value of counter C0 to D1
- (3) Transfer current value of timer T0 to D2 only during MOV instruction drive
- (4) Transfer current value of counter C0 to D3 only during MOV instruction drive
- (5) Transfer constant K153 to D4 only during MOV instruction drive
- (6) Transfer constant H4A9D to D5 only during MOV instruction drive

## <<Operation check>>

Use GX Works3 to monitor the circuit.

- (1) Turn "ON" X0 
  - The current value of timer T0 is always transferred to the data register D0 when X0 is ON.
  - If X0 is turned off, the data register D0 keeps the current value of the timer at the time when X0 is turned off.
- (2) Turn "ON" X1 
  - The current value of counter C0 is always transferred to D1 when X1 is ON. If X1 is turned off, the data register D1 keeps the current value of the counter at the time when X1 is turned off.
- (3) Turn "ON" X2 
  - The current value of timer T0 at the time when X2 is turned on is transferred to data register D2.
- (4) Turn "ON" X3 
  - The current value of the counter at the time when X3 is turned on is transferred to data register D3
- (5) Turn "ON" X4 
  - "153 (Decimal)" is directly transferred to D4. (Initial data setting)
- (6) Turn "ON" X5 
  - The decimal "19101" is transferred to D5. (Initial data setting)
  - Select [Online]→[Monitor]→[Change current monitor value (Hexadecimal)]. "H4A9D" is displayed.
  - To return it to decimal, select [Change current monitor value (decimal)] from the same menu .

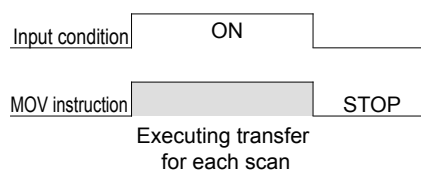
## Point

### Continuous execution vs. Pulse execution

[Continuous execution instruction]



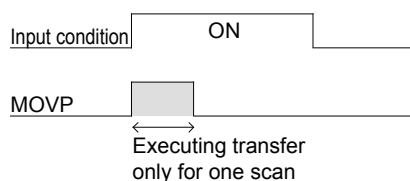
- For the continuous execution type instruction, when the drive input is ON, the instruction is executed and the transfer is performed for each scan.



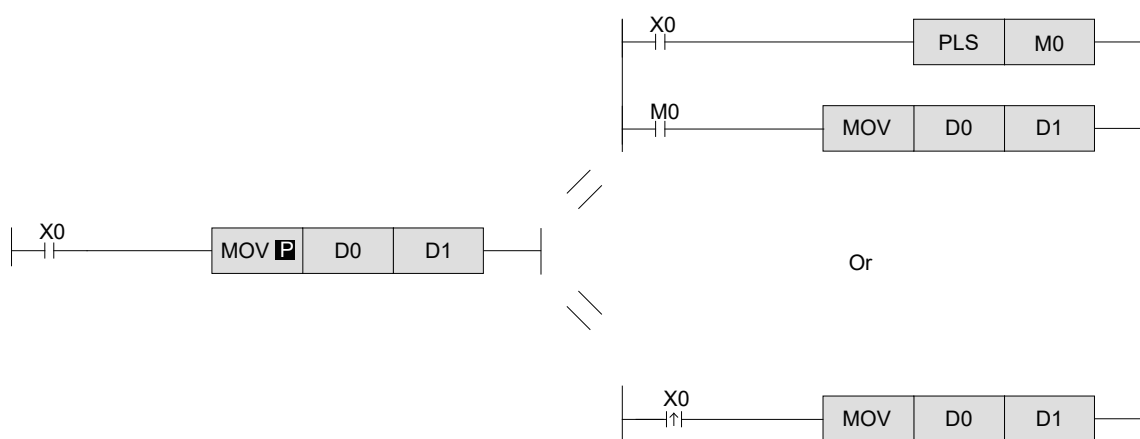
[Pulse execution instruction]



- P is added to the end of the pulse execution type instruction.
- For the pulse execution type, the instruction is executed only once when Input condition the input drive changes from OFF to ON.



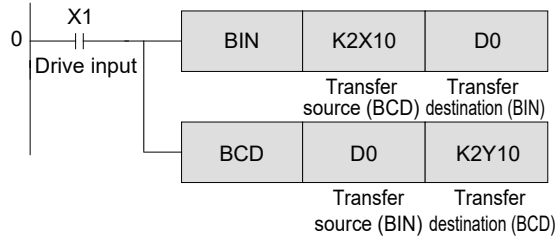
- Thus, the continuous execution instruction is used when data is constantly changing, while the pulse execution instruction is used for transfers that are needed only when the instruction is input turns on (When setting the initial value or the value at the specified time.)
- If the drive input is OFF, the MOV instruction is not executed and the transfer destination data does not change.
- The pulse execution operation can also be programmed as follows:



# 7.2 Conversion transfer instruction (BCD/BIN)

The operations of values in a PLC are all performed in BIN format. Thus, when inputting the digital switch values of a BCD to a PLC, use the BCD-to-BIN conversion transfer instruction. Also, to output to a 7-segment display module using BCD, it is necessary to use the BIN-to-BCD conversion transfer instruction.

## <<Operation outline>>

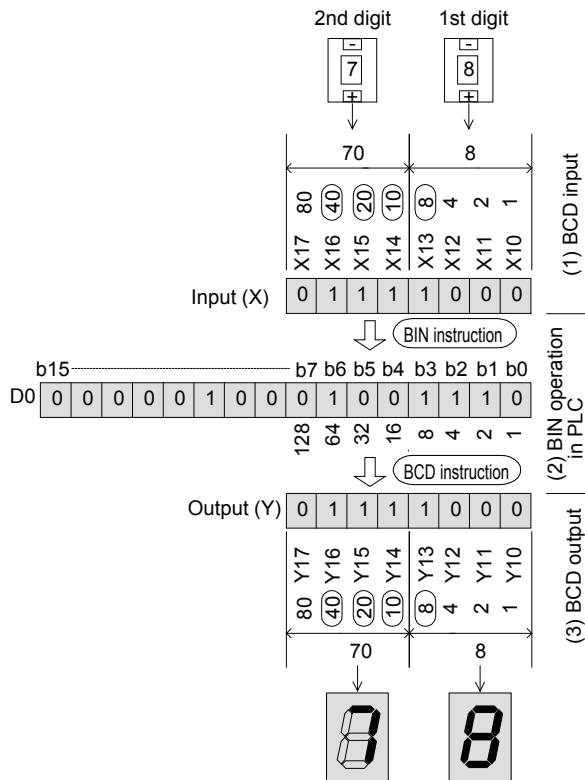


**BIN instruction.....** When the drive input is ON, the BCD value of the transfer source is converted to BIN and transferred.

**BCD instruction.....** When the drive input is ON, the BIN value of the transfer source is converted to BCD and transferred.

## <<Instruction operation>>

Input the above program.



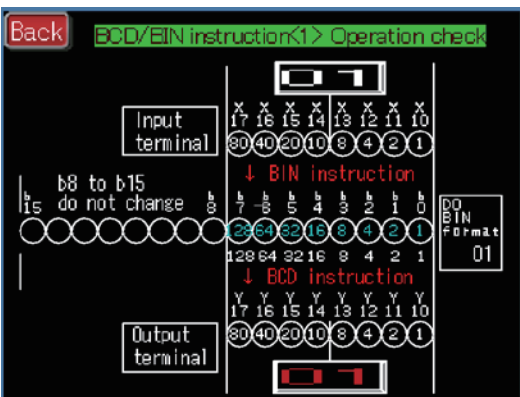
## <<Operation check>>

- (1) BCD codes are input to devices X10 to X13 (the first digit) and X14 to X17 (the second digit) according to the changes of the digital switch (BIN instruction).
- (2) In the case of the left example, the input value "78" (Decimal: 1001110) is stored to D0.
- (3) BCD codes are output to devices Y10 to Y13 (the first digit) and Y14 to Y17 (the second digit) for operating the 7-segment display module (BCD instruction).

(Reference)

| Input of digital SW | BCD value |
|---------------------|-----------|
| 0                   | 0000      |
| 1                   | 0001      |
| 2                   | 0010      |
| 3                   | 0011      |
| 4                   | 0100      |
| 5                   | 0101      |
| 6                   | 0110      |
| 7                   | 0111      |
| 8                   | 1000      |
| 9                   | 1001      |

## Training Machine Screen

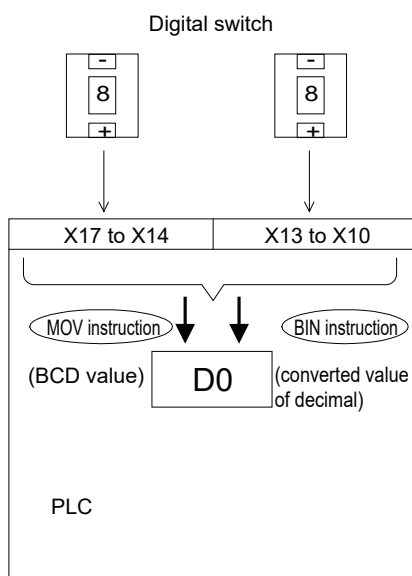


[Basics: MELSEC iQ-F Programming (GX Works3 Version)] → [BCD/BIN<1>]

It is possible to check the bit operations of the input relays (X), output relays (Y), and data registers in the GOT screen monitor.

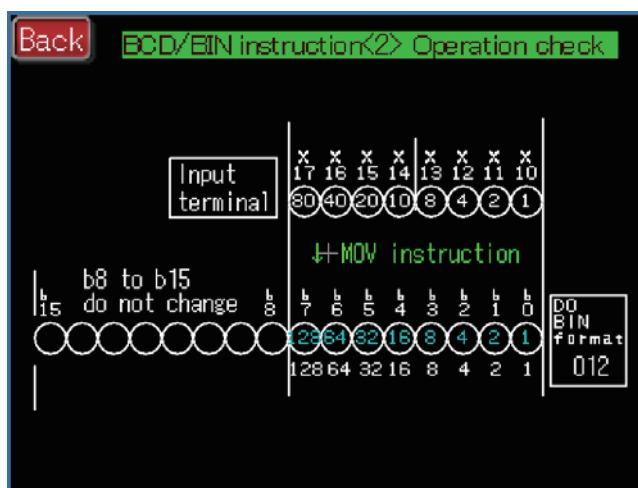
## <<Comparing the operation>>

Let's compare the BIN/BCD instruction to the MOV instruction and check the operation.

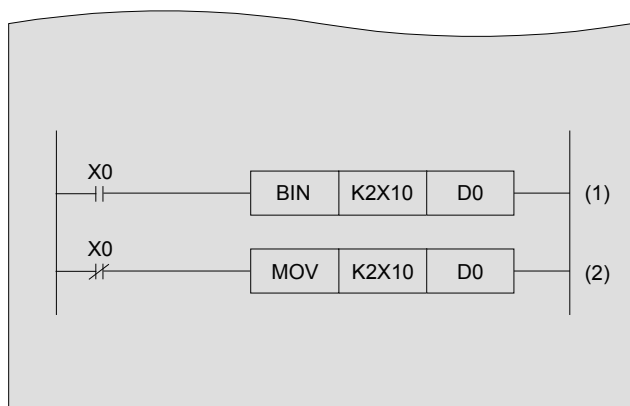


### Training Machine Screen

[Basics: MELSEC iQ-F Programming (GX Works3 Version)] → [BCD/BIN<2>]



It is possible to check the bit operations of the input relays (X) and data registers (D0) in the GOT screen monitor.



Transfer BIN-converted X10 to X17 ON/OFF (BCD value) to D0.

Transfer X10 to X17 ON/OFF (BCD value) to D0.

## <<Operation check>> Use GX Works3 to monitor device D0.

- (1) Turn "ON" X0 → The value of the digital switch (BCD input) is converted to a decimal value by "BIN instruction" and transferred to D0.
- (2) Turn "OFF" X0 → The input is the same as (2) above, and the value is not converted to a decimal value because the instruction used is the MOV instruction, which directly transfers the value to D0.

## Reference

### Operation error and error step number

- When the value of the transfer source is not BCD, the BIN instruction will lead to an "operation error" and cannot be executed.
- The code and the step number of errors are stored to the following special Internal relay or special data register.

The check can also be performed by selecting [Diagnostics] → [PLC diagnostics] from the menu.

SM0  
SD0  
SD88

If an operation error occurs, SM0 will turn on, and the error code of the operation error will be stored to SD0. The error step number will be stored to SD88.

If a new error occurs at another step, the error code of this instruction and the step number will be updated sequentially.

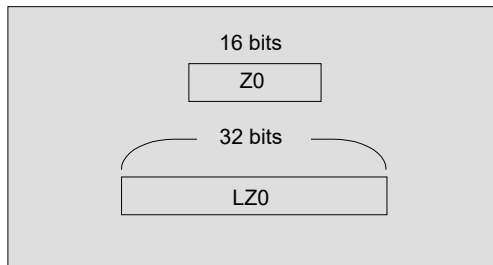
The error code is cleared when the PLC is reset, the power is turned ON, or SM50 is turned OFF and ON.

## 7.3 Indirectly specifying the transfer source and transfer destination

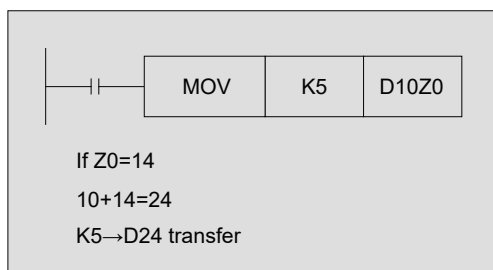
Devices in instructions can be specified directly (as described so far) or indirectly for data transfer operations.

The index registers V and Z can be used to specify devices indirectly.

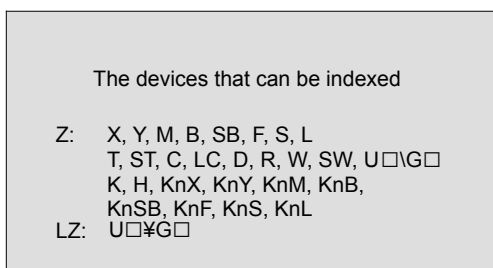
The index register includes the index register (Z) and long index register (LZ).



- Z is 16-bit data register where numeric values can be written to and read from in the same manner as the general data register.
- LZ are 32-bit data registers where numeric values can be written to and read from.
- The index register (Z) and long index register (LZ) can use a total of 24 words.



- Changing constants and device numbers according to the values of Z, as shown on the left, is called indexing.



The main devices that can be indexed with index registers are those listed on the left. The devices on the left are used in the instructions.

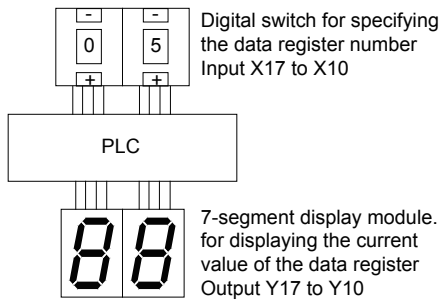
However, as shown below, Kn for nibble specification cannot be indexed.

(K4M0Z0 is valid, while K0Z0M0 is invalid)

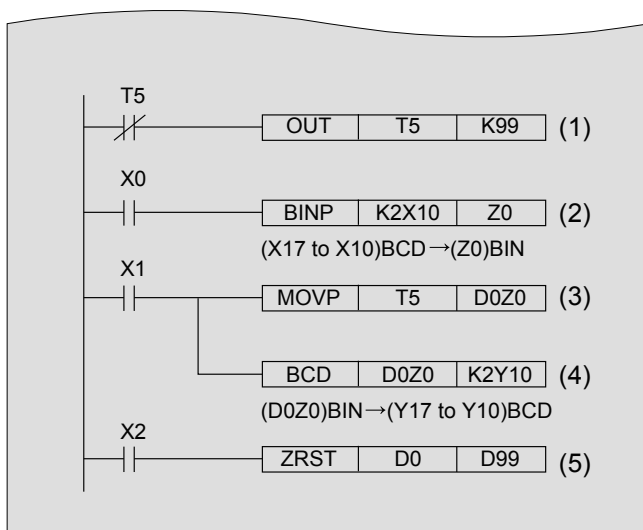
P cannot be indexed as a label number of a jump destination.

## <<Instruction operation>>

- Monitor the current values of the data registers (D0 to D99) that are specified by the index register Z.



## <<Operation check>>



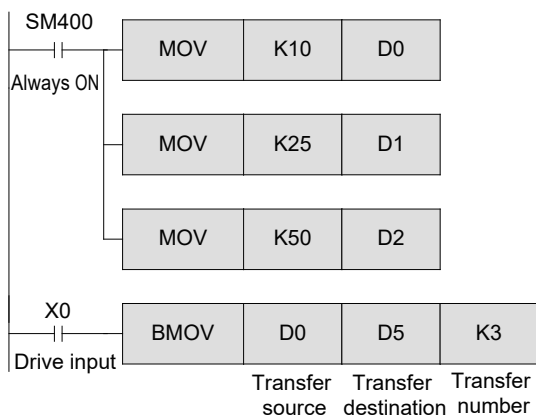




# 7.4 Other transfer instructions

## 7.4.1 Block Move (BMOV)

n pieces of data starting from the device specified in the transfer source are transferred in a batch to n devices starting from the one specified in the transfer destination.



Transfer K10 to D0

Transfer K25 to D1

Transfer K50 to D2

3 data registers, D0 to D2, are transferred to D5 to D7.



- If the transfer number is larger than the device range, the data within the range will be transferred.
- In the case of bit devices for nibble specification, set the same number of nibbles between the transfer source and destination.

BMOV K2X0 K2Y0 K5

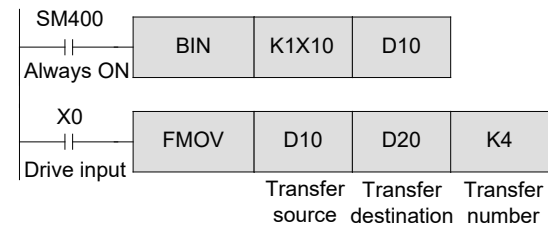


The number of nibble is the same!

# 7.4.2 Fill move (FMOV)

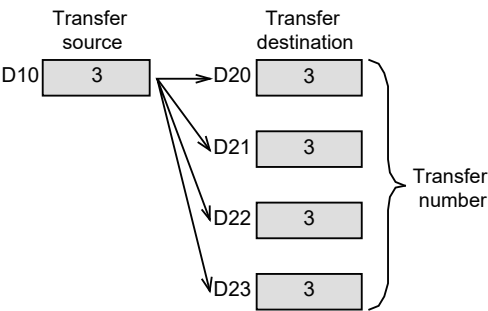
The value of the device specified in the transfer source is transferred to n consecutive devices starting from the transfer destination device.

The n pieces of transferred data are the same.



The data set by DSW1 is converted to BIN and then transferred to D10.

The value of D10 is transferred to 4 points from D20 to D23.

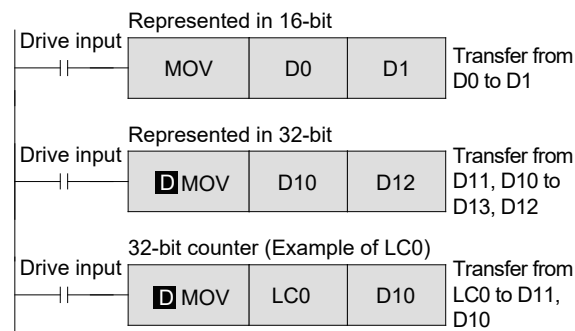


- If the transfer number is larger than the device range, the data within the range will be transferred.

## Reference

### Bit length for numeric values

- The instructions for numeric operations can be divided into 16-bit type and 32-bit type depending on the length of the numeric data.



- 32-bit instructions are represented with an added "D".
- The designated device can handle even or odd numbers, but the device with the number after the designated device is occupied.
- 1 point for a 32-bit counter occupies 32 bits. An operation error will occur if 16-bit instructions are used.

# Comparison of numeric data!

## Chapter 8

### THE COMPARISON INSTRUCTION FOR NUMERIC DATA

---

#### Comparing values in the PLC...

With basic value comparison instructions, two or more values can be compared to control a series of bit devices for the result.

For example, a changing numeric value can be instantaneously compared with a selected target value to determine which one is larger, which one is smaller, or whether they are equal.

#### Using zone comparison...

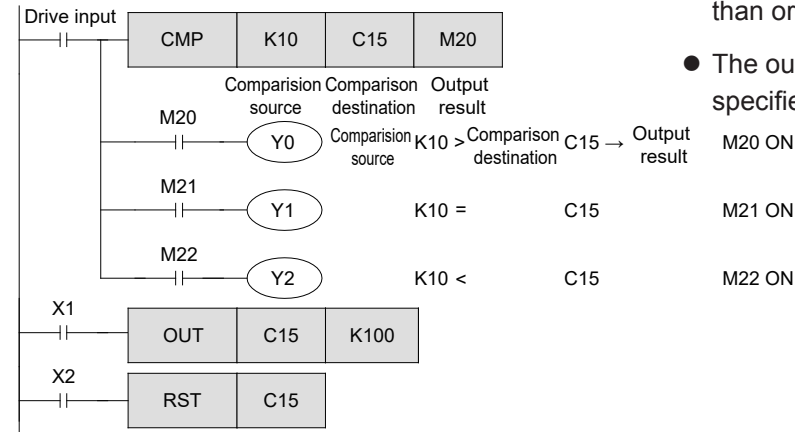
Zone comparison is beneficial for determining when a number is within a specified range of values. For example, depending on whether a device value is below, between, or above the range  $100 \pm 2$ , a specified bit can be turned on to specify where the value exists in relation to the zone.

# 8.1 Data comparison instructions CMP, ZCP

The comparison instructions are used when comparing the current values stored in the data registers, the timers and the counters, or the values representing the combined relays of X, Y, M, or S, along with constants K. There are 1-point comparison and 2-point zone comparison methods for comparing data. Both methods produce three results to determine whether a value is "less than," "greater than," or "equal to" the comparison source(s).

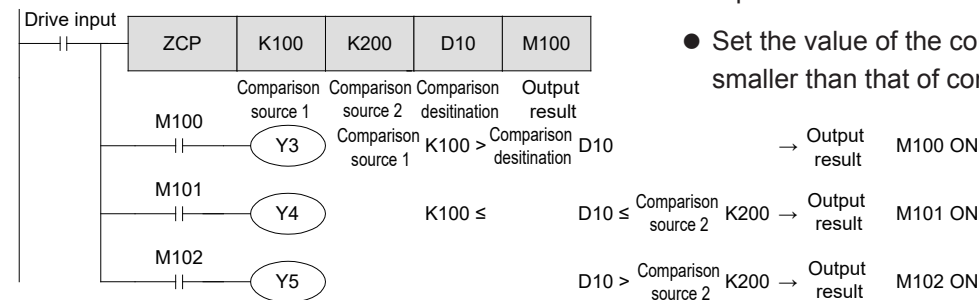
## <<Operation outline>>

One point comparison



- If the drive input is turned on, a result is output to display whether the target is larger than, smaller than or equal to the comparison source.
- The output result occupies the first 3 points of the specified device.

Zone comparison



- The zone comparison instruction is an instruction that performs the same operation as the 1-point comparison except that the comparison source is a 2-point zone.
- Set the value of the comparison source 1 to a value smaller than that of comparison source 2.

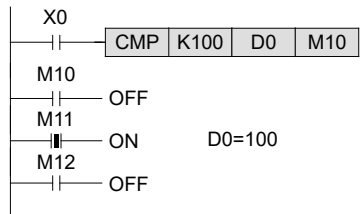
## Reference

### Operation of output result

In the following cases, the output result for data comparison instructions will not change:

1. When the drive input is ON, but the description of the instruction is mistaken.  
Example
  - When the number of applicable compare device is indexed so that it exceeds the device range.  
(The operation error flag SM0 turns on in this case.)
  - When the value of the comparison source 1 is larger than the value of comparison source 2 for zone comparison.
2. The drive input is turned on once, and then turned off after the comparison instruction is executed and the compare output does not change.  
(The operation error flag SM0 is not turned on in this case.)

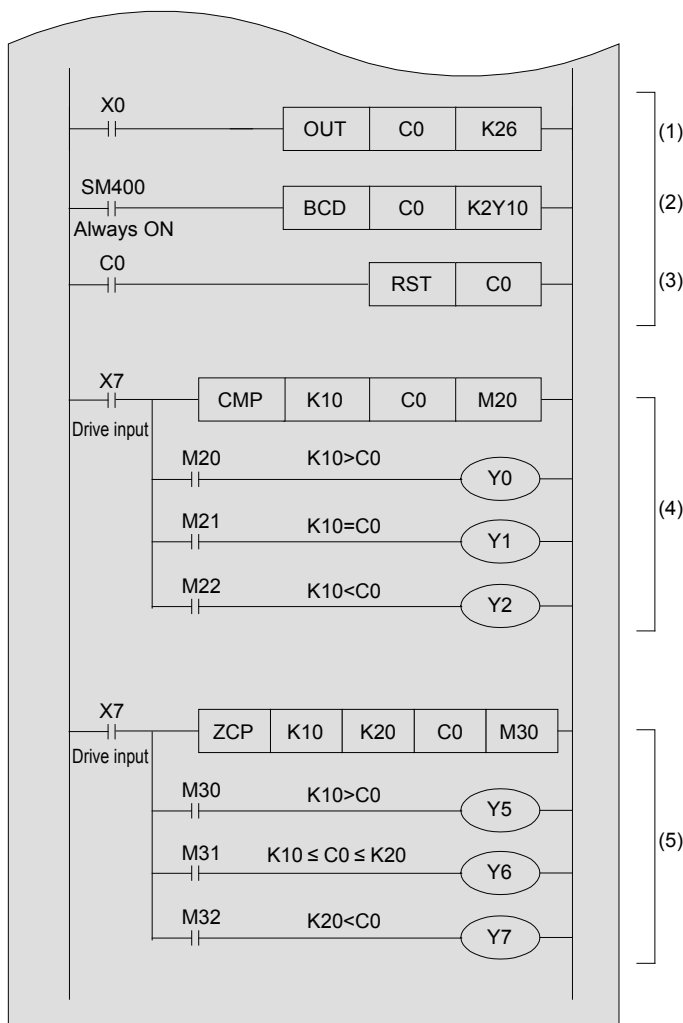
Example



When the output result directly starts from the bus line as shown in the left diagram and the drive input X0 is turned off, the output M11 remains ON without regard to changes in D0. It is recommended to serially connect the result input to the drive input as described in the above diagram, or to turn off the output destination devices using the RST instruction after the drive input is turned off.

# <<Instruction operation>>

Use the count value of the counter to check the operations of the CMP instruction and the ZCP instruction.



# <<Operation check>>

- (1) The current value of the counter C0 increases by "1" when the input of X0 is "ON"
- (2) The current value of the counter C0 is indicated in the 7-segment display module.
- (3) When the current value of the counter reaches 26, reset the counter and return it to the initial status.
- (4) Value comparison

|                          |                     |                     |                     |
|--------------------------|---------------------|---------------------|---------------------|
| Current value of counter | 11 or more          | 10                  | 0 to 9              |
|                          | Y2: ON<br>(M22: ON) | Y1: ON<br>(M21: ON) | Y0: ON<br>(M20: ON) |

- (5) Zone comparison

|                          |                     |                     |                     |
|--------------------------|---------------------|---------------------|---------------------|
| Current value of counter | 21 or more          | 10 to 20            | 0 to 9              |
|                          | Y7: ON<br>(M32: ON) | Y6: ON<br>(M31: ON) | Y5: ON<br>(M30: ON) |

## 8.2 Contact comparison instructions (LD \* , AND \* , OR \* )

Contact comparison instructions can use a comparison result as the contact information in a circuit.

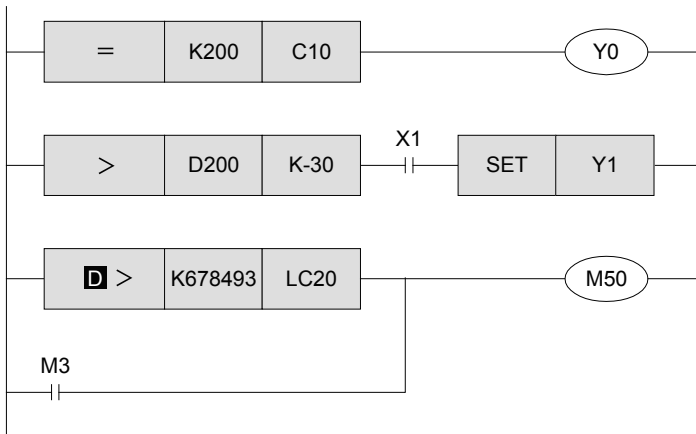
Therefore, the expression method is intuitive and easy-to-understand, and the sequence can be calculated according to the comparison results.

### <<Operation outline>>

- The contact compare instructions are divided into 3 types depending on their placement within a program:  
LD contacts (connected from the bus line), AND contacts (connected to others serially), and OR contacts (connected to others in parallel).

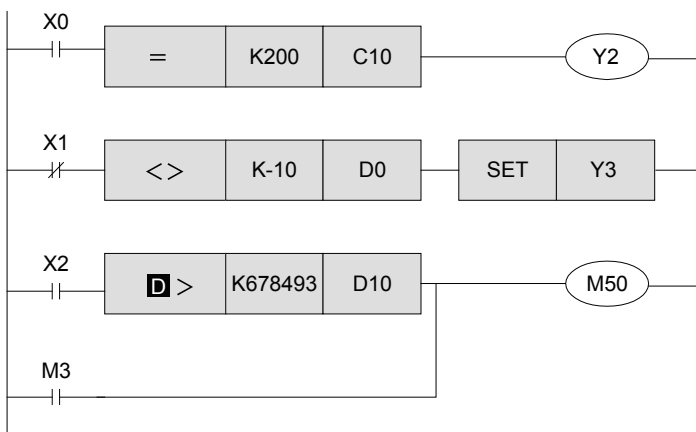
- When inputting with the GX Works3 tool button, "=", ">", "<", "<>", "≤", "≥" can be input after .

#### LD \*      \* : =, >, <, <>, ≤, ≥



- Y0 is turned on when the current value of the counter C10 is 200.
- Y1 is turned on when the value of D200 is -29 or more and X1 is ON.
- M50 is turned on when the value of the long counter LC20 is smaller than 678493 or M3 is ON.
- 32-bit instructions are used for long counters (LC0 onwards).

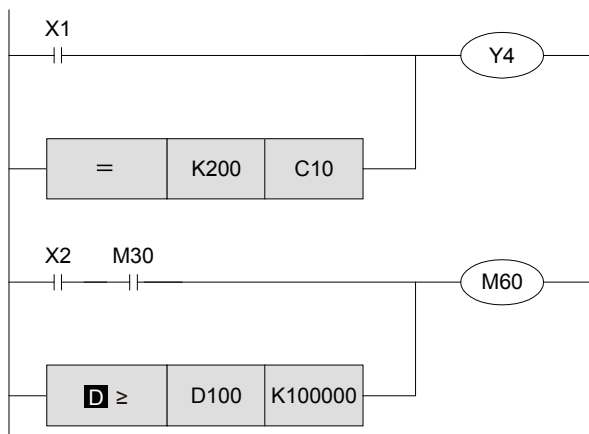
#### AND \*      \* : =, >, <, <>, ≤, ≥



- Y2 is turned on when X0 is ON and the current value of the data register C10 is 200.
- Y3 is SET when X1 is OFF and the value of the data register D0 is not -10.
- When X2 is ON, M50 is ON in the case that the value of D11 and D10 is smaller than 678493, or M3 is turned on.
- 32-bit instructions are used for 32-bit data.

OR \*

\* : =, >, <, <>, ≤, ≥



- Y4 is turned on when X1 is turned on or the current value of the counter C10 is 200.

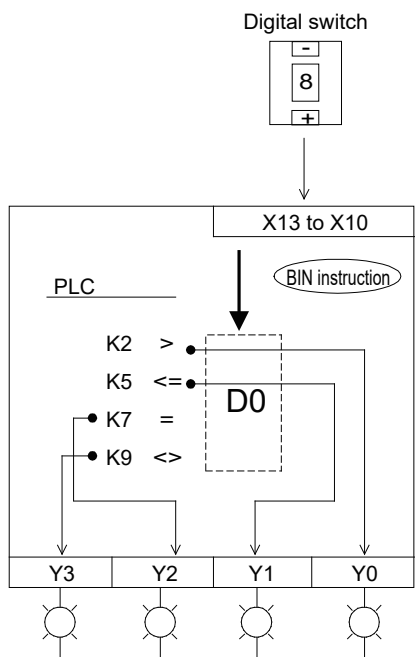
- M60 is turned on when both X2 and M30 are turned on, or the values of the data register D101 and D100 is 100000 or more.

- 32-bit instructions are used for 32-bit data.



# <<Instruction operation>>

Compare the input value from a digital switch to a value set in advance and then turn on an output.

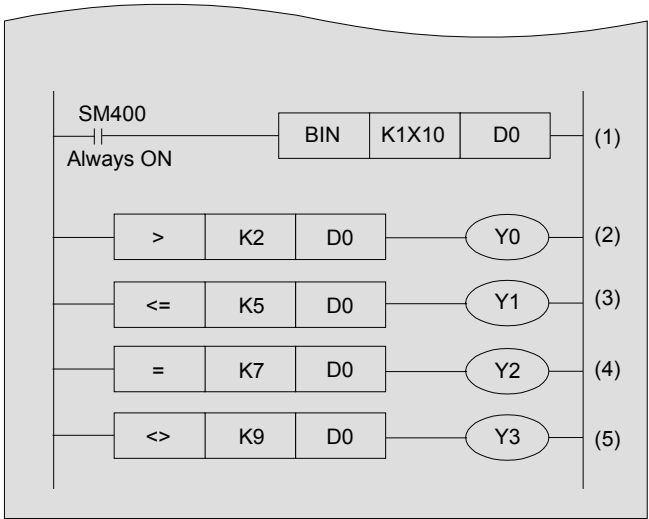


# <<Operation check>>

- (1) The input value from the digital switch is transferred to D0.
- (2) to (5) The values of Y0 to Y3 change according to the values of the digital switches as show below.

●: Output ON    -: Output OFF

| DSW value | Output |    |    |    |
|-----------|--------|----|----|----|
|           | Y3     | Y2 | Y1 | Y0 |
| 0         | ●      | -  | -  | ●  |
| 1         | ●      | -  | -  | ●  |
| 2         | ●      | -  | -  | -  |
| 3         | ●      | -  | -  | -  |
| 4         | ●      | -  | -  | -  |
| 5         | ●      | -  | ●  | -  |
| 6         | ●      | -  | ●  | -  |
| 7         | ●      | ●  | ●  | -  |
| 8         | ●      | -  | ●  | -  |
| 9         | -      | -  | ●  | -  |



BIN convert the X10 to X13 ON/OFF (BCD) and transfer to D0

Y0 is ON when D0 value is less than K2

Y1 is ON when D0 value is K5 or more

Y2 is ON when D0 value is K7

Y3 is ON when D0 value is other than K9

## Chapter 9

# ARITHMETIC OPERATION

---

### Arithmetic operation (+, −, \*, /)

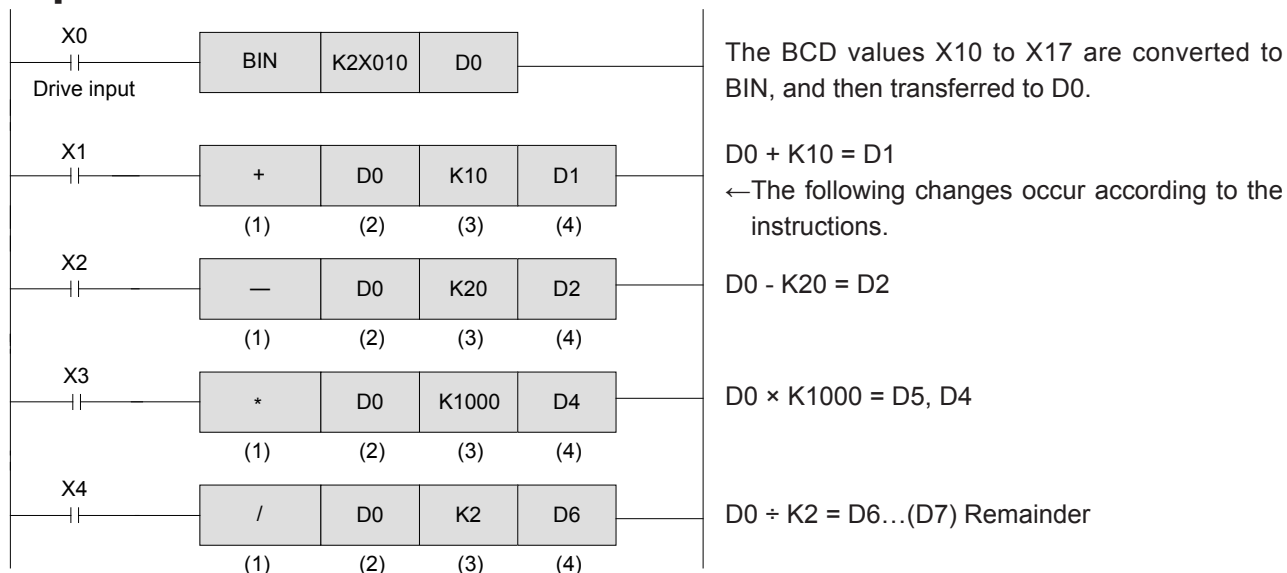
For basic arithmetic operations such as multiplication, addition and subtraction, specific applied instructions are available.

This chapter describes the basic instructions needed for binary arithmetic control.

# 9.1 Arithmetic operation instructions +, -, \*, /

PLC arithmetic instructions are used to perform operations of addition, subtraction, multiplication and division.

## <<Operation outline>>



### (1) Instructions

- + : BIN ADDITION
- : BIN SUBTRACTION
- \* : BIN MULTIPLICATION
- / : BIN DIVISION

(2) Specify the augend, minuend, multiplicand or dividend.

(3) Specify the addend, subtrahend, multiplier or divisor.

(4) Specify the storage destination for the operation result.

For the 16-bit instruction +, -, \*, /

Addition (D0) + (K10) = (D1)

Subtraction (D0) - (K20) = (D2)

Multiplication (D0) × (K1000) = (D5, D4)

Division (D0) ÷ (K2) = (D6)

Sum

Difference

Product (The result is 32 bits.)

Quotient...(D7) Remainder

For the 32-bit instruction **D** +, **D** -, **D** \*, **D** /

Addition (D1, D0) + (K10) = (D2, D1)

Subtraction (D1, D0) - (K20) = (D3, D2)

Multiplication (D1, D0) × (K5) = (D7, D6, D5, D4)

Division (D1, D0) ÷ (K2) = (D7, D6)

Sum

Difference

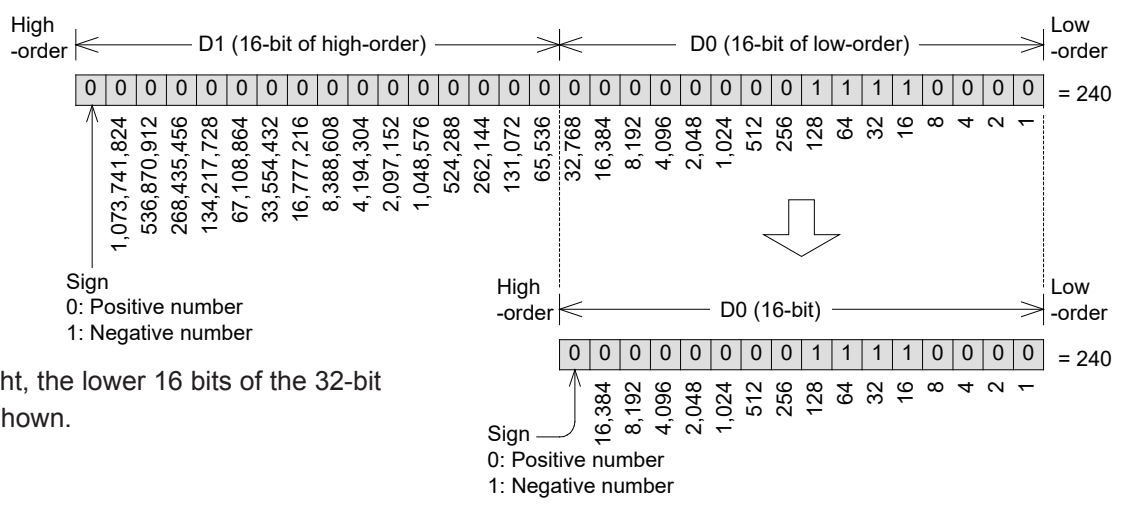
Product (The result is 64 bits.)

Quotient...(D9, D8) Remainder

- The operation result is 32-bit for multiplication (64 bits for the **D** instruction), and for division, a register is occupied by the remainder. Thus, it is necessary to avoid storage destination conflicts for operation results of multiplication and division instructions.
- For the 32-bit multiplication instruction (**D** \*), the operation result becomes 64 bits.  
In this situation, note that there are no applied instructions or peripheral equipment for the 64-bit data. For example, when division is also used, it is recommended to perform the division first in order to make the data for the multiplication as small as possible.
- If the INT/FLT instruction is used, floating point operation for values below decimal-point is also available.

The operation result of the multiplication instruction (product) is represented as 32-bit data with the 16-bit operation, while 64-bit data is required for the result of the 32-bit operation.

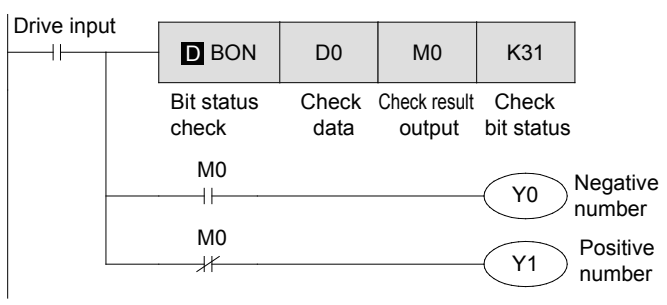
For example, if the product is K240, the 16-bit operation is shown below.  
In this situation, only the upper 16 bits can be used since the upper 16 bits are 0.



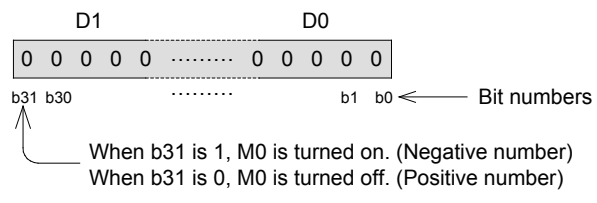
On the right, the lower 16 bits of the 32-bit data are shown.

When the operation result is within 16 bits (32 bits), the data of the lower words can be used as the operation data for the next time.

Moreover, it is convenient to use the bit status check instruction (BON) to check the positive and negative numbers.



When the 31st bit (highest bit) of the 32-bit data D1 and D0 is ON, M0 is turned on.



# MEMO

# Aspects of interrupt control!

## Chapter 10

### HIGH SPEED PROCESSING FUNCTIONS AND COMMANDS

---

#### Capturing high speed input signals to a PLC...

Normally, in order to securely capture an input signal to a PLC, a signal width of at least "scan cycle + filter time (10 ms)" is required.

In addition to normal inputs, however, the micro PLCs have built-in functions to capture high-speed signals, which makes it possible to process high frequency signals.

#### Using high speed processing...

"Input interrupts" and "high speed counters" are two examples of control mechanisms that use high speed processing procedures.

With micro PLCs, a variety of built-in high speed functions are available for capturing and controlling high speed signals.

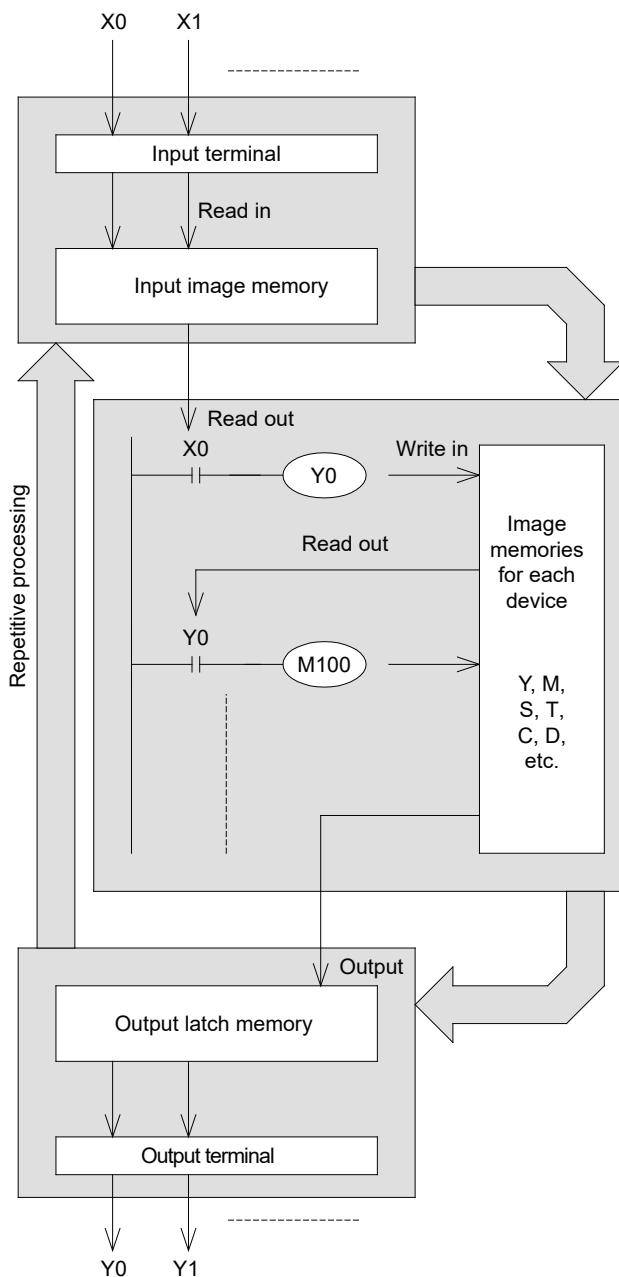
# 10.1 Concept of high speed processing

The micro PLC repeats a sequence of "input processing" → "program processing" → "output processing". This is called "batch refresh", and is commonly used with the PLC.

This series of processing actions (one scan cycle) only needs approximately 10 ms, enough to normally control a sequence. But 10 ms is not enough to execute processing immediately after an input is turned on or to capture an input signal shorter than one scan cycle of the PLC.

This section describes the processing methods that are not subject to the influence of the scan cycle of the program.

## Outline of refresh mode



### ● Input operation

Prior to execution of a program, the PLC reads all ON/OFF statuses of input terminals into the input image memory.

If an input changes its status during execution of the program, the input image memory does not change the contents at this time. The change will be read in the next input process cycle.

### ● Process of program

The PLC reads the ON/OFF statuses of required devices from the input image memory or other device's memory, in accordance with the contents of instructions stored in the program memory. Hence the image memory of each device can sequentially change its content in accordance with the progress of the program.

### ● Output operation

When all instructions have been executed, the PLC transfers the ON/OFF statuses of outputs Y to the output latch memory, which are the physical outputs.

# Types of high speed processing supported with FX5U CPU module

## For interrupt processing

Interruption, including input interrupts and timer interrupts, can be executed during the program operation.

- **Input interrupt** : Eight points of X0 to X17 can be used. The specified program is executed when an input point is turned on or off.
- **Timer interrupt**: The specified program is executed at the set time.  
For time specification, four points from 1 to 60,000 ms can be used.

## For high speed counter

High speed counters count how many times the inputs X0 to X17 are turned ON or OFF.  
FX5U CPU module can count short pulses within 200 kHz.

## For pulse catch

When the input relay (X0 to X17) changes from OFF→ON, the input device stays ON during the next scan.

## Instructions that execute high speed processes

In addition to the interrupt counters and high speed counters, the following instructions are executed at high speed.

|      |                                 |   |                        |
|------|---------------------------------|---|------------------------|
| MTR  | Input Matrix                    | } | for high speed counter |
| HSCS | Compare and Set                 |   |                        |
| HSCR | Compare and reset               |   |                        |
| HSZ  | High Speed Counter Zone Compare |   |                        |
| SPD  | Speed Detection                 |   |                        |
| PLSY | Pulse Y Output                  |   |                        |
| PWM  | Pulse Width Modulation          |   |                        |

## <<Additional note>> For input designation

Inputs X0 to X17 can be used for high speed processing. If they are set for high speed processing, they cannot be used for other processing instructions.

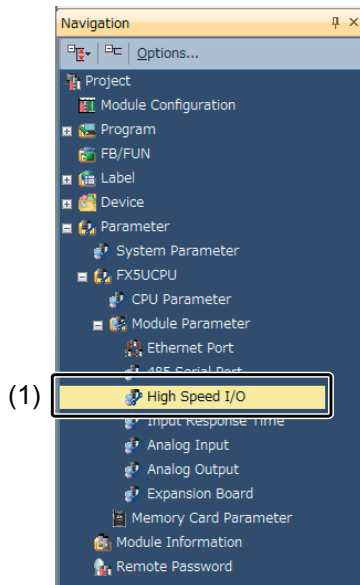
For example, when X0 is used for an interrupt instruction, it cannot be used for a high speed counter. If X0 is programmed for both purposes, an error will occur.



# 10.2 Using input interrupts

X0 to X17 are available for input interrupts. Up to eight points can be used.  
Parameter settings and an interrupt program are required to use the input interrupt.

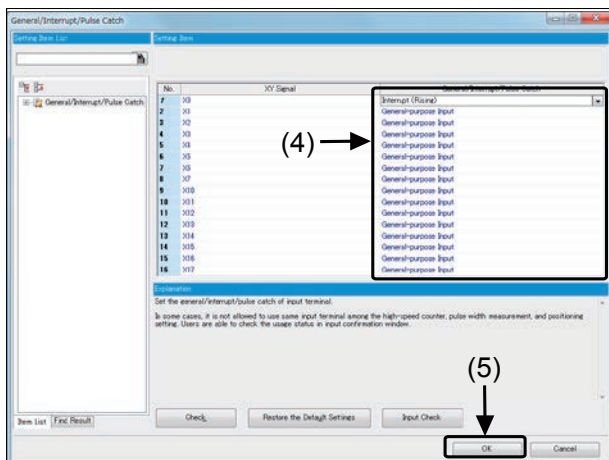
Settings for the input interrupt are explained here.



- (1) Double-click [Parameter] → [FX5UCPU] → [Module Parameter] → [High Speed I/O] on the navigation window.

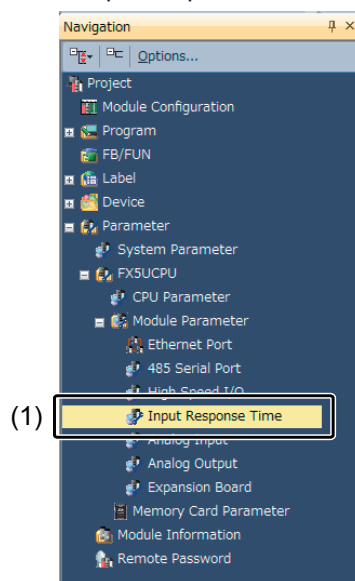


- (2) Select [Input Function].
- (3) Double-click [General/Interrupt/Pulse Catch] → [Detailed Setting].

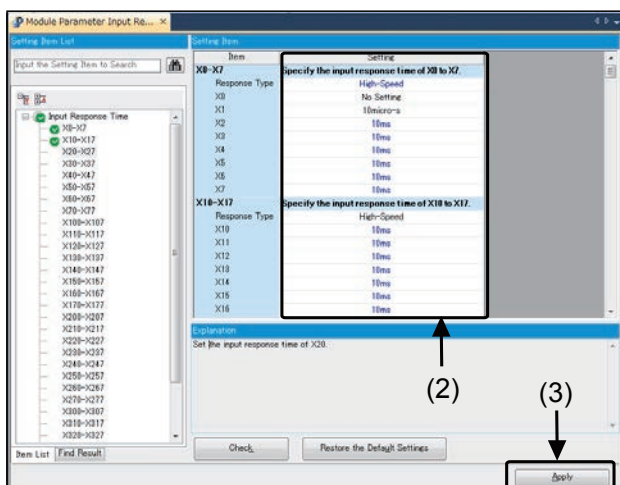


- (4) Select the input interrupt settings from the following.
  - Interrupt (Rising)  
The interrupt program is executed when OFF→ON of the input signal is detected.
  - Interrupt (falling edge)  
The interrupt program is executed when ON→OFF of the input signal is detected.
  - Interrupt (rising edge + falling edge)  
The interrupt program is executed when OFF→ON or ON→OFF of the input signal is detected.
  - Interrupt (rising edge) + pulse catch  
The interrupt program is executed when OFF→ON of the input signal is detected.  
The pulse catch function can also be used.
- (5) After setting, click [OK].

The settings for the input response time are explained next.



- (1) Double-click [Parameter] → [FX5UCPU] → [Module Parameter] → [Input Response Time] on the navigation window.



- (2) Set the input response time. (Default value: 10 ms)

- Response type  
High speed: 1-point module  
Standard: 8-point module
- Input response time  
10  $\mu$ s, 50  $\mu$ s, 0.1 ms, 0.4 ms, 0.6 ms, 1 ms, 5 ms, 10 ms, 20 ms, 70 ms

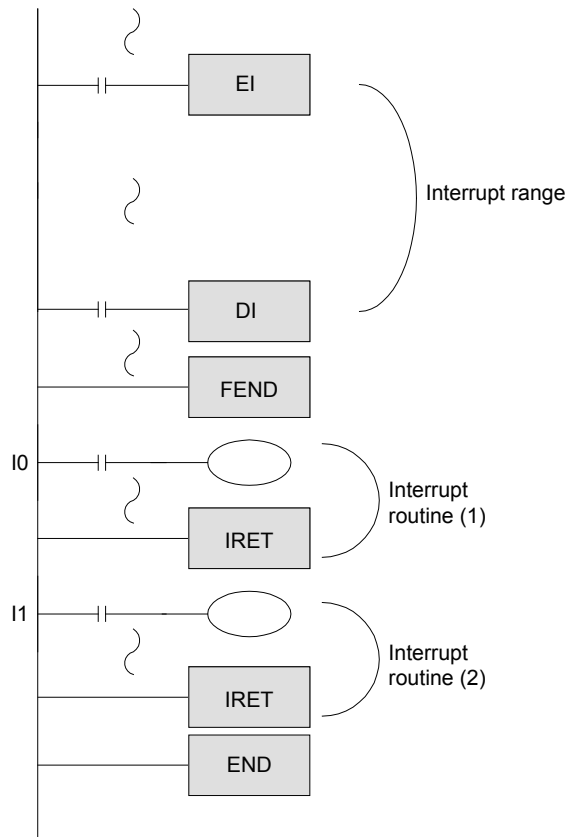
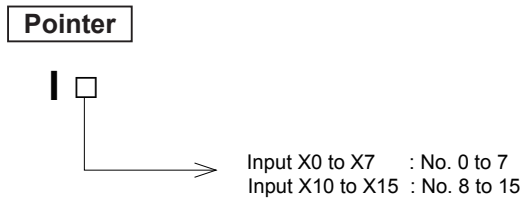
- (3) After setting, click [Apply].

## Reference

The actual input response time will be the value to which the hardware filter value has been added.  
The FX5U CPU module hardware filter delay time is shown below.

| Input No. |                      | Hardware filter value |             |
|-----------|----------------------|-----------------------|-------------|
| FX5U-32M□ | FX5U-64M□, FX5U-80M□ | When ON               | When OFF    |
| X0 to X5  | X0 to X7             | 2.5 $\mu$ s           | 2.5 $\mu$ s |
| X6 to X17 | X10 to X17           | 30 $\mu$ s            | 50 $\mu$ s  |
| —         | X20 and following    | 50 $\mu$ s            | 150 $\mu$ s |

## <<Operation outline>>

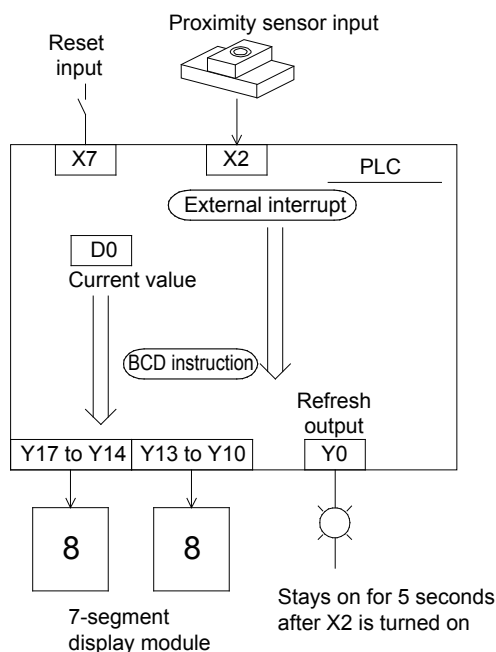


- The PLC is usually in the interrupt prohibit state. If X0 or X1 is turned on when the program is executed between the EI and the DE instructions, the interrupt routine (1) or (2) is executed. The program returns to the main program by the IRET instruction.
- Basically, an interrupt program cannot be executed while another interrupt program is in progress. However, it can be accepted if multiple interrupt is “enabled” with the parameters.
- Use a routine timer in the subroutine or interrupt routine.  
The parameters must be set to use the routine timer.
- If the signal width is input response time + hardware filter, the input interrupt operation can be executed.
- If multiple interrupts occur in succession, the interrupt with the smaller order of priority will have the higher priority. If the interrupt order of priority is the same, the interrupts will be executed in the interrupt order of priority.
- Interrupts that occur after the DI instruction are processed after the EI instruction is executed.

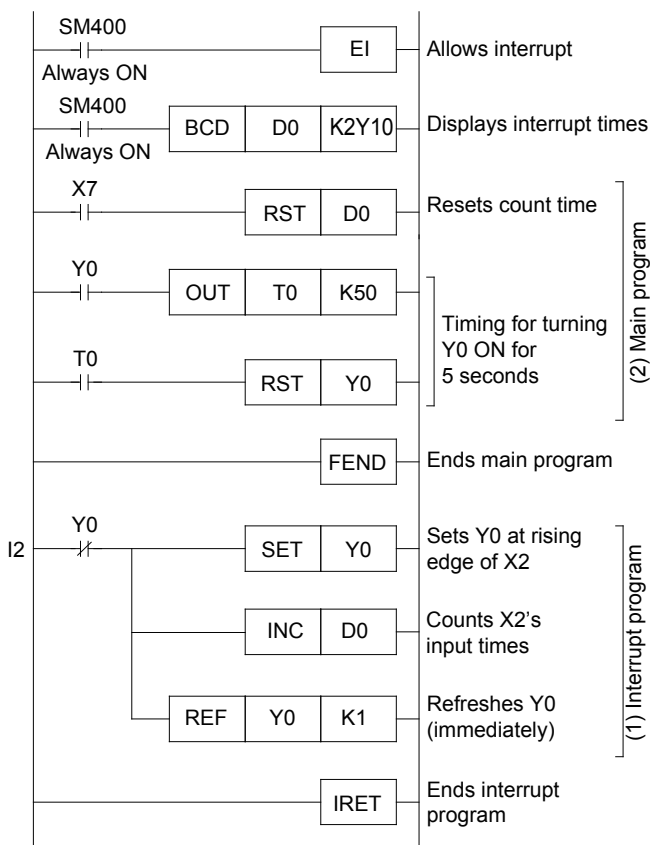
## <<Instruction operation>>

Confirm the actions of the external interrupt signal of X2.

Operate with the image that an object is passing by the proximity sensor connected to X2 at a high speed.

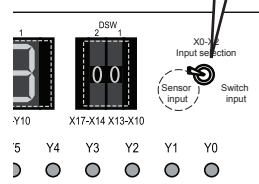


- Parameter setting <using X2>
  - High speed I/O : Interrupt (rising edge)
  - Input response time : No setting
- Program example



### [Preparing the training machine]

Set the selection switch to the left.



## <<Operation check>>

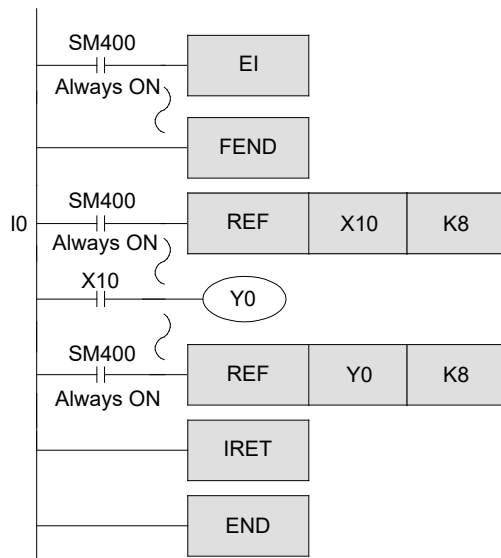
- Y0 is turned on when X2 is turned on, and the data is output immediately by the REF instruction. X2 is used for high speed input. The input signal needs to stay on for only 2.5  $\mu$ s to be recognized.
  - In this example program, the PLC does not recognize a signal from X2 while Y0 is ON (5 seconds).
  - The number of times X2 is turned on is counted by the INC instruction (increment a value by 1), and stored in the data register D0.
- The current value of D0 is reset when X7 is turned on.
  - The timer T0 times out and is reset after Y0 stays on for 5 seconds.

### Reference

- When input interrupt is used, short input signals can be accepted without missing any. In this program example, the operation to accurately count the workpieces that pass over the proximity sensor at a high speed is realized.
- The INC instruction is an instruction that adds "1" to the specified device. If the INC instruction of the continuous execution type is used, 1 is added every operation cycle. To avoid this, generally, the "INCP" instruction of the pulse execution type is used. On the left program, 1 is added by an instruction only in response to an interrupt input. Therefore the program runs properly with the "INC" instruction of the continuous execution type.

## Using an interrupt instruction with an I/O refresh instruction

- In the program between the pointer and the IRET instruction, input processing is executed by way of "ON/OFF" general input processing. The result of the interrupt program is not executed until the whole program is finished.
- For this reason, the result of the interrupt program may not be prompt even though it is an interrupt program.
- However, if the I/O refresh instruction is used, the latest I/O information can be used for the operation.



- End of the main program
- I0 is the X0 interrupt pointer.
- The values of X10 to X17 are stored.
- X10 is refreshed and then processed.
- The result of the operation is output.  
(Y0 to Y7)
- End of the interrupt

## Reference

### HIOEN instruction

This command controls the start and stop of the high speed input/output function.

|  |       |     |     |     |
|--|-------|-----|-----|-----|
|  | HIOEN | (1) | (2) | (3) |
|--|-------|-----|-----|-----|

(1) Set the number of the function to be started and stopped.

| Function number | Function name                                  |
|-----------------|--|
| K0              | High speed counter                             |
| K10             | Pulse density                                  |
| K20             | High speed comparison table                    |
| K30             | Multi-point output high speed comparison table |
| K40             | Pulse width measurement                        |
| K50             | PWM  |

(2) Set the CH No. bit for starting the function.

For function No. K0, the start of the high-speed counter can be individually controlled for each parameter high-speed counter CH.

| Bit position |     |     |     |     |     |    |    |     |     |     |     |     |     |     |     |
|--------------|-----|-----|-----|-----|-----|----|----|-----|-----|-----|-----|-----|-----|-----|-----|
| b15          | b14 | b13 | b12 | b11 | b10 | b9 | b8 | b7  | b6  | b5  | b4  | b3  | b2  | b1  | b0  |
| —            |     |     |     |     |     |    |    | CH8 | CH7 | CH6 | CH5 | CH4 | CH3 | CH2 | CH1 |

(3) Set the CH No. bit for stopping the function.

For function No. K0, the stop of the high-speed counter can be individually controlled for each parameter high-speed counter CH.

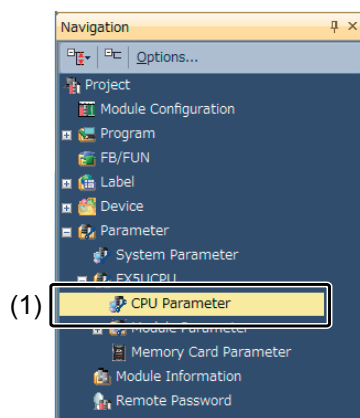
| Bit position |     |     |     |     |     |    |    |     |     |     |     |     |     |     |     |
|--------------|-----|-----|-----|-----|-----|----|----|-----|-----|-----|-----|-----|-----|-----|-----|
| b15          | b14 | b13 | b12 | b11 | b10 | b9 | b8 | b7  | b6  | b5  | b4  | b3  | b2  | b1  | b0  |
| —            |     |     |     |     |     |    |    | CH8 | CH7 | CH6 | CH5 | CH4 | CH3 | CH2 | CH1 |

- If a value that turns the same CH ON is set for the start and stop, the stop operation will have the priority.

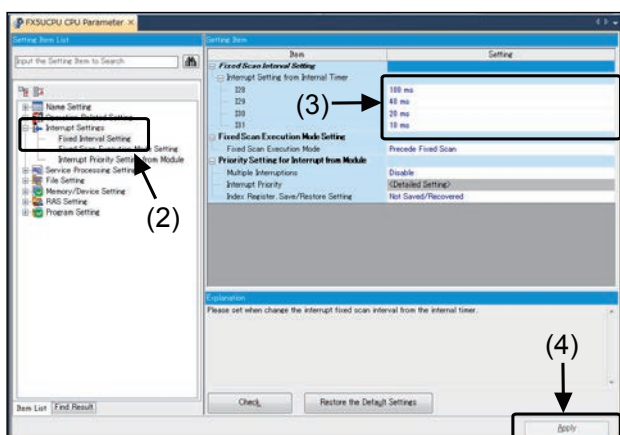
## 10.3 Using a timer interrupt program

The four points I28 to I31 can be used for the interrupt timer.

The timer interrupt cycle is set with the parameters.



- (1) Double-click [Parameter] → [FX5UCPU] → [CPU Parameter] on the navigation window.



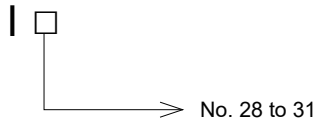
- (2) Click [Interrupt Settings] → [Fixed Interval Setting].

- (3) Set the timer interrupt set cycle interval.  
(Setting range: 1 ms to 60000 ms)

- (4) After setting, click [Apply].

## <<Operation outline>>

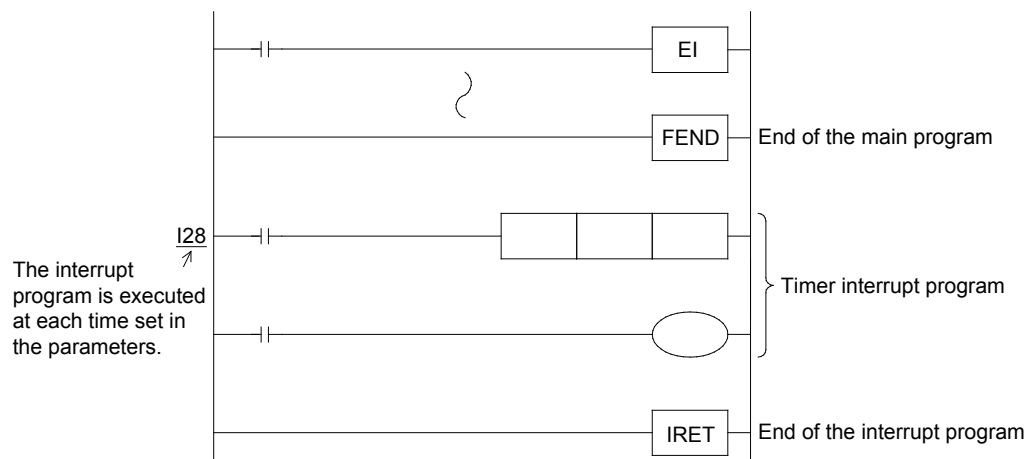
### Pointer



The interrupt program starts when the time specified by the pointer has arrived.

Other conditions for timer interrupt programs are the same as those for the input interrupt programs. The time specified in the parameter is used as the timer value, so there is no need to program another timer circuit for interrupt.

The following instructions use several operation cycles to execute a series of actions: RAMP, SEGL, PLSY. Using these instructions may take a long time to complete all of the actions, or may not even complete all of the actions successfully due to time fluctuation. Use a timer interrupt program for such cases.





# 10.4 Using high speed counters

## 10.4.1 Types of high speed counters

A high speed counter counts how many times an input device turns on or off in interrupt processing. It does not depend on the operation cycle.

As shown in the table on the next page, the input of the high speed counter is specified by the device number of the high speed counter. The input can be X0 to X17.

There are four types of high speed counters (including the internal clock counter).

|                                |                 | Input signals form | Counting directions  |
|--------------------------------|-----------------|--------------------|--|
| 1-phase<br>1-counting<br>input | S/W             |                    | <p>The counting direction (up or down) is specified with SM4580 to SM4587.</p> <p>ON: Down-counting<br/>OFF: Up-counting</p>   |
|                                | H/W             |                    | <p>Down-counting or up-counting are designated by the ON or OFF state of the B-phase. The counting direction of the counter can be monitored with SM4564 to SM4571.</p> <p>ON: Down-counting<br/>OFF: Up-counting</p>                    |
| 1-phase<br>2-counting input    |                 |                    | <p>This counter counts up or down as shown on the left.</p> <p>The counting direction of the counter can be monitored with SM4564 to SM4571.</p> <p>ON: Down-counting<br/>OFF: Up-counting</p>   |
| 2-phase<br>2-counting<br>input | 1-edge<br>count |                    | <p>This counter counts up or down automatically according to the input status in A- and B-phases.</p> <p>The counting direction of the counter can be monitored with SM4564 to SM4571.</p> <p>ON: Down-counting<br/>OFF: Up-counting</p> |
|                                | 2-edge<br>count |                    |  |
|                                | 4-edge<br>count |                    |  |
| Internal clock                 |                 |                    | <p>The counting direction (up or down) can be monitored with SM4580 to SM4587.</p> <p>ON: Down-counting<br/>OFF: Up-counting</p>   |

## 10.4.2 High speed counters and input terminal numbers

Assign the high speed counter input device with the parameter.

The corresponding assignment is determined according to the type of counter set for each channel with the parameter.

For example, if CH1 is set to 1-phase 1-input (H/W), a 1-phase 1-input counter with X0 for the A-phase input and X1 for the B-phase input is created. If 1-phase 1-input (H/W) is used with CH1, 1-phase 1-input (S/W) cannot be used with CH2.

| CH  | High speed counter type | X0 | X1 | X2 | X3 | X4 | X5 | X6 | X7 | X10 | X11 | X12 | X13 | X14 | X15 | X16 | X17 |
|-----|-------------------------|----|----|----|----|----|----|----|----|-----|-----|-----|-----|-----|-----|-----|-----|
| CH1 | 1-phase 1-input (S/W)   | A  |    |    |    |    |    |    |    | P   | E   |     |     |     |     |     |     |
|     | 1-phase 1-input (H/W)   | A  | B  |    |    |    |    |    |    | P   | E   |     |     |     |     |     |     |
|     | 1-phase 2-input         | A  | B  |    |    |    |    |    |    | P   | E   |     |     |     |     |     |     |
|     | 2-phase 2-input         | A  | B  |    |    |    |    |    |    | P   | E   |     |     |     |     |     |     |
| CH2 | 1-phase 1-input (S/W)   |    | A  |    |    |    |    |    |    |     |     | P   | E   |     |     |     |     |
|     | 1-phase 1-input (H/W)   |    |    | A  | B  |    |    |    |    |     |     | P   | E   |     |     |     |     |
|     | 1-phase 2-input         |    |    | A  | B  |    |    |    |    |     |     | P   | E   |     |     |     |     |
|     | 2-phase 2-input         |    |    | A  | B  |    |    |    |    |     |     | P   | E   |     |     |     |     |
| CH3 | 1-phase 1-input (S/W)   |    |    | A  |    |    |    |    |    |     |     |     |     | P   | E   |     |     |
|     | 1-phase 1-input (H/W)   |    |    |    |    | A  | B  |    |    |     |     |     |     | P   | E   |     |     |
|     | 1-phase 2-input         |    |    |    |    | A  | B  |    |    |     |     |     |     | P   | E   |     |     |
|     | 2-phase 2-input         |    |    |    |    | A  | B  |    |    |     |     |     |     | P   | E   |     |     |
| CH4 | 1-phase 1-input (S/W)   |    |    |    | A  |    |    |    |    |     |     |     |     |     |     | P   | E   |
|     | 1-phase 1-input (H/W)   |    |    |    |    |    |    | A  | B  |     |     |     |     |     |     | P   | E   |
|     | 1-phase 2-input         |    |    |    |    |    |    | A  | B  |     |     |     |     |     |     | P   | E   |
|     | 2-phase 2-input         |    |    |    |    |    |    | A  | B  |     |     |     |     |     |     | P   | E   |
| CH5 | 1-phase 1-input (S/W)   |    |    |    |    | A  |    |    |    | P   | E   |     |     |     |     |     |     |
|     | 1-phase 1-input (H/W)   |    |    |    |    |    |    |    |    | A   | B   | P   | E   |     |     |     |     |
|     | 1-phase 2-input         |    |    |    |    |    |    |    |    | A   | B   | P   | E   |     |     |     |     |
|     | 2-phase 2-input         |    |    |    |    |    |    |    |    | A   | B   | P   | E   |     |     |     |     |
| CH6 | 1-phase 1-input (S/W)   |    |    |    |    |    | A  |    |    |     |     | P   | E   |     |     |     |     |
|     | 1-phase 1-input (H/W)   |    |    |    |    |    |    |    |    |     |     | A   | B   | P   | E   |     |     |
|     | 1-phase 2-input         |    |    |    |    |    |    |    |    |     |     | A   | B   | P   | E   |     |     |
|     | 2-phase 2-input         |    |    |    |    |    |    |    |    |     |     | A   | B   | P   | E   |     |     |
| CH7 | 1-phase 1-input (S/W)   |    |    |    |    |    |    | A  |    |     |     |     |     | P   | E   |     |     |
|     | 1-phase 1-input (H/W)   |    |    |    |    |    |    |    |    |     |     |     |     | A   | B   | P   | E   |
|     | 1-phase 2-input         |    |    |    |    |    |    |    |    |     |     |     |     | A   | B   | P   | E   |
|     | 2-phase 2-input         |    |    |    |    |    |    |    |    |     |     |     |     | A   | B   | P   | E   |
| CH8 | 1-phase 1-input (S/W)   |    |    |    |    |    |    |    | A  |     |     |     |     |     |     | P   | E   |
|     | 1-phase 1-input (H/W)   |    |    |    |    |    |    |    |    |     |     |     |     |     |     | A   | B   |
|     | 1-phase 2-input         |    |    |    |    |    |    |    |    |     |     |     |     |     |     | A   | B   |
|     | 2-phase 2-input         |    |    |    |    |    |    |    |    |     |     |     |     |     |     | A   | B   |

A: A phase input

B: B phase input (Directional input used for 1-phase 1-input (H/W))

P: External preset input

E: External enable input

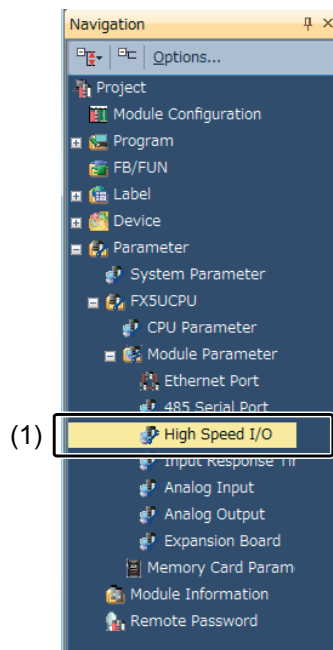
### Reference

The approximate maximum frequency that can be counted for each high speed counter type is shown below.

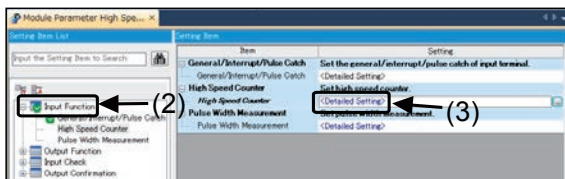
| 1-phase 1-input (S/H)                  | Maximum frequency |
|--|-------------------|
| 1-phase 1-input counter (S/W)          | 200 kHz           |
| 1-phase 1-input counter (H/W)          | 200 kHz           |
| 1-phase 2-input counter                | 200 kHz           |
| 2-phase 2-input counter [1-edge count] | 200 kHz           |
| 2-phase 2-input counter [2-edge count] | 100 kHz           |
| 2-phase 2-input counter [4-edge count] | 50 kHz            |
| Internal clock                         | 1 MHz (fixed)     |

## 10.4.3 High speed counter actions

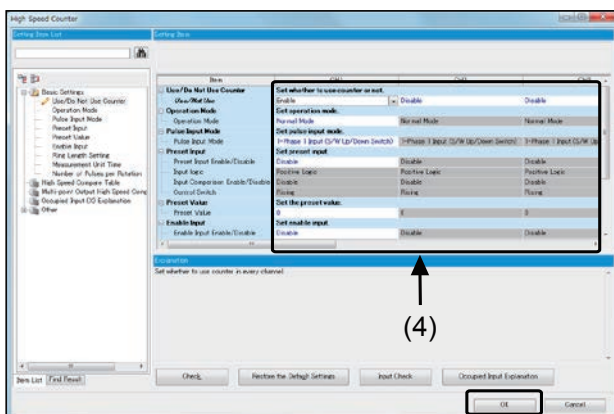
### <<Outline of parameters>>



- (1) Double-click [Parameter] → [FX5UCPU] → [Module Parameters] → [High Speed I/O] on the navigation window.



- (2) Select [Input Function].  
(3) Double-click [High speed Counter] → [Detail Settings].

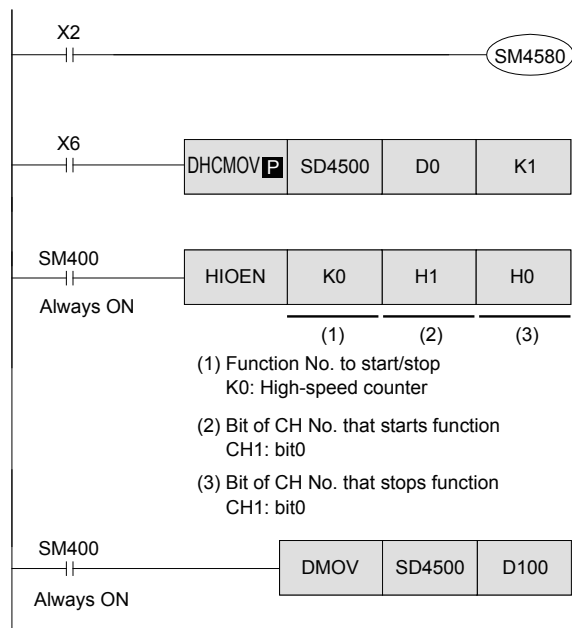


- (4) Set each item for the high speed counter.  
(5) After setting, click [OK].

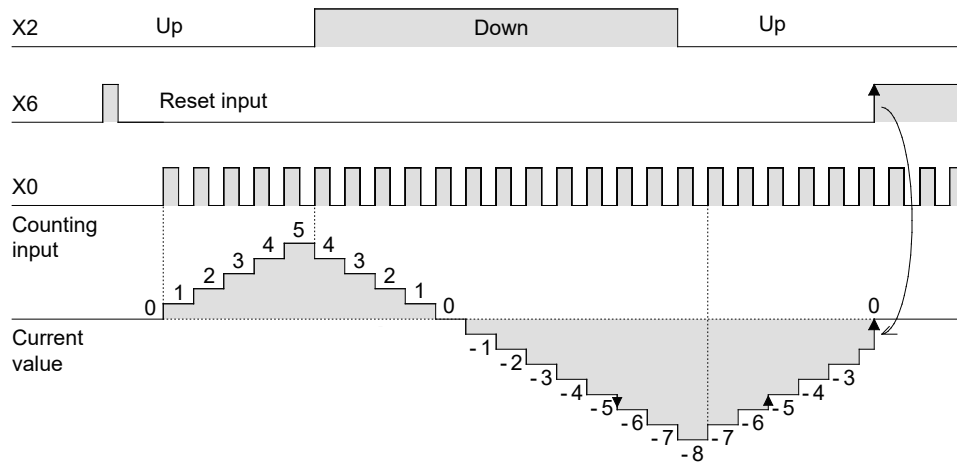
- When using the high speed counter, also set the input response time. Refer to the previous section “10.2 Using input interrupts” for details on the settings.

## <<Operation outline>>

- Example of high speed counter CH1: 1-phase 1-input (software)



- Select the up counter or the down counter.  
ON: Down counter, OFF: Up counter
- When X6 changes from OFF to ON, the counter's current value (SD4501, SD4500) is transferred to D1, D2, and the counter's current value (SD4501, SD4500) is set to 0.
- The high speed counter (CH1) measurement starts.
- The high speed counter (CH1) counter current value (SD4501, SD4500) is always transferred to D101, D100.



- The current value changes regardless of the output contact ON/OFF status. If the counter counts up from 2,147,483,647, the value is changed to -2,147,483,648, and if the counter counts down from -2,147,483,648, the resulting value is 2,147,483,647.  
(This counting operation is called a ring counter.)
- The current value of the counter is latched.

## 10.4.4 1-phase high speed counter operation

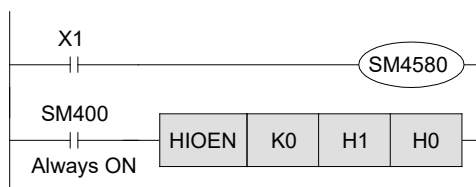
- The above counters are latched binary counters that use 32 bits.
- By using the high speed counting inputs, interrupt instructions are executed to count independently from the sequence operation. (The PLC provides instructions that are used to execute interrupt processes for output or comparison.)
- The parameters explained previously must be set to use the high speed counter.
- If external enable input or external preset input is valid, the count can be started and reset with the interrupt input.

The operation when using high speed counter CH1 with preset and enable validated is explained here.

Refer to the previous section “High speed counter and input terminal numbers” for details on the preset and enable device assignments.

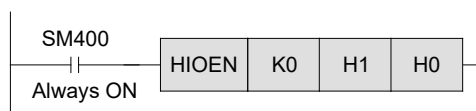
(The preset and enable input logic is “Positive Logic”.)

### 1-phase 1-input (S/W)



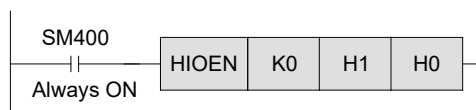
- Changes to down or up with the X1 ON/OFF state.
- When X11 is ON, input X0 OFF to ON is counted.
- When X10 turns ON, the counter's current value is preset.

### 1-phase 1-input (H/W)



- Changes to down or up with the X1 ON/OFF state.
- When X11 is ON, input X0 OFF to ON is counted.
- When X10 turns ON, the counter's current value is preset.

### 1-phase 2-input



- Counting starts immediately when X11 turns ON. Counts up when X0 changes from OFF to ON, and counts down when X1 changes from OFF to ON.
- When X10 turns ON, the counter's current value is preset.

## <<Additional note>>

Note that a malfunction occurs in counters due to switch chattering when high speed counters are activated with simulation switches.

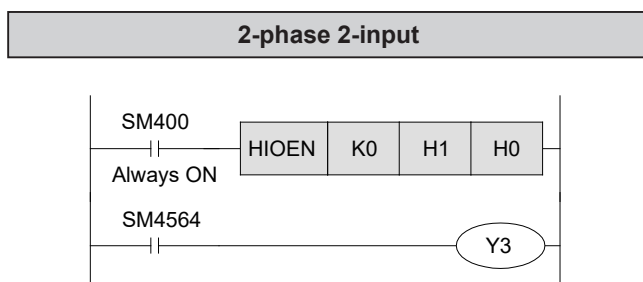
## 10.4.5 2-phase high speed counter operation

- The above counters are latched binary counters that use 32 bits.
- By using the high speed counting inputs, interrupt instructions are executed to count independently from the sequence operation. (The PLC provides instructions that are used to execute interrupt processes for output or comparison.)
- The parameters explained previously must be set to use the high speed counter.
- If external enable input or external preset input is valid, the count can be started and reset with the interrupt input.
- While an A-phase input is ON, this counter counts up when the B-phase input is changed from OFF to ON, and counts down when the B-phase input is changed from ON to OFF. Additionally, the counting direction (up or down) can be recognized by monitoring the ON/OFF status of SM4564 to SM4571.

The operation when using high speed counter CH1 with preset and enable validated is explained here.

Refer to the previous section “High speed counter and input terminal numbers” for details on the preset and enable device assignments.

(The preset and enable input logic is “Positive Logic”.)



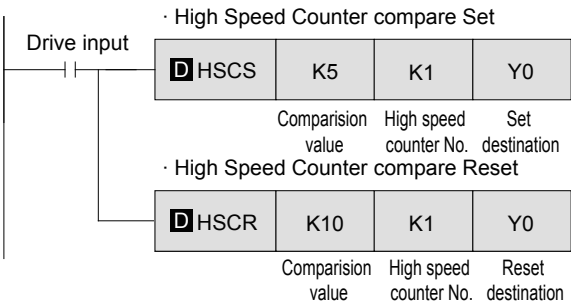
- When X11 is ON, the input X0 (A-phase) and X1 (B-phase) operation is counted.
- When X10 turns ON, the counter's current value is preset.
- Y3 is turned on (count-down) or off (count-up) according to the counting direction.

# 10.4.6 Instructions and their actions for high speed counters

The previous section described basic ways on how to use the high speed counters. When the current value reaches the setting value for a counter, the following instructions are used to output signals immediately. Similar to the high speed counters, the applied instructions are executed independently from the sequence operation. Thus, outputs can be used without any operation delays.

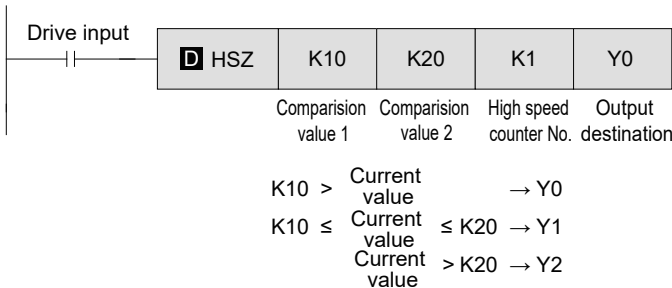
## <<Operation outline>>

### [High Speed Counter Set/Reset instructions]



- When the current value reaches the comparison value, interrupt processing is used to operate output signals.
- High speed counters use 32 bits. Thus, 32-bit instructions must be used with D added.

### [High Speed Counter Zone Compare]

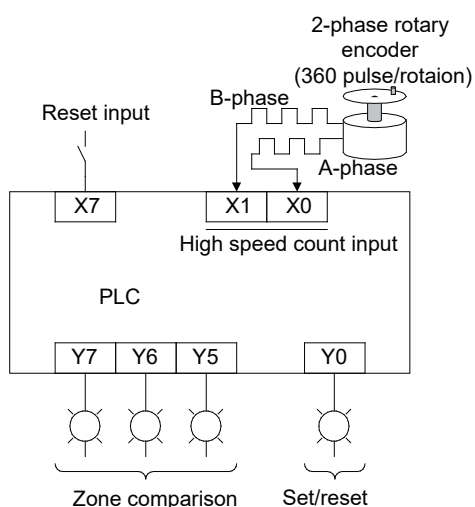


- This instruction is a High Speed Counter Zone Compare instruction.
- Three output points are controlled according to the current value of the high speed counter.

- Simultaneous execution of the above instructions must be limited to 32 instructions or less (More than 32 of the instructions can be programmed if they are not simultaneously executed.)

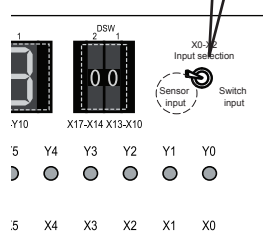
## <<Instruction operation>>

Using the training machine, create a sequence program with a high speed counter to count input signals from a 2-phase rotary encoder (high speed output device) and to operate the following outputs accordingly.



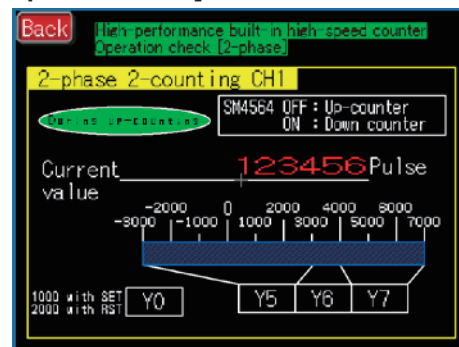
### [Preparing the training machine]

Set the selection switch to the left.



### Training Machine screen

[Basics: MELSEC iQ-F Programming (GX Works3 Version)] → [High speed counter]

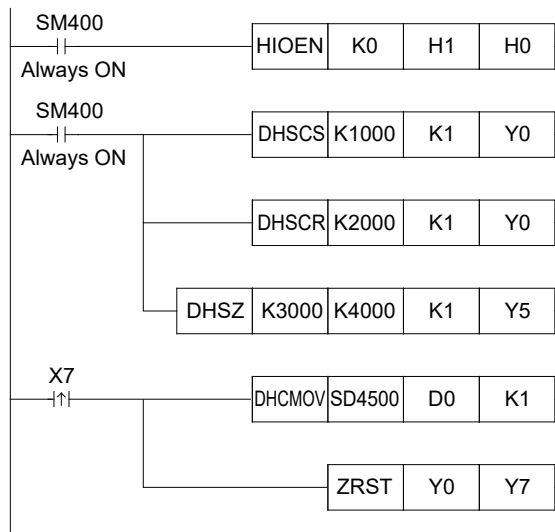


- Parameter setting  
[High speed I/O] – [High speed counter]  
CH1 enabled/disabled : Enabled  
Operation mode : Normal mode  
Pulse input mode : 2-phase 1-edge count  
Preset input : Invalid  
Enable input : Invalid

### [Input response time]

X0: No setting  
X1: No setting

### ● Program example



Always count high speed counter CH1

Y0 is set when counter's current value reaches 1000

Y0 is reset when counter's current value reaches 2000

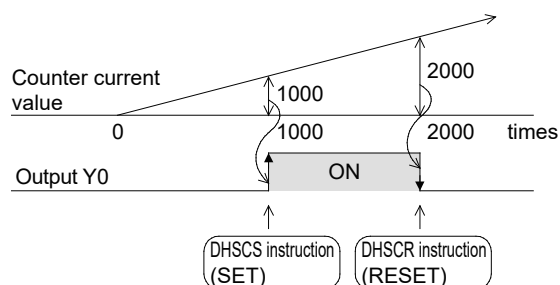
Y6 is ON while counter's current value is between 3000 and 4000  
If less than 3000, Y5 turns ON  
If 4000 is exceeded, Y7 turns ON

Transmit counter's current value (SD4501, SD4500) to D1, D0, and set SD4501, SD4500 to 0

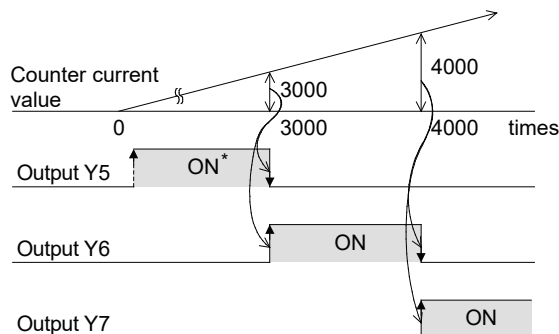
Batch reset Y0 to Y7

## <<Operation check>>

### [Count value is 0 to 2000]



### [Count value is 3000 to 4000]



\* Y5 turns on when the counter counts up from 0 to 1.



# MEMO

# Let's try using the analog function!

## Chapter 11

# ANALOG FUNCTION

---

### In this chapter...

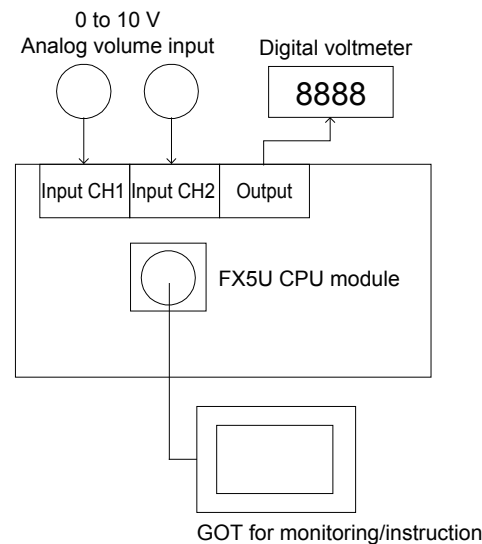
The analog input and output will be explained with setting examples using the FX5U CPU module built-in analog input/output function.

# 11.1 Using the built-in analog function

## <<Instruction operation>>

The FX5U CPU module has two analog input points (voltage) and one analog output point (voltage). In this chapter, we will use the built-in analog input/output function.

### [Exercise configuration]



### [Related devices]

| Devices | Contents                         | R: read<br>W: write |
|---------|----------------------------------|---------------------|
| SD6020  | Analog input CH1 (digital value) | R                   |
| SD6060  | Analog input CH2 (digital value) | R                   |
| SD6180  | Analog output (digital value)    | R/W                 |

- For this exercise, only the required device numbers have been extracted. Do not use the other numbers.

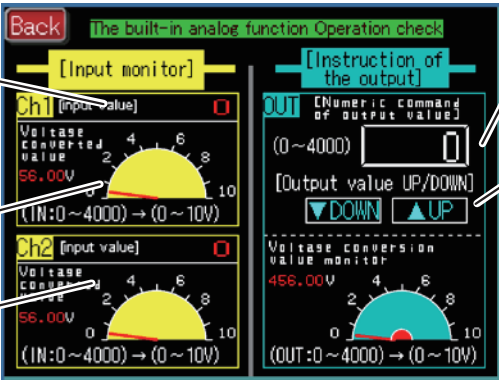
## Training Machine screen [Basics: MELSEC iQ-F Programming (GX Works3 Version)] → [Analog]

### [Analog input value SD6020 monitor]

The digital value retrieved using the potentiometer is displayed.

The retrieved digital value 0 to 4000 is converted to 0 to 10 V by the GOT and displayed.

### [Analog input value SD6060 monitor]



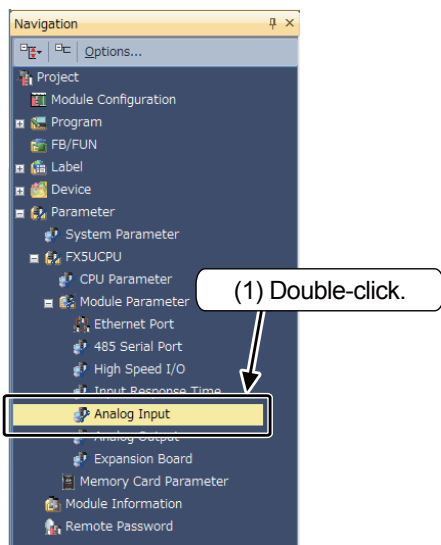
### [Output value SD6180 monitor]

The output value can be instructed by touching the screen.

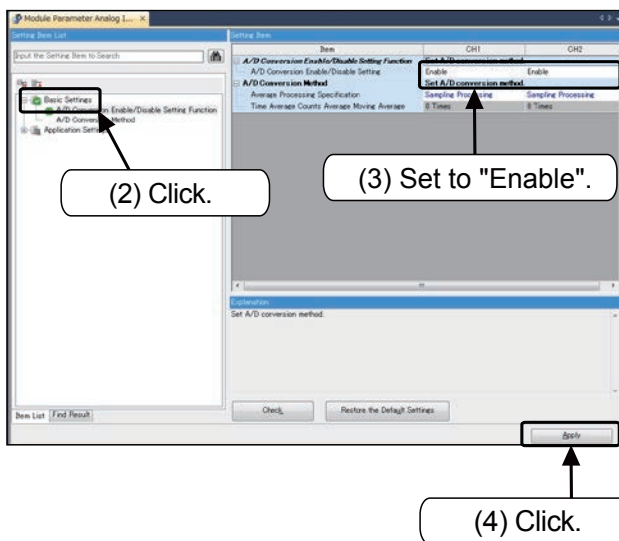
### [Output value SD6180 value UP/DOWN]

The digital value 0 to 4000 being output is converted to 0 to 10 V by the GOT and displayed.

- Analog input parameter settings

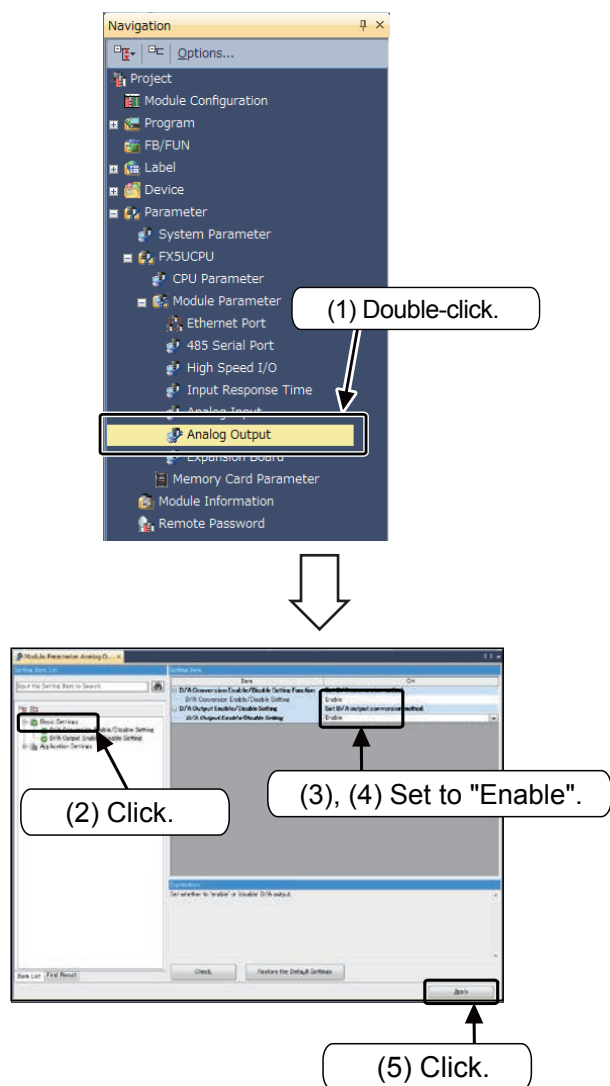


(1) Double-click [Parameter] → [FX5UCPU] → [Module Parameter] → [Analog Input] on the navigation window.



(2) Select [Basic Settings].  
 (3) Set the A/D conversion Enable/Disable setting to "Enable".  
 (Set for CH1 and CH2.)  
 (4) After setting, click [Apply].

## ● Analog output parameter setting



(1) Double-click [Parameter] → [FX5UCPU] → [Module Parameters] → [Analog output] on the navigation window.

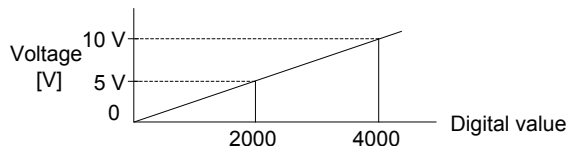
- (2) Select [Basic Settings].
- (3) Set the D/A Conversion Enable/Disable Setting to "Enable".
- (4) Set the D/A Output Enable/Disable Setting to "Enable".
- (5) After setting, click [Apply].

## <<Operation check>>

Use GX Works3 to monitor SD6020, SD6060 and SD6180.

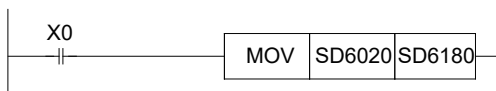
Display the training machine screen from the previous page.

- (1) Rotate the knob of ch1/ch2 and confirm on the GOT screen that the value of [0 to 4000] is input.
- (2) Operate the GOT screen, designate the instruction value of the output within 0 to 4000 and confirm whether the voltage is output.



(3) Example

When X0 is set to ON, the ch1 volume input value (0 to 4000) can be used as the analog output instruction (0 to 10 V output).



## Chapter 12

### LET'S LEARN THE PROGRAM FLOW

---

The sequence of program execution may be changed

A PLC is not just a machine that conducts cyclic operations by following program steps in a fixed sequence of operations.

The sequence of program execution can be changed by using various instructions. Additionally, as described in Chapter 10, the sequence of a program may be changed with interrupt processing.

#### In this chapter...

In order to create programs for efficient execution, the major control instructions that have a direct affect on the program flow for changing the sequence of program execution will be explained in detail.

These control instructions include I/O refresh, jump instructions, subroutines, loop instructions, and other important instructions.

This chapter will also examine the operation methods of the PLC.

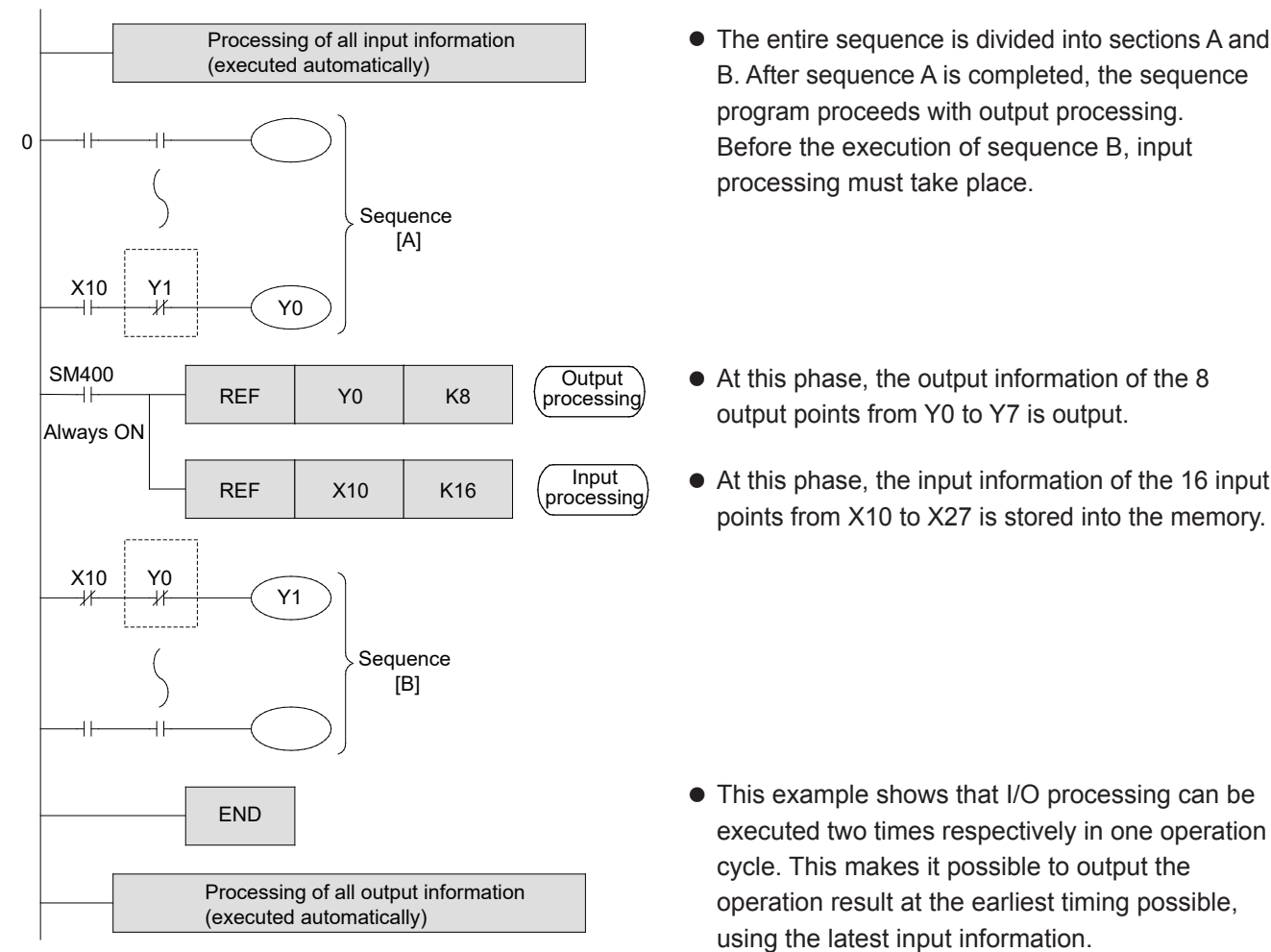
# 12.1 I/O refresh instructions (REF)

The I/O processing mode for micro PLCs is known as a batch refresh mode. The information at all of the input terminals (input ON or OFF) is stored into an input image memory prior to the operation of step 0. After the END instruction (or the FEND instruction) is executed, the information is output from the output image memory to the latch memory, and then simultaneously transferred from the latch memory to the output terminals (See page 10-2.)

To acquire the latest input information during the sequence operation, or to output the result of the operation as quickly as possible, the I/O refresh instruction can be used.

With the FX5U CPU module, by specifying a direct access input/output (DX, DY), the input/output can be directly accessed in 1-point modules.

## <<Operation outline>>



| Reference   |
|---|
| <h3>Output interlock</h3> <p>In a program where I/O processing is executed more than one time in a single operation cycle, the operation result may differ between sequences A and B if the input has changed between ON and OFF during the operation cycle. As in the above figure, if no interlock is provided on outputs Y0 and Y1, the outputs may be activated simultaneously.</p> |

## 12.2 Input filter adjustment function

- Generally, to avoid chattering and noise at the input contacts, the inputs of the PLC are equipped with a 10 ms C-R filter.  
However, if the PLC uses non-contact inputs to avoid noise, the use of the above-mentioned filter will just impede the execution of high-speed import.
- With the FX5U CPU module, a digital filter is used for all inputs. The filter value can be changed to 10  $\mu$ s, 50  $\mu$ s, 0.1 ms, 0.4 ms, 0.6 ms, 1 ms, 5 ms, 10 ms, 20 ms or 70 ms.  
Note that a 2.5  $\mu$ s to 150  $\mu$ s hardware filter is applied on each input of the CPU model and I/O module.  
Thus, the actual filter time is the value to which the hardware filter has been added.
- Change the input response time with the parameter when using the following functions or instructions.
  - Interrupt pointer
  - High speed counter function
  - When using X10 to X17 with MTR instruction
  - SPD instruction
- Refer to the previous section “10.2 Using input interrupt” for details on setting the input response time parameter.

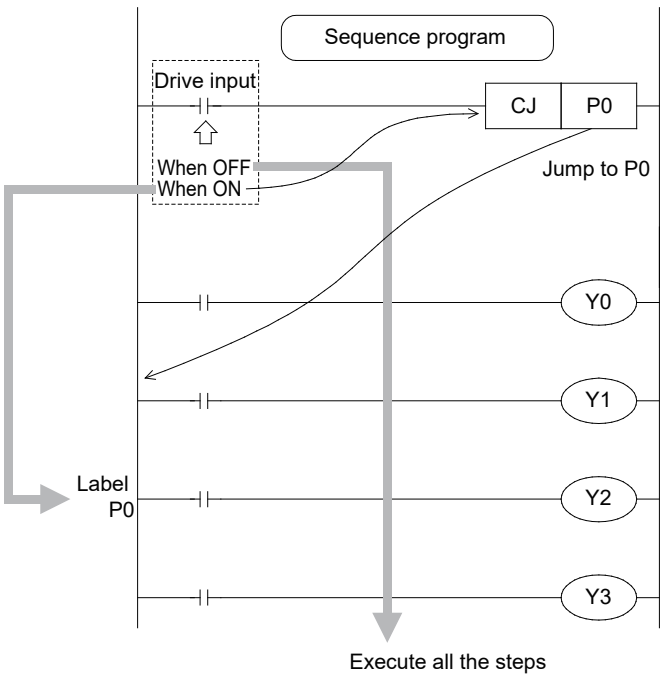


# 12.3 Jump instructions (CJ)

The jump instruction is an instruction that can shorten the operation cycle and enable the use of dual coils by preventing some parts of the sequence program from running.

## <<Operation outline>>

When the drive input is turned on, a jump instruction is executed and the program jumps to the step labeled with PXXX. The executed actions may vary with the device and the number as follows.



- When the drive input is OFF, steps in the program will be executed.
- When the drive input is ON, the program jumps to pointer P0. In this case, the steps before pointer P0 will not be executed.

When the drive input is ON, these steps are skipped and not executed. The specific contents will be covered later on.

Reference

### Pointer numbers

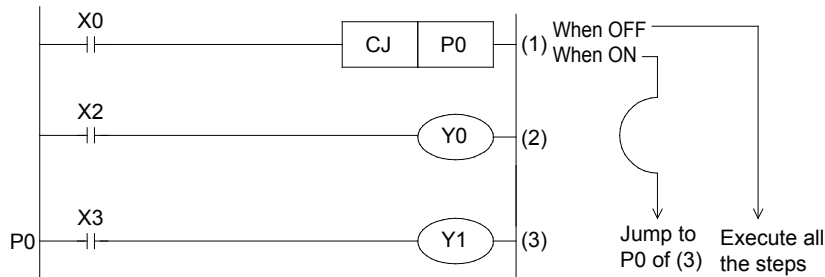
- The FX5U CPU module pointers include the global pointer and label assignment pointer.

| Pointer                  | Description  |
|--------------------------|--|
| Global pointer           | This pointer can be referred to from all programs.   |
| Label assignment pointer | This pointer is assigned to a label and used. The pointer number assigned to the label is automatically determined by the GX Works3, so the user cannot specify the pointer number to be assigned. |

- Use the GOEND instruction to jump to the END instruction or FEND instruction.
- Label numbers are also used by the CALL instruction or XCALL instruction described later. The numbers cannot be overlapped.

## <<Instruction operation>>

Let's confirm the execution of the jump instruction.



## <<Operation check>>

Use GX Works3 to monitor the circuit.

### When X0 is OFF

(1) [Turn "OFF" X0]



(2) Y0 turns ON or OFF when X2 is turned ON or OFF.



(3) Y1 turns ON or OFF when X3 is turned ON or OFF.

### When X0 is ON

(1) [Turn "ON" X0]



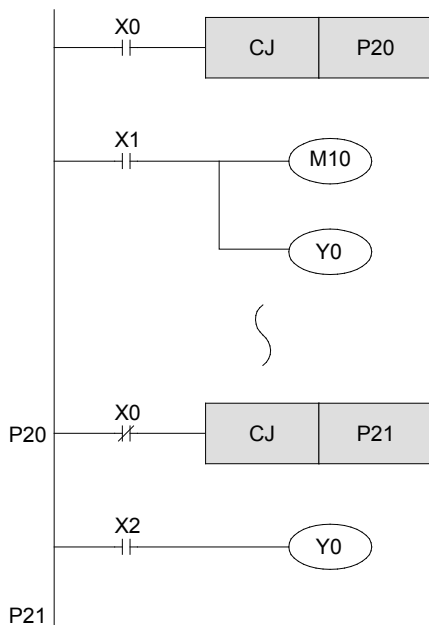
(2) Y0 does turn ON or OFF when X2 is turned ON or OFF.

(The program at (2) is skipped by the jump instruction.)

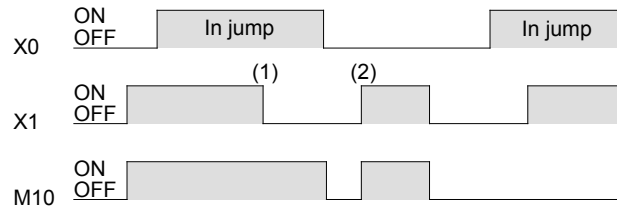


(3) Y1 turns ON or OFF when X3 is turned ON or OFF.  
(During a jump to the label P0)

## ● Functional principles of Y, M coils



- When the coil of a Y (output), M (Internal relay), or S (step relay) is skipped, the ON/OFF status that was stored prior to the jump will be maintained.

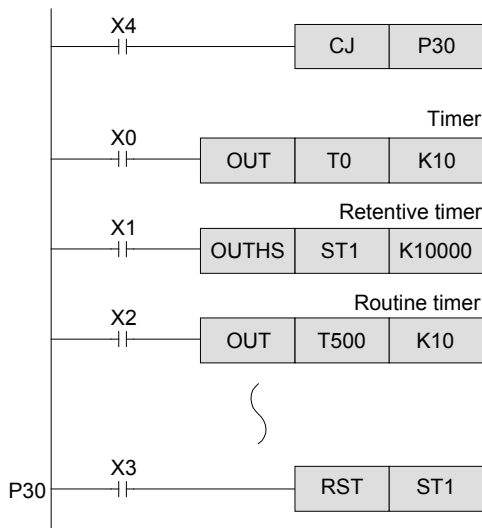


(1) Even if X0 turns off, M10 stays ON.

(2) Without jump instruction, M10 turns ON or OFF according to the status of X0.

- The output Y0 is a double coil. When X0 = OFF, the program runs according to the status of X1. When X0 = ON, the program runs according to the status of X2.
- Even with a double coil, if one of the two is skipped, only the other can be activated. As a result, the coils may be activated separately.

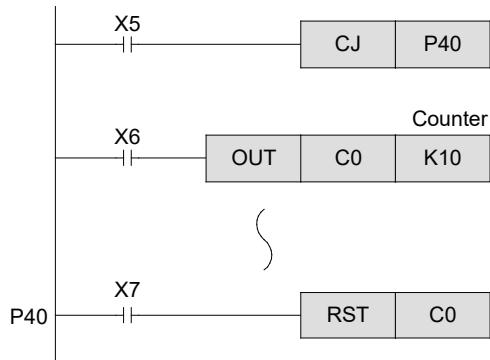
## ● Functional principles of timers



- The general timer suspends clocking when skipped by a jump instruction, and resumes clocking after the jump instruction is deactivated.
- The routine timer continues clocking even when skipped by a jump instruction. If the timers timed out while a jump instruction is activated, the output contact of the routine timer opens. The parameters must be set to use the routine timer.

- If the reset instruction for a retentive timer is programmed after or before a jump instruction is programmed, the reset instruction (e.g. to reset a contact or clear a current value) can be executed even if the coil of the retentive timer is skipped.

## ◎ Functional principles of counters



- A general counter suspends counting when skipped by a jump instruction.
- If the reset instruction for a counter is programmed after or before the location where a jump instruction is programmed, the reset instruction (e.g. reset a contact or clear a current value) can be executed even if the coil of the counter is skipped.

## ◎ Functional principles of instructions

- An instruction will not be executed when skipped by a jump instruction.

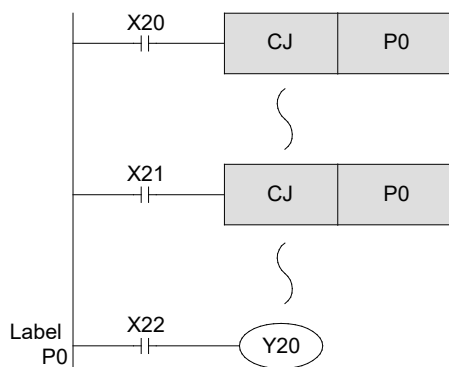
However, the operation of the following instructions and some other instructions continues.

TMR instruction, SPD instruction, DSPD instruction, PLSY instruction <sup>\*1</sup>, DPLSY instruction <sup>\*1</sup>, PWM instruction

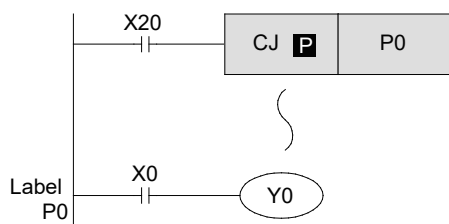
<sup>\*1</sup>: While the PLSY instruction or DPLSY instruction is being executed, normal operation will not take place in an environment where execution at every scan is not possible such as in the user program, or when jumping with the CJ(P) instruction. However, pulse output will continue.

## Jump methods

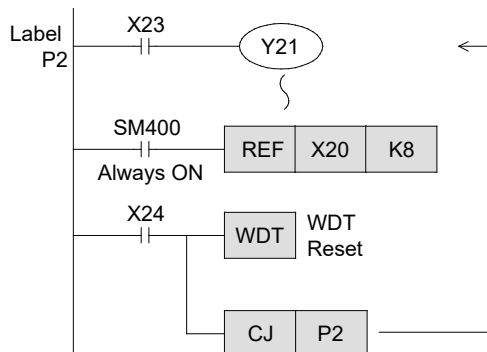
[Jump to the same pointer]



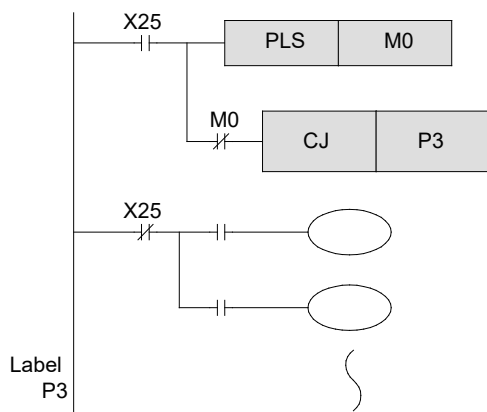
[Jump only for one operational cycle]



[Jump upward]



[Delay jump by one operation cycle]



- The pointer number in the operands to the left have the same number.
- When X20 is ON, the program will jump to label P0 from here. When X20 is OFF but X21 is ON, the program will jump to label P0 from CJ of X21.
- Duplicate label numbers (including labels for CALL instructions) cannot be used. If two label numbers are the same, a PLC error will result.
- The CJ **P** is used. If the drive input changes from OFF to ON, the program jumps to label P0 only for one operational cycle.
- Although a label can be programmed at an step earlier than the CJ instruction, if X24 turns ON for more than 200 ms (scan monitor time), a watch dog error will occur, and the PLC will stop (ERR LED will light).
- One of the following procedures must be taken.
  - Change the scan time monitor time in the CPU module parameter RAS setting to a longer time.
  - Using the program, rewrite the contents of the special register SD8000 (watch dog timer time) to a longer time.
  - Program the WDT instruction (watch dog timer reset instruction) as shown on the left. Write a condition that turns the CJ instruction OFF so a repeated flow is not created. (In the left example, the X24 input refresh is executed with the REF instruction.)
- In the circuit to the left, if X25 turns ON, the jump to P3 will be turned on in the second operational cycle. During the first operation cycle, all the outputs between CJP3 and P3 are turned off.

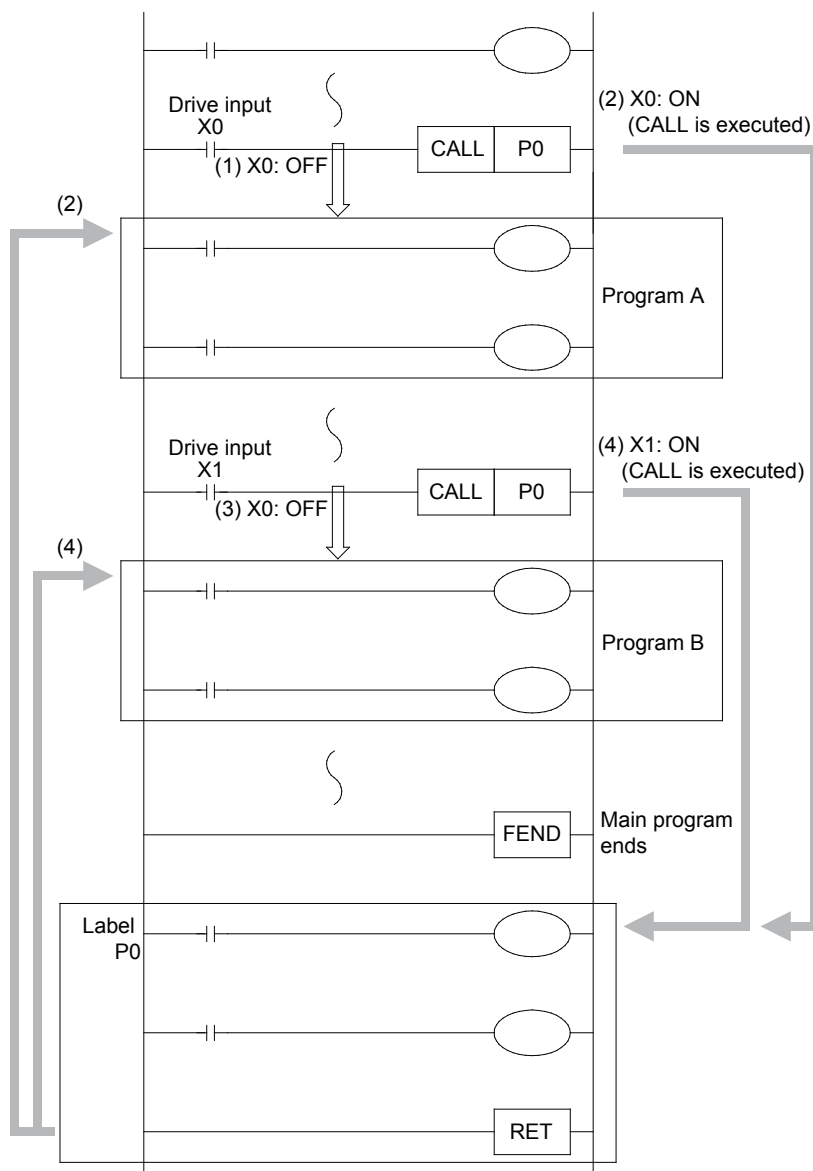
## 12.4 Call subroutine instructions (CALL, RET)

The CALL Subroutine instruction and XCALL subroutine program call instruction are instructions for executing a subroutine program within the main program.

A subroutine program can be a program that contains actions to be executed several times or a program that executes only the necessary parts of an action.

The following explanation uses the CALL instruction.

### <<Operation outline>>

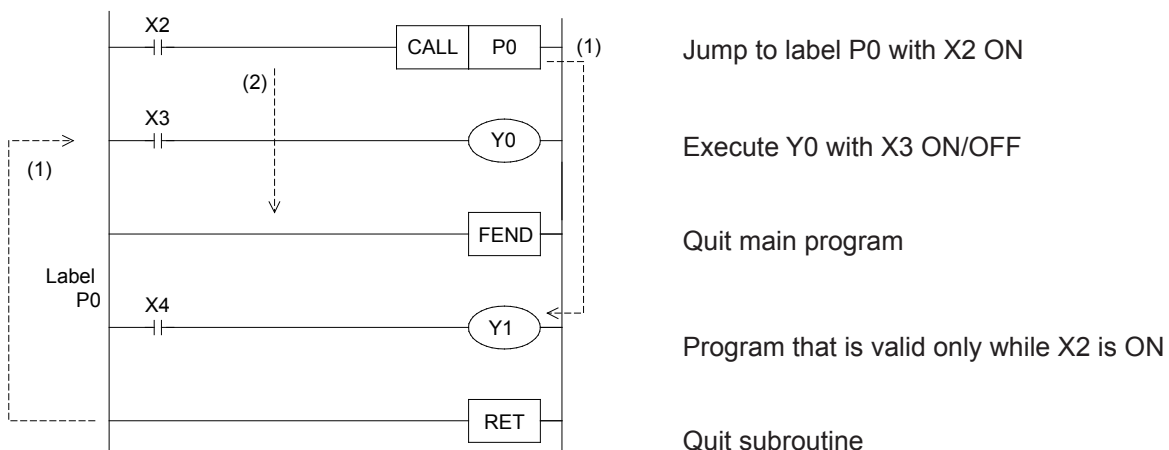


- When the CALL instruction is executed, the program will jump to the designated label P0. After the subprogram is executed at P0, it returns to the original program step by the SRET instruction.
- The label used by a CALL instruction must be programmed after the FEND instruction.
- The same label number must not be used including labels for CJ instructions.
- Generally, the I/O refresh instruction is used before and after a subroutine program. Additionally, for timers in subroutine programs (as with interrupt routine programs) it is necessary to use the routine timers.

- (1) When X0 is "OFF", "Program A" will be executed.
- (2) When X0 is "ON", "Program A" will be executed after the subroutine program of "label P0" is executed.
- (3) When X1 is "OFF", "Program B" will be executed.
- (4) When X1 is "ON", "Program B" will be executed after the subroutine program of "label P0" is executed.

## <<Instruction operation>>

Execute a subroutine program with a CALL instruction, and confirm the actions of the subroutine program.



## <<Operation check>>

Use GX Works3 to monitor the circuit.

(1) [When X2 is OFF]

- Y0 turns ON or OFF when X3 is turned ON or OFF.
- Y1 does turn ON or OFF when X4 is turned ON or OFF (since the subroutine was not called).

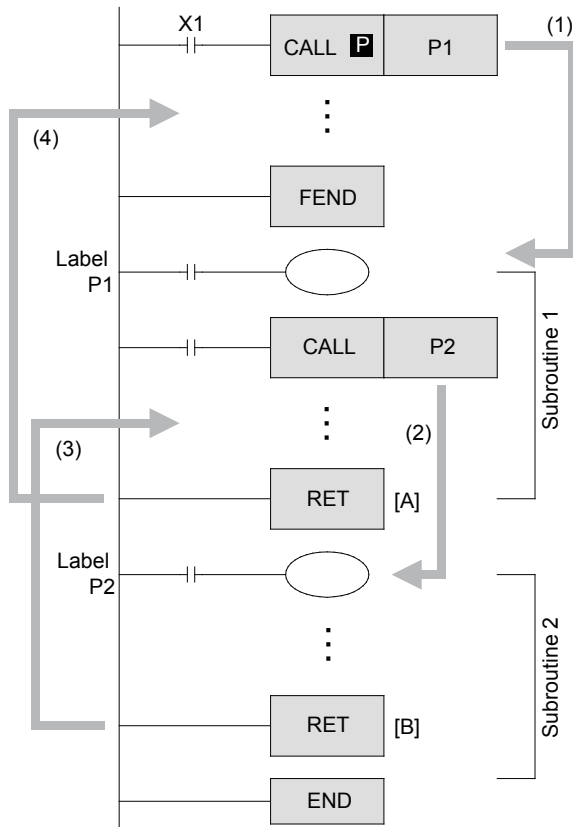
(2) [When X2 is ON]

- Y0 turns ON or OFF when X3 is turned ON or OFF.
- Y1 when X4 is turned ON or OFF (since the subroutine).

# [CALL instruction or XCALL instruction nesting (multi-nesting)]

If a CALL instruction or XCALL instruction is programmed within a subroutine, it is known as multi-nesting. This type of CALL instruction or XCALL instruction can be programmed up to 15 times. In all, a 16-level nest is permitted.

The following explanation uses the CALL instruction.



- (1) When the CALL **P** instruction is used, the CALL instruction is executed only when the input X1 is turned on, and the program jumps to label P1.
- (2) If the CALL P2 instruction is executed in the subroutine program labeled as P1, the program will jump to label P2.
- (3) The second subroutine with label P2 is executed. When the operation moves to the RET instruction [A], the program will return to the next step of CALL P2.
- (4) Similarly, when the operation moves to RET instruction [B], program will return to the next instruction of CALL **P** P1.

## Reference

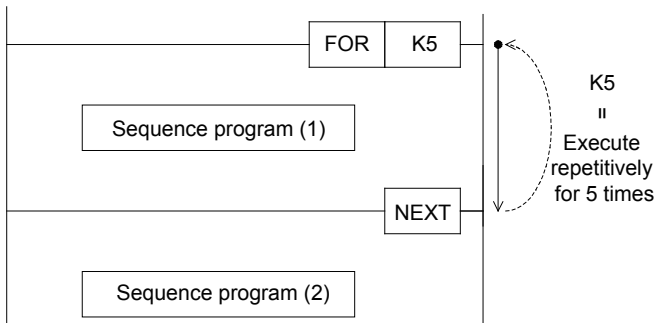
- Actions of timers and counters in subroutine and interrupt routine programs...  
If general timers are used in a subroutine or interrupt routine program, clocking is activated only in the main program.  
This is the same for counters. Generally, counters should not be used in subroutine or interrupt routine programs. However, in a routine program that executes at each operation cycle, as shown in this example if the CALL instructions are always driven, general timers and counters can be used. The actions of the timer and counter in a subroutine are the same as those for the jump instruction.
- Label numbers are also used by the CJ instruction described previously. The numbers cannot be overlapped.
- In the P-RET instruction, it is not allowed to use MC-MCR, STL-RETSTL, I-IRET and another P-RET instructions for programming.  
In addition, the P-RET instruction cannot be used in MC-MCR, FOR-NEXT, STL-RETSTL and I-IRET instructions.



# 12.5 Loop instruction (FOR-NEXT)

The loop instruction is an instruction that executes program segments from a FOR instruction to a NEXT instruction for n times and then executes the program content after the NEXT instruction. n is set to 1 to 32767 times. Specifying "n = -32768 to 0" is equal to specifying "n = 1".

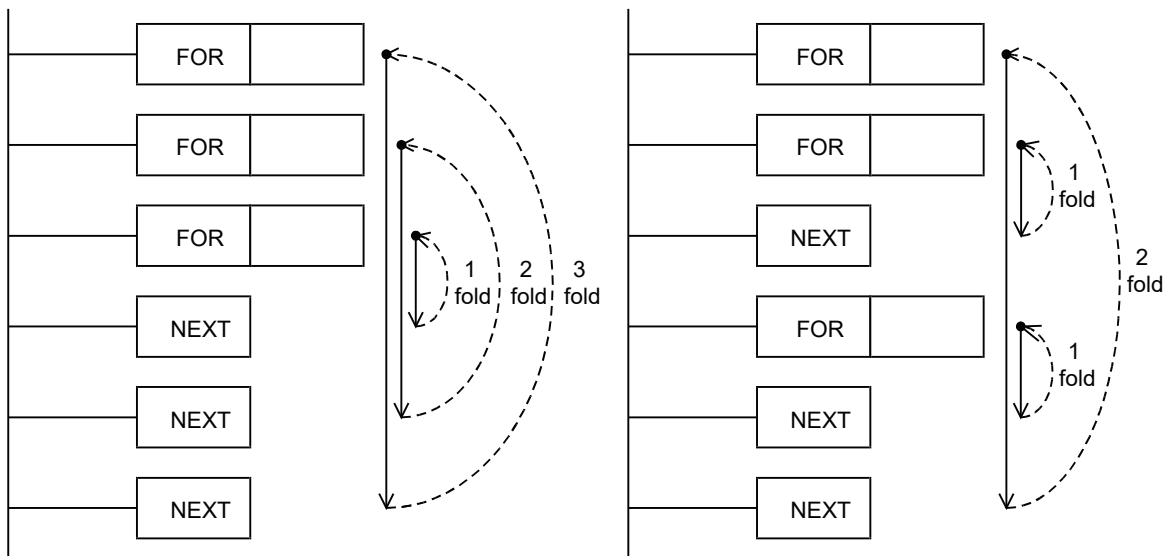
## <<Operation outline>>



- The "sequence program (1) " is executed for the specified number of times between the FOR-NEXT instructions.
- After the repetitive execution for the specified number of times, the program proceeds with the execution of "sequence program (2) ", which is placed after the NEXT instruction.

## Reference

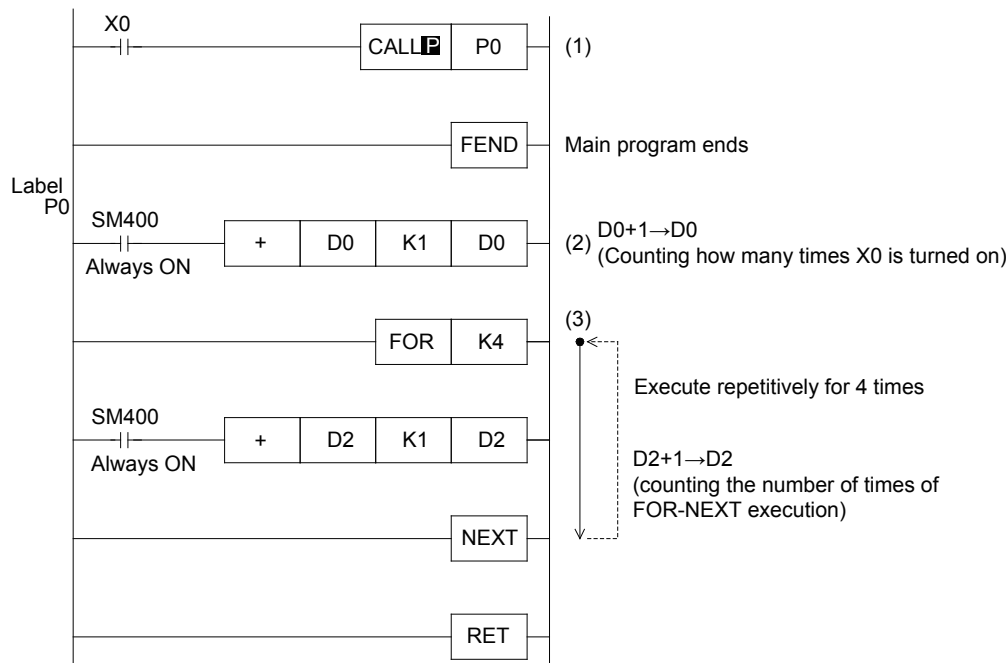
- About nesting (multi-nesting)  
When a FOR-NEXT instruction is programmed in the FOR-NEXT program, up to 16 nesting levels are possible.



If the numbers of FOR and NEXT are not identical, an error may occur.

## <<Instruction operation>>

Use FOR-NEXT instructions and confirm the actions of the program.



## <<Operation check>>

Use GX Works3 to monitor the circuit.

(1) [Set X0 to ON.]



- [CALL P0] instruction will be executed, and the subroutine at label P0 will be executed for only one operation cycle.

(2)



- By [+ D0 K1 D0] instruction, the number of times the subroutine is executed is counted at D0.

(3)



- [+ D2 K1 D2] instruction is executed repetitively for four times by the [FOR K4] instruction.
- As a result of the execution, [4] is stored into D2. (Then, 4 is added to D2 every time X0 is turned ON.)

Since the execution ends in a split second, switch X0 between ON and OFF, and try repeating the action.

# MEMO

# You can be a professional!

## Chapter 13

### GUIDE TO HANDY INSTRUCTIONS AND FUNCTIONS

---

#### Handy purpose-oriented instructions

Handy purpose-oriented instructions are principle control that can become extremely complicated when combined with general instructions and which have been bundled into a single macro instruction.

#### Instructions for intelligent function module

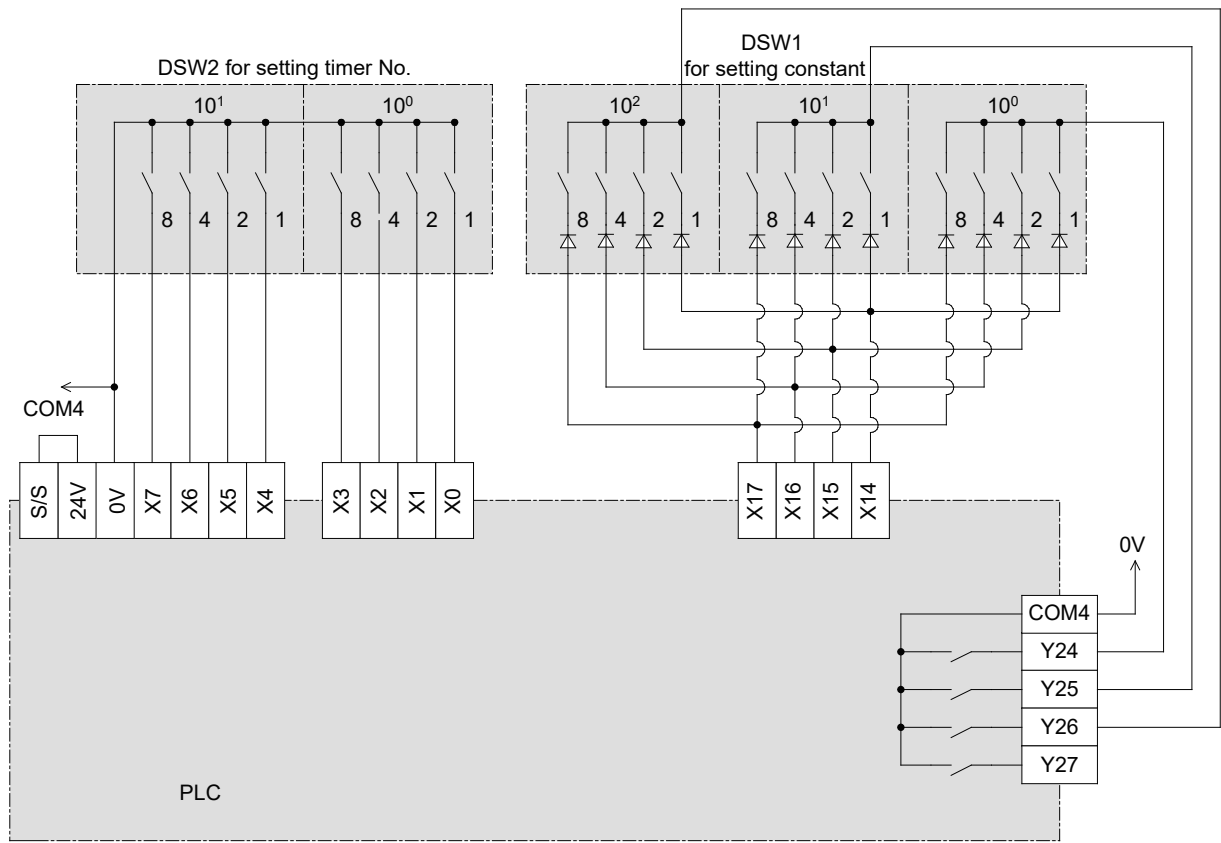
Data can be exchanged with various handy devices (intelligent function modules) using FROM/TO instructions.

#### In this chapter...

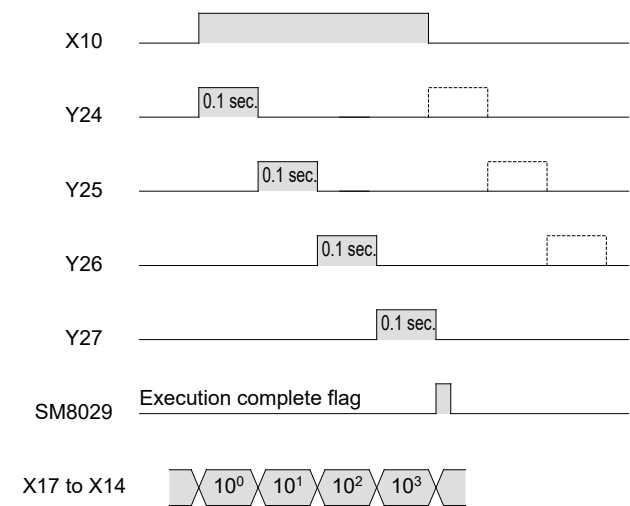
Of the many handy instructions, the ones that are not restricted by the PLC's number of input/output points and that do not require special devices, and the mechanism of communication with the intelligent function module are introduced. By understanding each function, you will see how handy the instructions are.

# 13.1 Digital switch time-division input instruction DSW

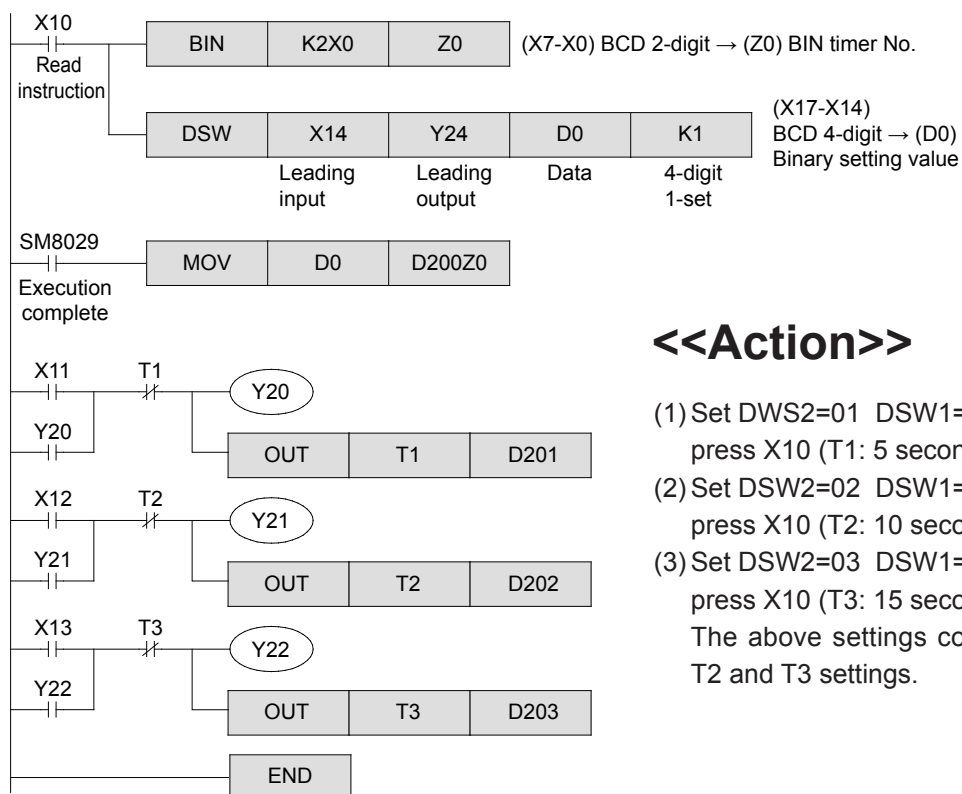
The digital switch (DSW) is used as a simple value setting module.  
In this section, examples of circuit that inputs the timer setting value by directly reading a 2-digit digital switch and by using time-division input with a the 3-digit digital switch are explained.  
By using the DSW instruction, 4-digit 2-set digital switches can be time-division read.



The timing for reading the DSW instruction is as follows.



- When the instruction is executed for an instant, Y24 to Y27 are sequentially operated at a 0.1 second pitch, and each time the DSW  $10^0$  to  $10^3$  digits are input into the PLC.
- When retrieval of the data is completed, the execution complete flag SM8029 activates.
- The above operation can be repeated by continuously turning the drive input X10 ON. However, the PLC will require a transistor output in this case.



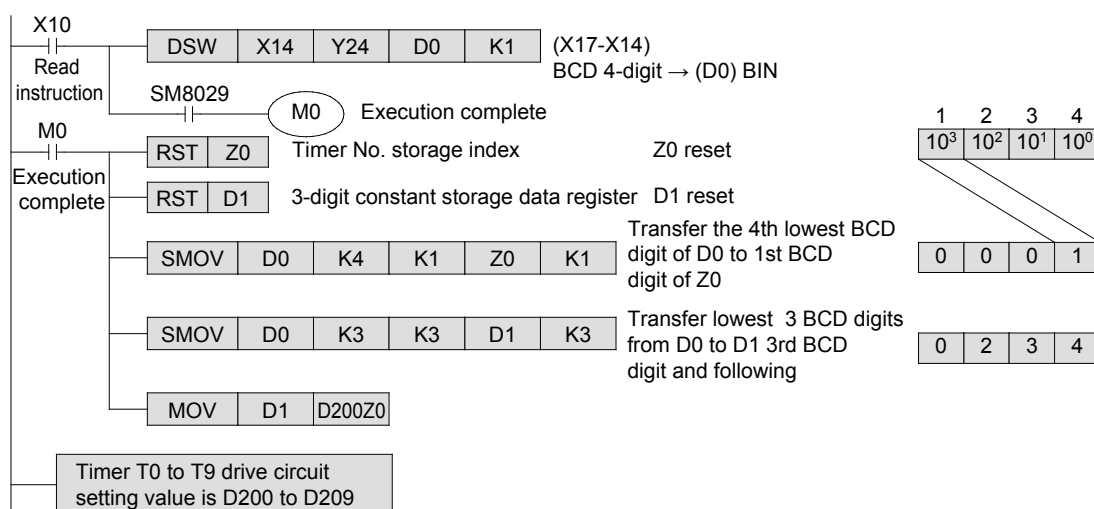
## <<Action>>

- (1) Set DWS2=01 DSW1=050, and press X10 (T1: 5 seconds).
  - (2) Set DSW2=02 DSW1=100, and press X10 (T2: 10 seconds).
  - (3) Set DSW2=03 DSW1=150, and press X10 (T3: 15 seconds).
- The above settings complete the timer T1, T2 and T3 settings.

## Reference

### Other usage methods

A circuit in which the uppermost digits of the 4-digit 1-set digital switch DSW are used for the timer number setting, and the last three digits are used for setting the timer is as follows.

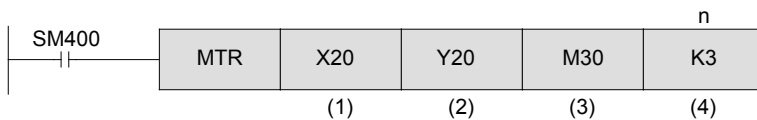


The SMOV instruction handles BIN data, but when this instruction is used, the data is automatically converted to BCD. Each BCD digit is moved, before it is returned to a BIN value.

Thus, this instruction is suitable for distributing and combining BCD digits for the BCD calculation.

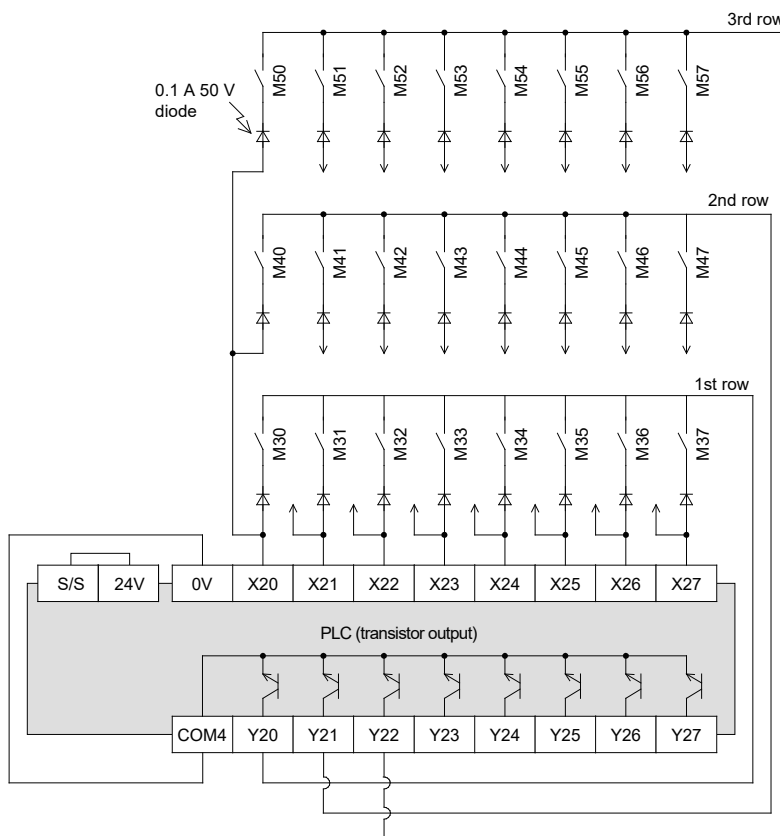
# 13.2 Matrix input instruction MTR

The MTR instruction is a handy instruction that can greatly reduce the number of PLC input points by acting as a transistor output for general contact inputs that do not require a high speed response.

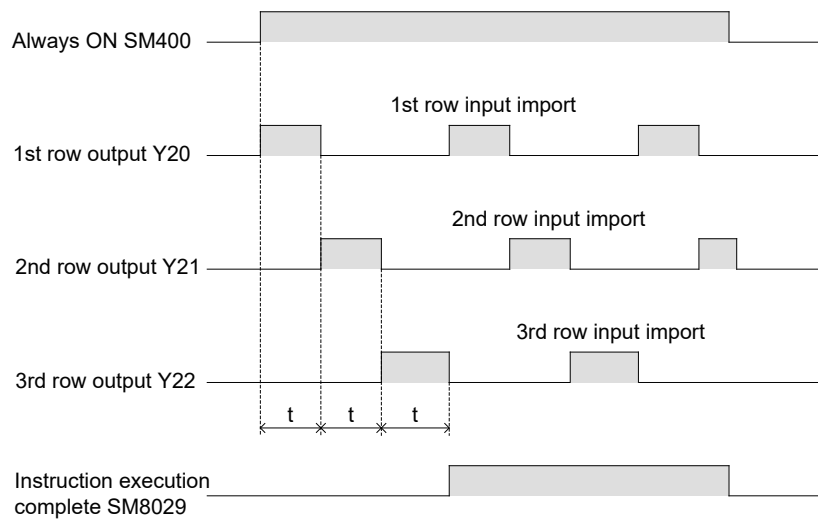


- (1) Lowest order digit such as X0, X10, X20 is 0 input
- (2) Lowest order digit such as Y0, Y10, Y20 is 0 output
- (3) Element such as Y, M, S with lowest digit of 0
- (4) n = K2 to K8 is valid

- This instruction is used to sequentially read the 8 point x n row (n=2 to 8) input signal using the 8-point input and n-point output.

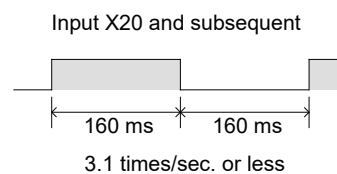
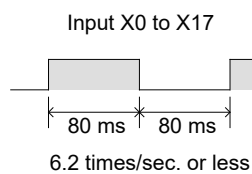


- A compact diode must be serially connected to each input as shown on the left.
- The ON/OFF storage destination number for each external switch is M30 to M57 in this example.
- When the PLC runs, the output Y20, Y21 and Y22 turn ON sequentially.
- Allowing for a delay in the input filter response, the input is read after a specified time and then the next row's output turns ON.



## <<Control timing>>

- When using the input X0 to X17,  $t=10$  ms and it takes 80 ms to retrieve the 8-row 64-point input. In this case, change the input response time set in the module parameters to 5 ms, and connect a pull-up resistor to the transistor output being used with the MTR instruction.
- When using input X20 and following,  $t=20$  ms, and it takes 160 ms to read the 8-row 64-point input.
- This instruction is executed with a 10 ms or 20 ms cyclic interrupt (EI instruction is not required), and is not affected by the PLC's operation cycle. The row switchover output and input retrieval are also conducted immediately with the refresh operation.
- The 80 ms or 160 ms retrieval cycle for the 8-row 64-point input means that the ON/OFF width for each input must be larger than the following value.





# 13.3 Pulse width modulation function PWM output

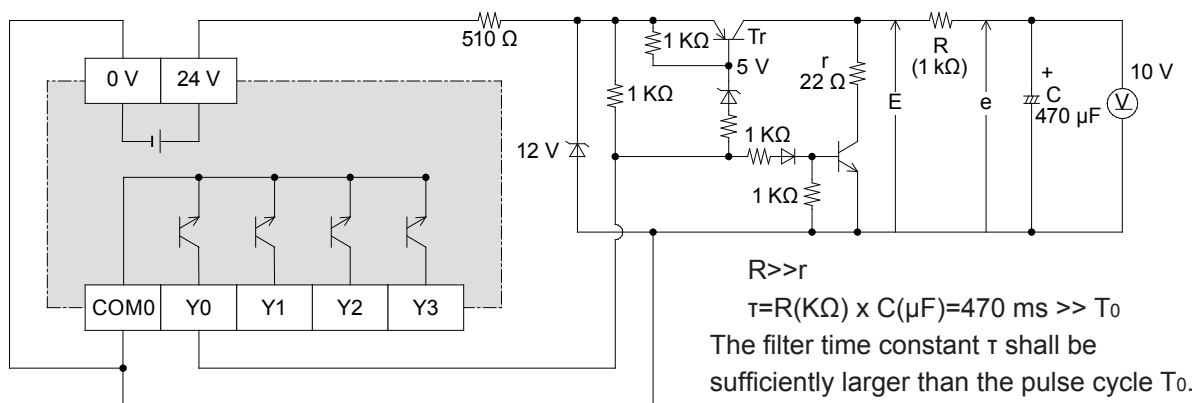
The PWM output outputs pulse train at the specified cycle and pulse width.

The cycle and pulse width module, and the output number assignment, etc., are set with the parameters.

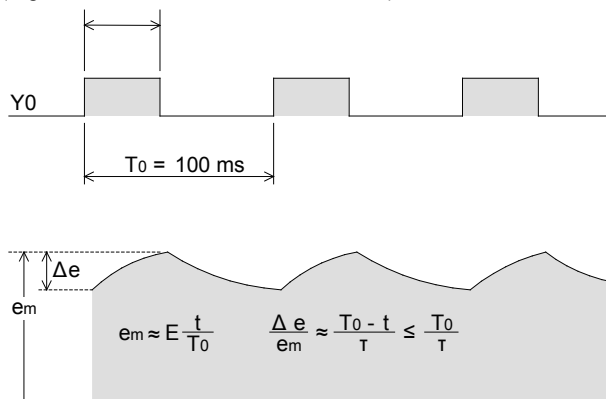
The HIOEN instruction is used to start and stop the pulse output.

The pulse width/cycle setting range is 1 to 2147483 ms or 1 to 2147483647  $\mu$ s.

These can be used to control the ON/OFF proportion, to provide a smoothing circuit and display a meter, or to output a speed instruction for the inverter.



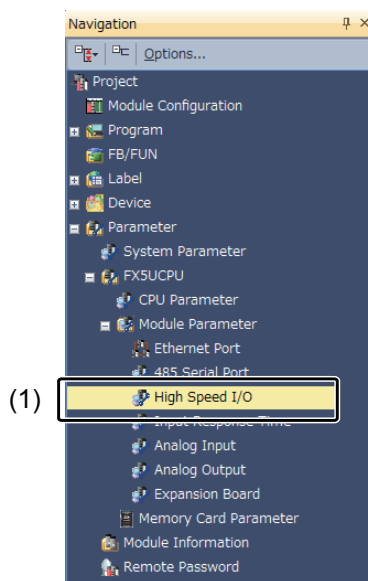
PWM CH1 pulse width  $t$   
 (High-order: SD5303, low-order: SD5302)



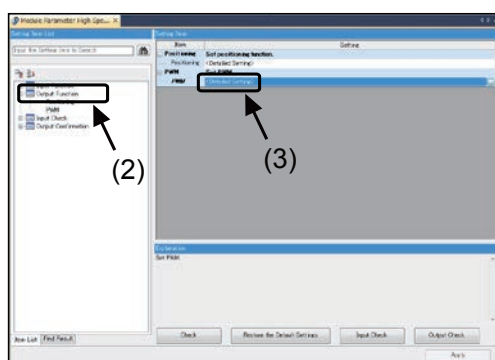
- The pulse cycle is 100 ms in the left row, and if the CH1 pulse width (high-order: SD5303, low-order: SD5302) is changed between 1 and 100, an output of 1 to 100% will be attained.
- The smoothing circuit's output has a ripple as shown on the left. The maximum value  $e_m$  and ripple  $\Delta e$  can be calculated with the expression on the left.
- $E$  is the collector side voltage when transistor  $Tr$  turns ON, and the  $\tau \gg T_0$  condition is required.

# <<Operation outline>>

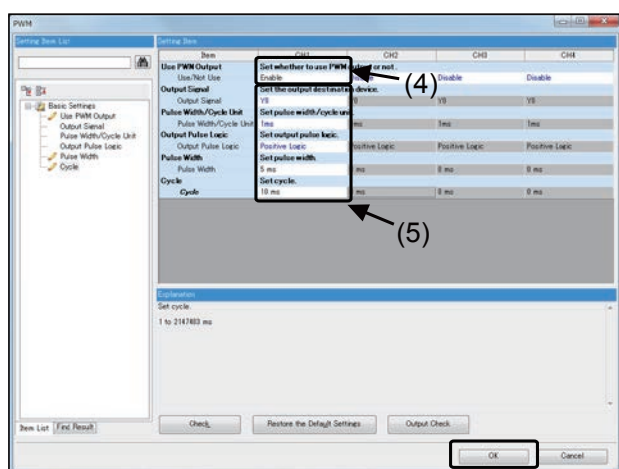
## ● Parameter setting



(1) Double-click [Parameter] → [FX5UCPU] → [Module Parameter] → [High speed I/O] on the navigation window.



(2) Click [Output Function].  
(3) Double-click [PWM] → [Detailed Setting].

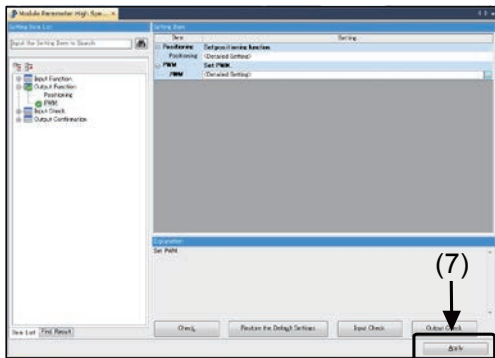


(4) Set CH1 to "Enable".  
(5) Set each item as shown below.

|                          |                  |
|--------------------------|------------------|
| Output signal            | : Y0             |
| Pulse width/cycle module | : 1 ms           |
| Output pulse logic       | : Positive logic |
| Pulse width              | : 5 ms           |
| Cycle                    | : 10 ms          |

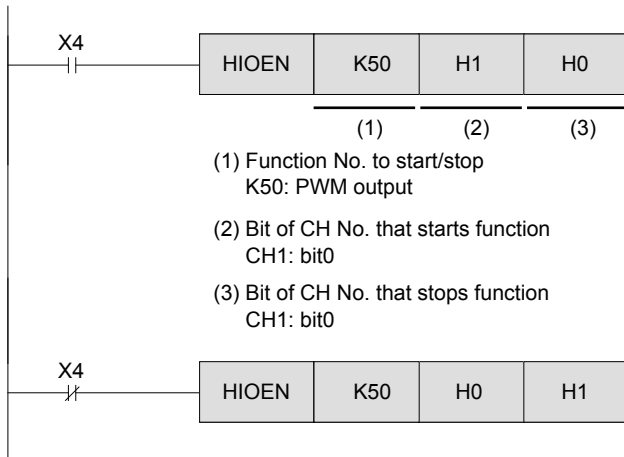
(6) After setting, click [OK].

(6)



(7) Click [Apply].

## ● Program example



● Start the CH1 (Y0) PWM output.

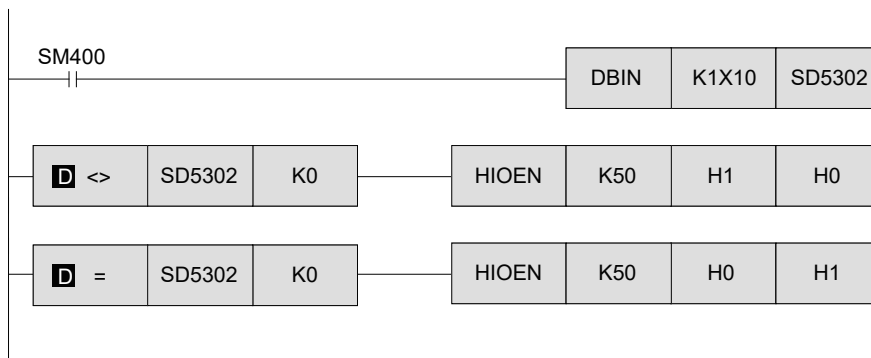
● Stop the CH1 (Y0) PWM output.

## Let's try

Set the demonstration machine's DSW between 1 to 9, and adjust the brightness of the Y0 LED.

As the setting value increases from 0 to 9, the Y0 LED brightness will change.

In this example, ON/OFF control is executed at a 10 ms cycle.



## 13.4 Module access instruction FROM/TO

An intelligent function module can be connected to the FX5U CPU module.

This intelligent function module can be used for analog control, and positioning control, etc.

To perform these controls, the intelligent function module has an internal 16-bit RAM memory called a buffer memory (BFM).

The FROM/TO instructions can be used to communicate with this buffer memory. It is similar to a monitoring office and satellite that conduct individual work and communicate when necessary.

- What is analog control...

The PLC mainly uses ON/OFF (1 or 0) digital control.

Thus, it is difficult to directly control matters that continuously change, such as temperature, flow rate or wind rate. A dedicated module is required to perform analog control. The FX5U CPU module has a 2-point analog voltage input and a 1-point analog voltage output function built-in.

Refer to the previous section “ANALOG FUNCTION” for details on the built-in analog function.

Examples of analog control

- Temperature control
- Tension control
- Voltage/current monitoring control, etc.
- Flow rate control
- Pressure control
- Speed control
- Wind power control

- What is positioning control?

For example, if we consider the control used to transfer workpieces with a belt conveyor, etc., how would you make sure that the position where the workpiece stops is accurate?

You could install a sensor at the stop position, and use the input ON state to stop the conveyor.

However, if you want to feed the workpieces to that stop position at a high speed, you will face various problems.

The positioning module is a dedicated module used to ensure that the workpiece moves to the designated position at a high speed and stops with a high precision.

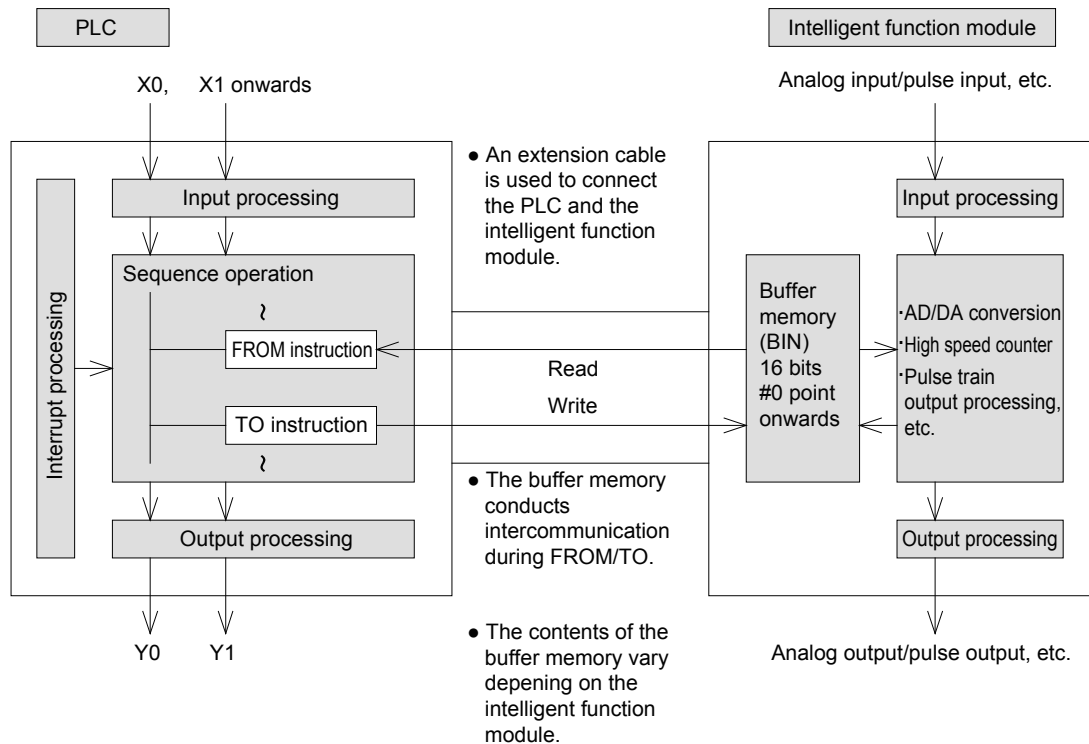
Examples of positioning control

- Constant step and stop control
- Rotary angle control
- 2-axis synchronous control, etc.
- Constant multi-step feed control
- Variable speed pattern control

Communication with the intelligent function module's buffer memory is carried out when the PLC executes the FROM/TO instruction in the sequence operation.

The intelligent function module's current value and status information is read out with the FROM instruction, and the various settings for operating the intelligent function module are written in with the TO instruction.

### ◎ Mechanism of communication between PLC and intelligent function module



## Reference

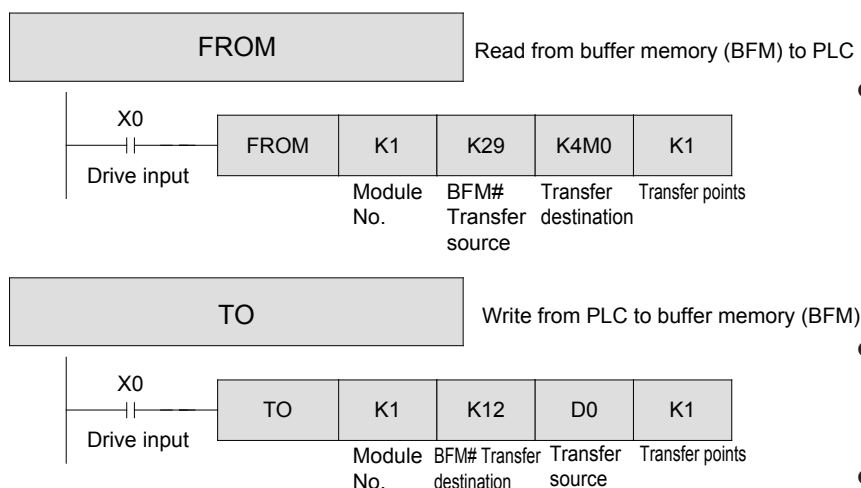
### Main types of intelligent function modules

The following types of intelligent function modules are available.

- Analog input
- Analog output
- Temperature regulator
- High speed counter
- Simple motion module (SSCNETIII/H compatible)
- Pulse train output (for 1 axis)
- CC-Link interface
- CC-Link master
- AnyWireASLINK master

Up to 16 module including input modules, output modules, intelligent function modules, and bus conversion modules (excluding some products) can be connected to one FX5U CPU module.

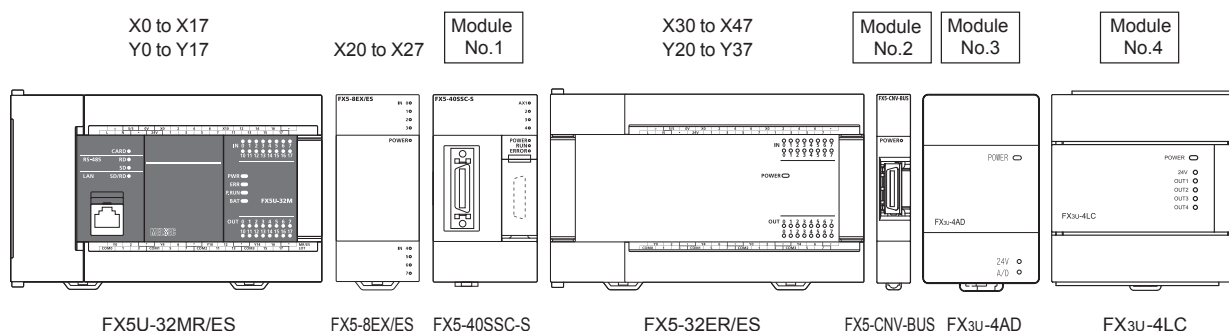
The FROM/TO instructions are expressed in the following manner.



- The buffer memory for the designated module number is read out. The drive input turns ON, and reading is executed. Reading is not executed when the drive input is OFF, and the data at the transfer destination does not change.
- The data is written to the buffer memory for the designated module number.
- The drive input turns ON, and writing is executed. Reading is not executed when the drive input is OFF, and the data at the transfer destination does not change.

## ◎ Module number

- Up to 16 modules including input modules, output modules, intelligent function modules, and bus conversion modules (excluding some products) can be connected to one FX5U CPU module. Module numbers are assigned to identify with which intelligent function module communication is performed.

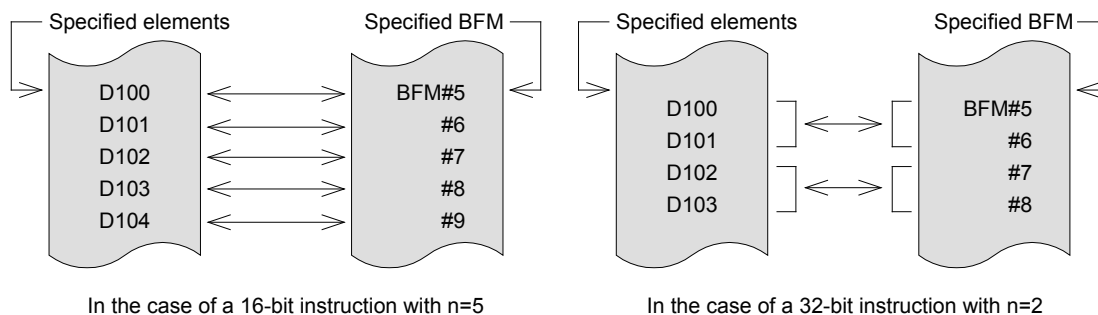


- The intelligent function module is connected with the extension cable on the right side of the PLC in the same manner as the input module, output module and input/output module. At this time, I/O numbers are assigned to the input module, output module and I/O module, and a module number is automatically assigned to the intelligent function module.
- The module number is a serial number between No. 1 (H01) and No. 16 (H10) that is assigned in order from the PLC CPU module.
- Each intelligent function module occupies eight input/output points (either input or output can be counted), but the I/O numbers are not assigned. The number of PLC input/output points are expressed with the following expression when the intelligent function module is connected.  
Number of input/output points = 256 - number of occupied points (8 points) x number of intelligent function modules<sup>\*1</sup>  
<sup>\*1</sup>: Depending on the intelligent function module, more than eight points may be occupied.
- For the intelligent function module, the 5 V power is supplied from the CPU module, power built-in I/O module or extended power module, so the total current consumption must be less than the specified value.

## ◎ Transfer origin, transfer destination

- The buffer memory number is input in the transfer origin for the FROM instruction and in the transfer destination for the TO instruction.  
The buffer memory has 16 bits. The details and number of points will vary according to the intelligent function module.
- The PLC word device (K2M10, K4X0, etc., including the bit device nibble designation) is entered in the transfer destination for the FROM instruction and in the transfer origin for the TO instruction.
- Some buffer memories have 32 bit content. In this case, D must be attached to create a 32-bit instruction.

## ◎ Number of transfer points



The number of transfer points is designated with n. The 16-bit instruction's n=2 and the 32-bit instructions n=1 have the same significance.

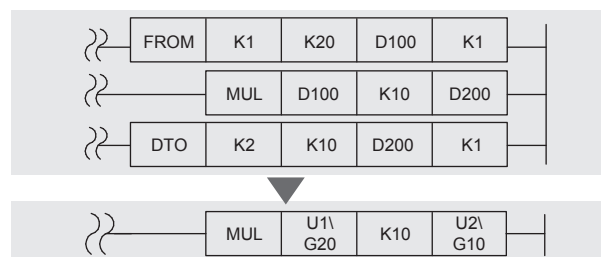
### Handy tip!

#### Using intelligent function module's data directly in applied instruction

By using the module access device, the intelligent function module data can be handled without using FROM/TO instructions.

The module access device is designated with U [intelligent function module's module No.] \ [buffer memory address].

Example: Multiply the intelligent function module No. 1 buffer memory (BFM) #20 data by 10, and write into the intelligent function module No. 2 buffer memory (BFM) #10 and #11.



# Try applying what you've learned!

## Chapter 14

### IMPLEMENTATION PROCEDURES OF PLC

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#### Anyone can use PLC ...

Recent PLCs have many handy functions.

Measures have been taken so that even beginner engineers, who are unfamiliar with sequence design, can use the PLC.

It's important to try using the PLC first. The implementation procedures are explained in this chapter.

#### In this chapter...

The procedures follow the steps for replacing a conventional relay panel type sequence circuit with a PLC.

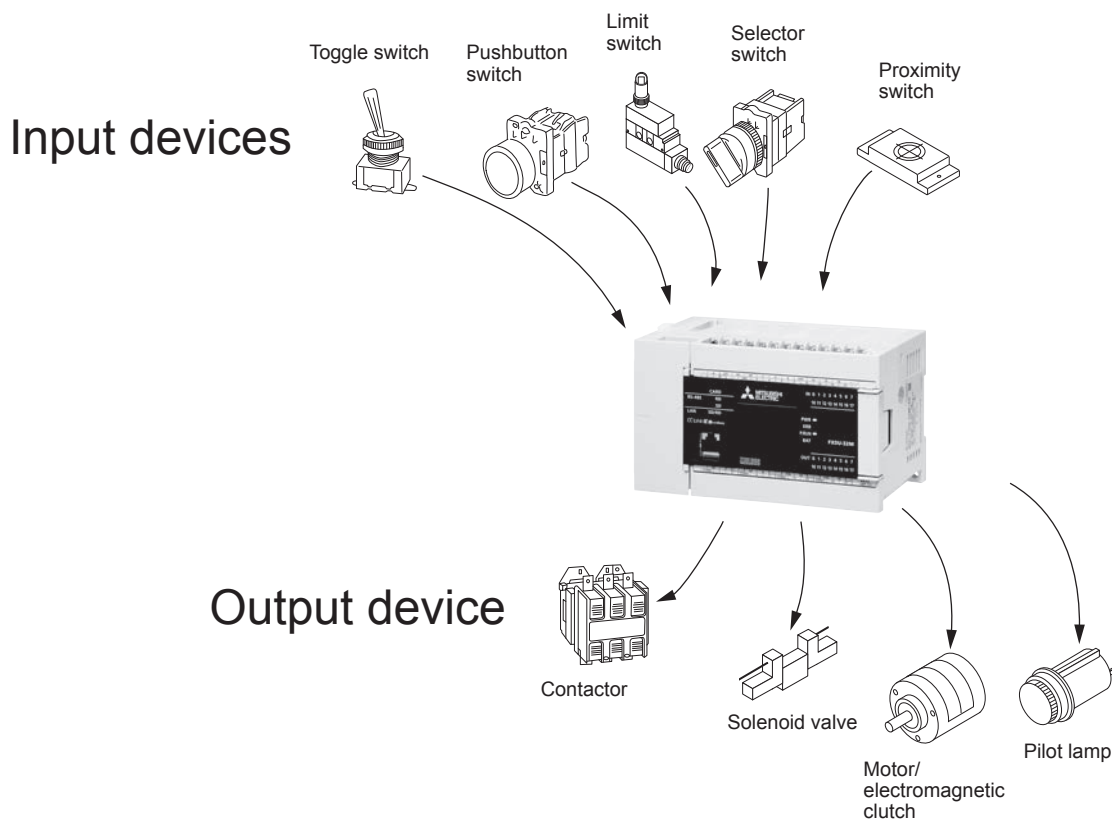
The steps are basically the same as when using the PLC from the start. Gain experience, and learn how to realize the PLC's capabilities to the maximum.



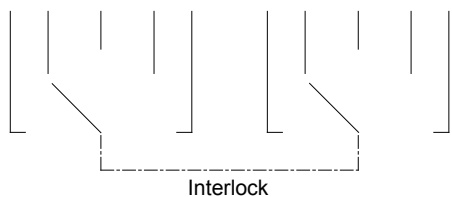
# 14.1 Selecting a model

## 14.1.1 Counting the number of input/output points

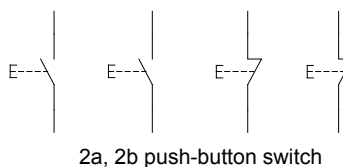
When selecting the PLC, the number of input points and output points must be counted to clarify the scale of the PLC.



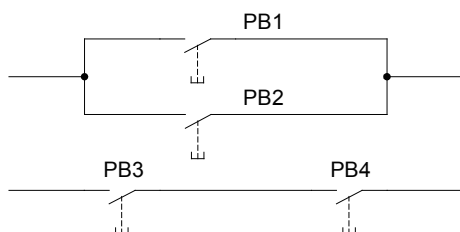
The number of input points does not always match the number of input devices.



If there is one 2-step 5-notch select switch (rotary switch) as shown on the left, the PLC input will be 5 points.



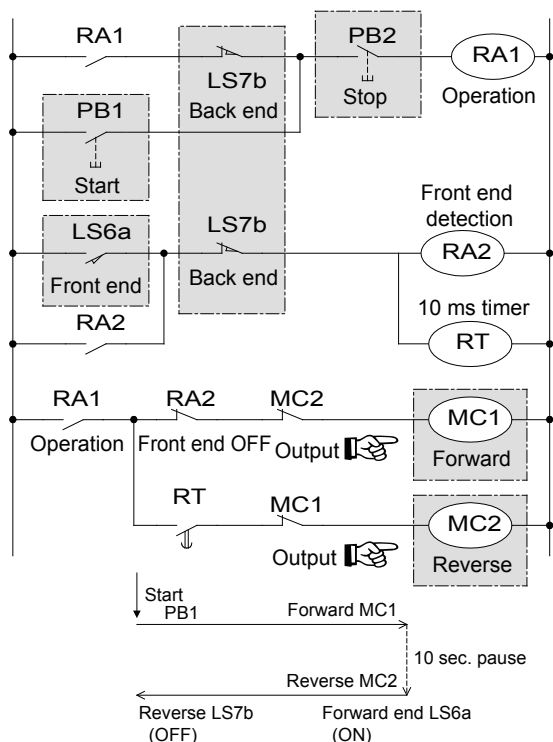
When a pushbutton switch has 2a, 2b contacts as shown on the left, the PLC needs one input for the 1a or 1b contact.



An input switch always connected in parallel or an input switch used as a serial connection can each be handled as one input.

## 14.1.2 Determining the number of input/output points from the sequence diagram

The following figure shows part of a sequence related to the conveyor's bidirectional control.



- (1) When the start button PB1 is pressed, the operation output RA1 continues self-hold operation until the stop button PB2 is pressed or the back end is reached.
- (2) When the front end limit switch LS6a turns ON, the front end detection RA2 operates until the back end limit switch LS7b turns OFF, and the timer RT contact activates 10 seconds later.
- (3) When the operation output RA1 activates, the advance output MC1 operates until the front end detection RA2 activates.
- (4) 10 seconds after the front end is reached and the MC1 is de-energized, the retract output MC2 will energize. When the back end is reached, the timer RT is reset, and the retract output MC2 is de-energized.
- (5) In this example, four input points and two output points are required for the PLC.  
The PLC's internal relays and timers are used for the relays RA1 and RA2 and for the timer RT, etc.

### Reference

The FX5U and FX5UC can handle up to a total of 256 input/output points\*1 by using together with the I/O module.

\*1: Maximum 512 points including remote I/O for CC-Link and AnyWireASLINK

#### [FX5U Lineup]

##### FX5U CPU module

| Type          | Input     | Output    | No. of extension block points  |
|---------------|-----------|-----------|--|
| 32-point type | 16 points | 16 points | Max. 512 points<br>(Including remote I/O for<br>CC-Link and AnyWireASLINK) |
| 64-point type | 32 points | 32 points |  |
| 80-point type | 40 points | 40 points |  |

##### I/O module (extended cable type)

| Type                      | Input     | Output    |
|---------------------------|-----------|-----------|
| 8-point input dedicated   | 8 points  | —         |
| 8-point output dedicated  | —         | 8 points  |
| 16-point input dedicated  | 16 points | —         |
| 16-point output dedicated | —         | 16 points |
| 32-point type             | 16 points | 16 points |

#### [FX5UC Lineup]

##### FX5UC CPU module

| Type          | Input     | Output    | No. of extension block points  |
|---------------|-----------|-----------|--|
| 32-point type | 16 points | 16 points | Max. 512 points<br>(Including remote I/O for<br>CC-Link and AnyWireASLINK) |
| 64-point type | 32 points | 32 points |  |
| 96-point type | 48 points | 48 points |  |

##### I/O module (extended connector type)

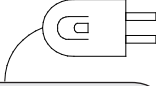
| Type                      | Input     | Output    |
|---------------------------|-----------|-----------|
| 16-point input dedicated  | 16 points | —         |
| 16-point output dedicated | —         | 16 points |
| 32-point input dedicated  | 32 points | —         |
| 32-point output dedicated | —         | 32 points |
| 32-point type             | 16 points | 16 points |

##### I/O module (extended cable type)

| Type                      | Input     | Output    |
|---------------------------|-----------|-----------|
| 8-point input dedicated   | 8 points  | —         |
| 8-point output dedicated  | —         | 8 points  |
| 16-point input dedicated  | 16 points | —         |
| 16-point output dedicated | —         | 16 points |

## 14.1.3 Selecting the PLC type

What is the power voltage?



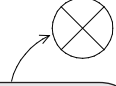
Typically, the power voltage for the PLC is common with the 100/200 V AC system. A 24 V DC power type is used for special applications such as a battery cart or emergency power.

What is the input/output format?



A screw-type terminal block is typically used. The block has connectors and is compact, so various devices can be downsized.

What is the output format?



The relay output type that can be used commonly for the AC load and DC load is often used. A transistor output available as a long-life type or no-contact type is used for the DC load.

For information on the specifications available in each PLC series, refer to the individual catalogs.

## 14.2 Design setup

### 14.2.1 Assigning the input/output devices

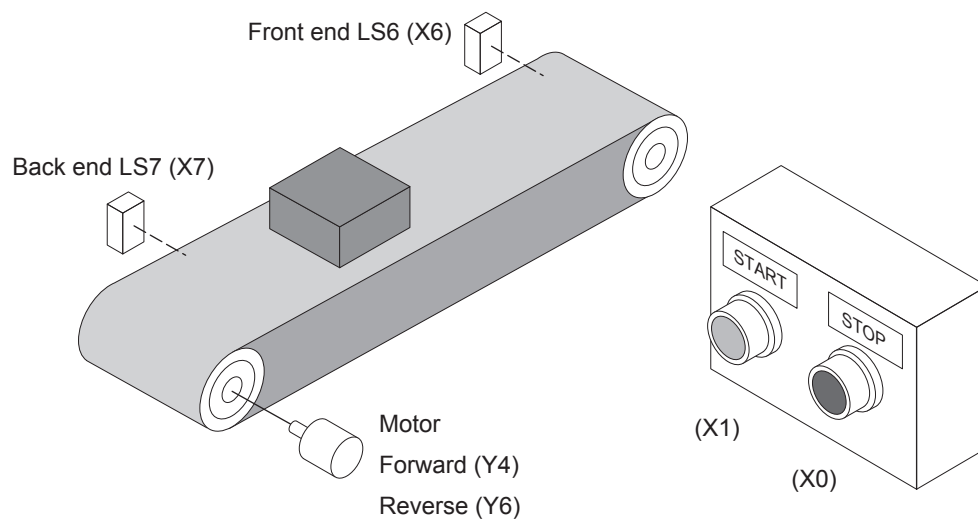
The type of PLC to be used was selected in the previous section.

Next, clarify the correspondence of the input/output device and PLC input/output relay numbers.

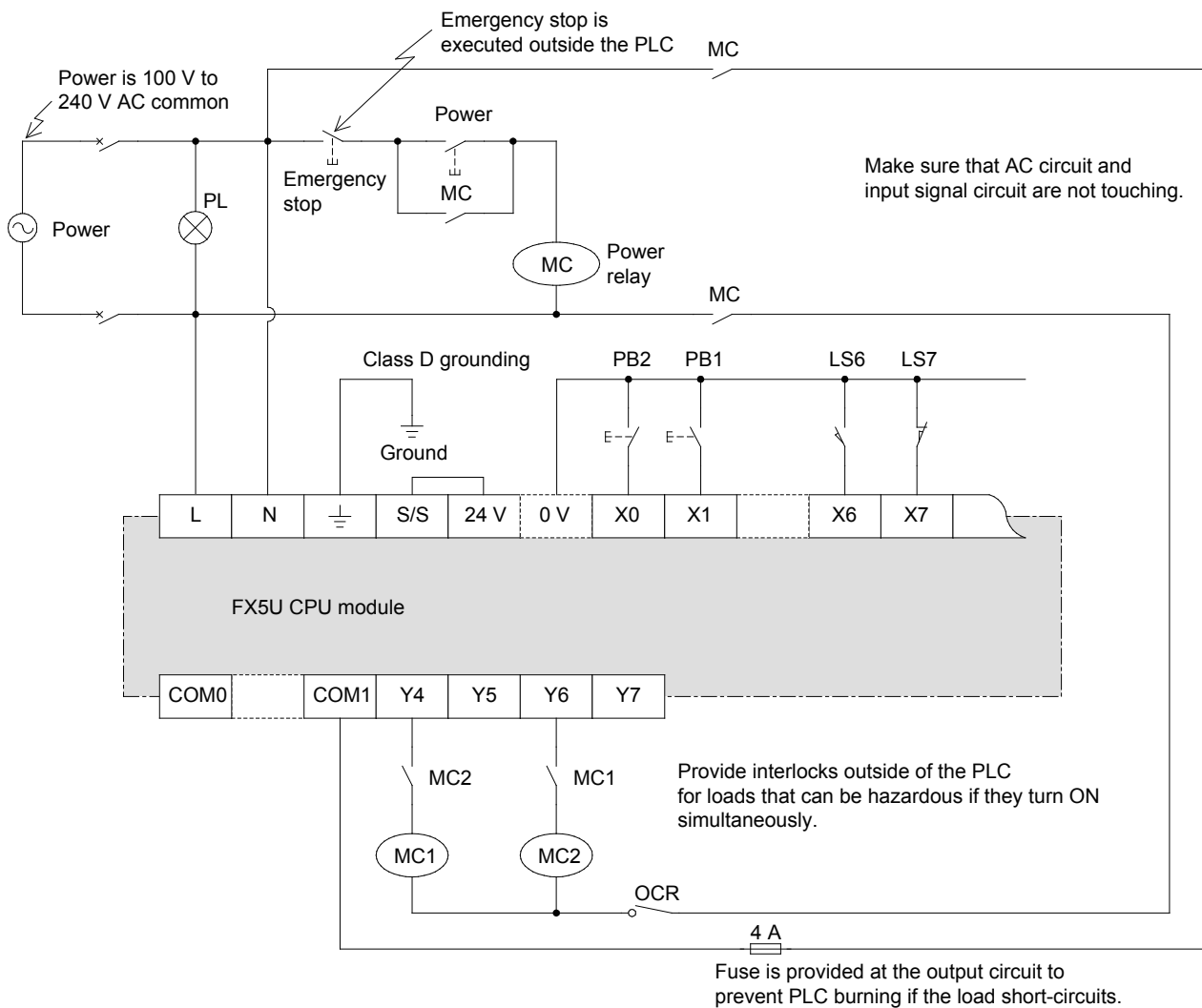
After this step, the input/output wiring diagram and sequence explained later can be designed.

| Input devices   |     | Input relay No. |
|-----------------|-----|-----------------|
| Start button    | PB1 | X1              |
| Stop button     | PB2 | X0              |
| Front end limit | LS6 | X6              |
| Back end limit  | LS7 | X7              |

| Output device  |     | Output relay No. |
|----------------|-----|------------------|
| Advance output | MC1 | Y4               |
| Retract output | MC2 | Y6               |

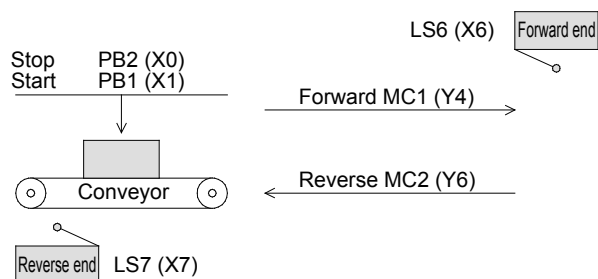


## 14.2.2 Creating an external connection diagram



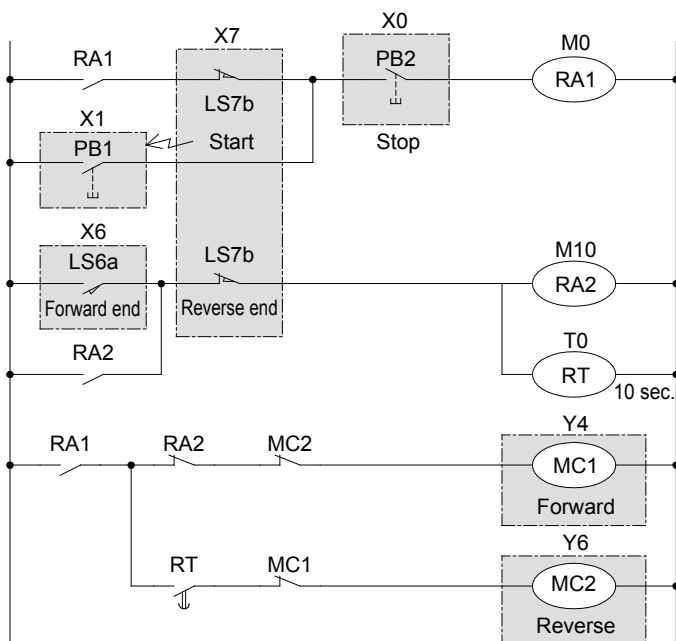
- When using an I/O module, the input/output numbers are assigned sequentially starting from that closest to the CPU module.

## 14.2.3 Deciding the device numbers



The following sequence circuit expresses the movement of a conveyor as shown on the left. The limit switch LS6 N.C. contact and the LS7 N.C. contact are de-energized at the conveyor's forward end and reverse end.

In addition to the input/output relays, the timer RT and controller relays RA1 and RS2 are assigned to T0, M0 and M10.

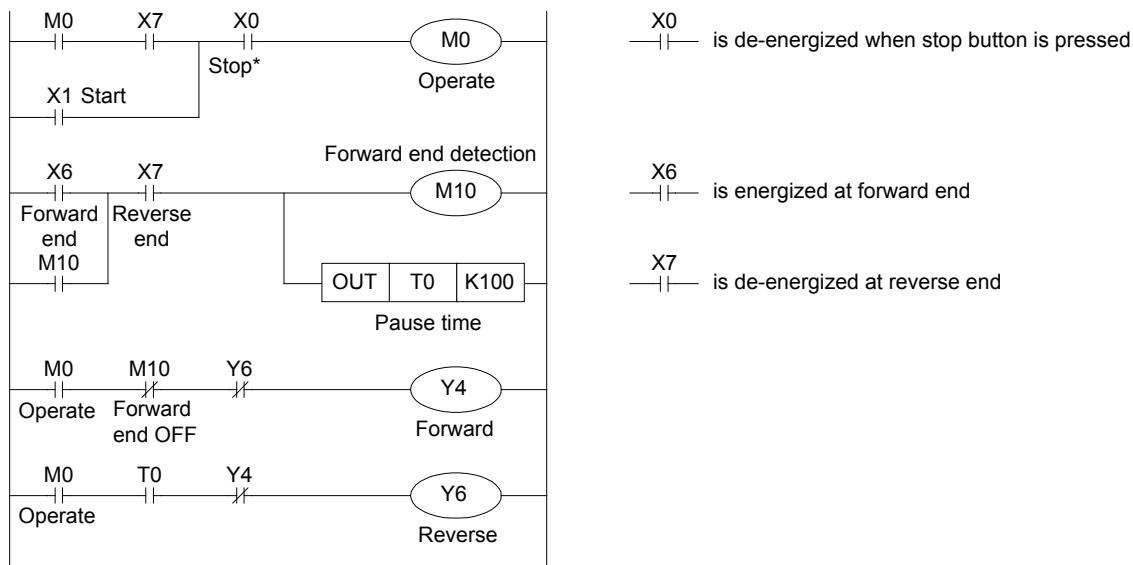


### Reference

#### Designing the sequence circuit

The sequence circuit in the PLC can be designed with basically the same procedures as the sequence circuit in the relay panel. However, in this example the circuit for the section excluding the external connection configured by the input/output devices is designed.

## 14.2.4 Upgrading to the PLC internal circuit

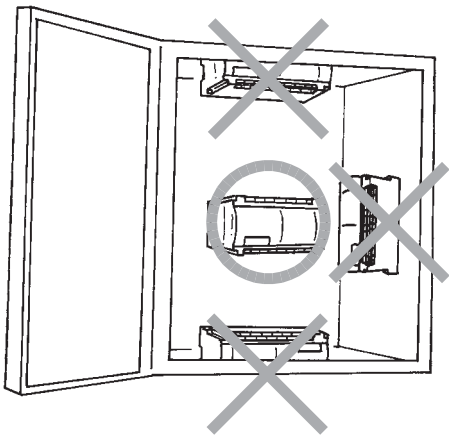


\* A N.C. contact (normally closed contact) is used for the stop button PB2, so the N.O. contact (normally open contact) is used on the sequence circuit.

### <<Explanation of operation>>

- When the start button PB1 is pressed, the input X1 operates and the operation output M0 starts the self-hold operation. When the stop button PB2 (N.C. contact) is pressed, the N.O. contact of the input X0 is de-energized, and the self-hold of the operation output M0 is released. The self-hold is also released when the reverse end is reached.
- When X6 is energized at the forward end, the forward end detection M10 starts self-holding, and continues until the X7 N.C. contact is de-energized at the reverse end.
- When the start button PB1 is pressed and the operation output M8 operates, the advance output Y4 operates until the forward end detection M10 N.C. contact is de-energized.
- After the front-end detection M10 operates and the timer T0 reaches the time-up, the retract output Y6 operates, and continues to operate until the reverse end is reached and the timer T0 contact is de-energized.

## 14.3 Installation and wiring work



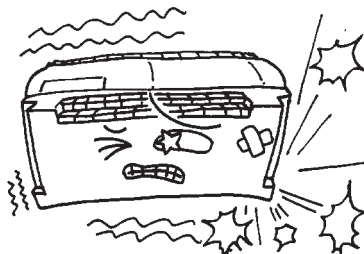
The PLC can be directly mounted onto the control panel using the mounting holes on the four corners, or directly mounted onto a DIN rail.

To prevent the temperature from rising, do not mount onto the floor or ceiling.

Provide a space of 50 mm or more around the PLC to ensure air circulation.



Do not install directly in a place where there is dust, oil mist, conductive gas or corrosive gas.



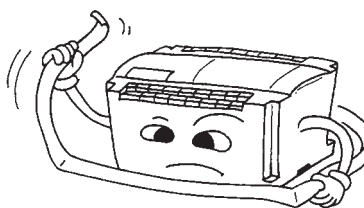
Do not install directly in a place subject to vibration or impact.



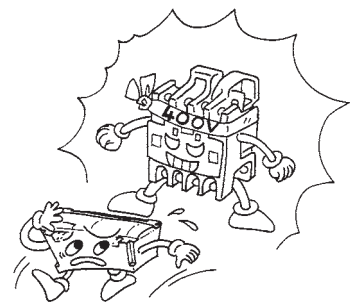
Do not install near a heating element, where the module could be subject to direct sunlight, dew condensation, rain or wind.



Pay special caution during drilling or wiring work so that cutting chips or wire scraps do not get into the PLC.

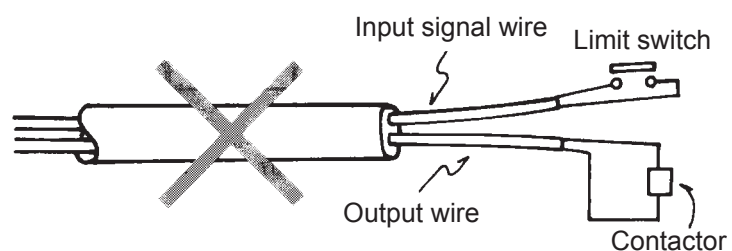


A dust-proof sheet is wrapped around the exterior of the PLC. When the work is completed, remove the sheet to prevent heating.



Separate the module as far away as possible from high-voltage wires, high-voltage devices and power devices.

Do not pass the input signal wire and output wire through the same cable as other power wires, and do not bind them.





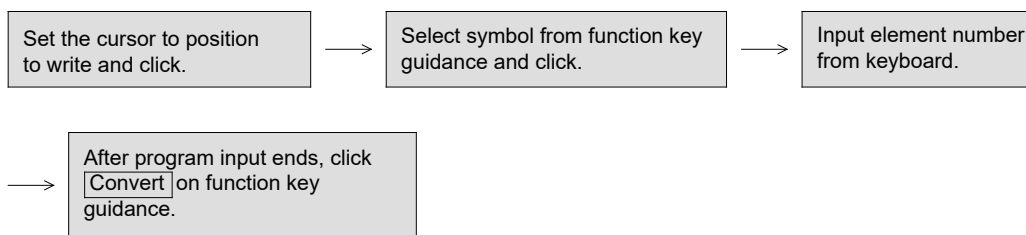
# 14.4 Operation

## 14.4.1 Preparing the program

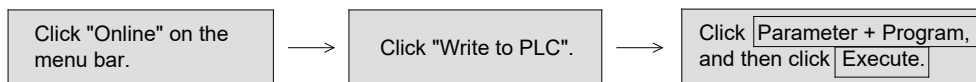
- Is programming cable connected?
- Turn OFF the PLC RUN input.
- Turn ON the PLC power.

## Writing the program

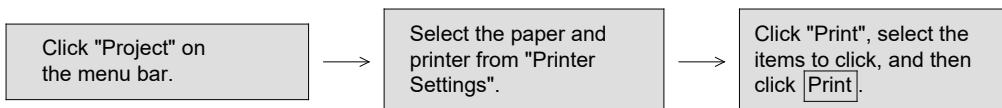
- Operations for writing the program



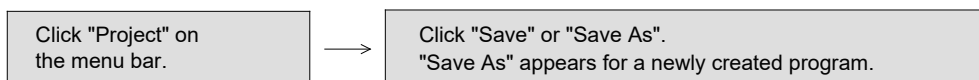
- Transferring the program



- Printing the program



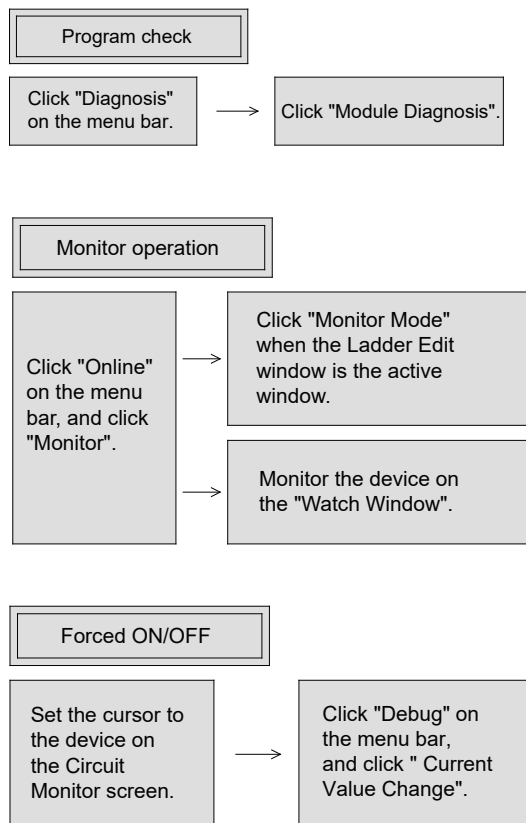
- Saving the program



## 14.4.2 Trial operation and adjustment

The PLC starts operation when the PLC RUN input turns ON.

The roles of the personal computer's engineering tool, etc., in the test operation stage are explained below.



- If there is an error in the program, the ERR display on the front of the PLC will flash or light when the PLC RUN input is turned ON, and the PLC may not RUN. The step No. in which the error occurred will display when the steps shown on the left are taken. (The PLC RUN input is ON or OFF)
- The error code is written into the special register SD0, and the cause of the error can be identified by monitoring this register.
- Each contact and coil ON/OFF status can be inspected while displaying the circuit.
- The ON/OFF status of X, Y, M, S, T and C can be inspected by designating the device No. The current value is also displayed for T and C.
- Forced ON/OFF can be performed from the personal computer by designating the device No. When the PLC is running, this is valid for output relays and internal relays being driven with the self-hold operation or set instruction. When forcing ON or OFF while the PLC is stopped, ON and OFF are valid even if there is no self-hold circuit.

### Important

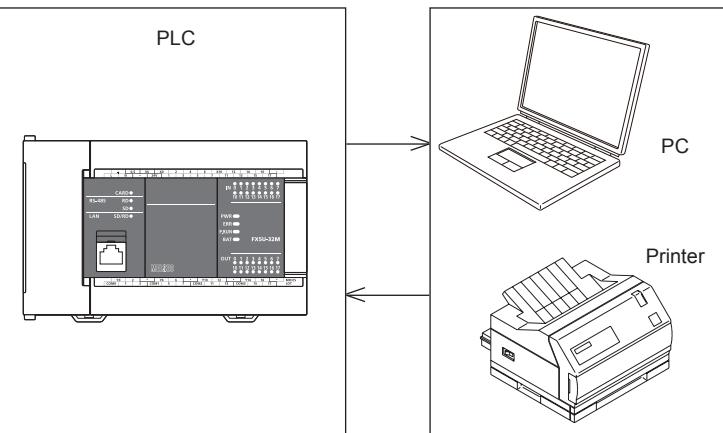
#### Checking the wiring

The following type of incorrect wiring will damage the PLC. Always carry out a preliminary inspection before turning the power ON.

- Power terminal : Is the power connected to the **L** and **N** terminals ?
- Input terminal : Are the 24 V DC series terminals contacting the 100 V AC or 200 V AC?
- Output terminal : Is the load short-circuited?

# 14.5 Basics of maintenance

## 14.5.1 Saving and documenting the program

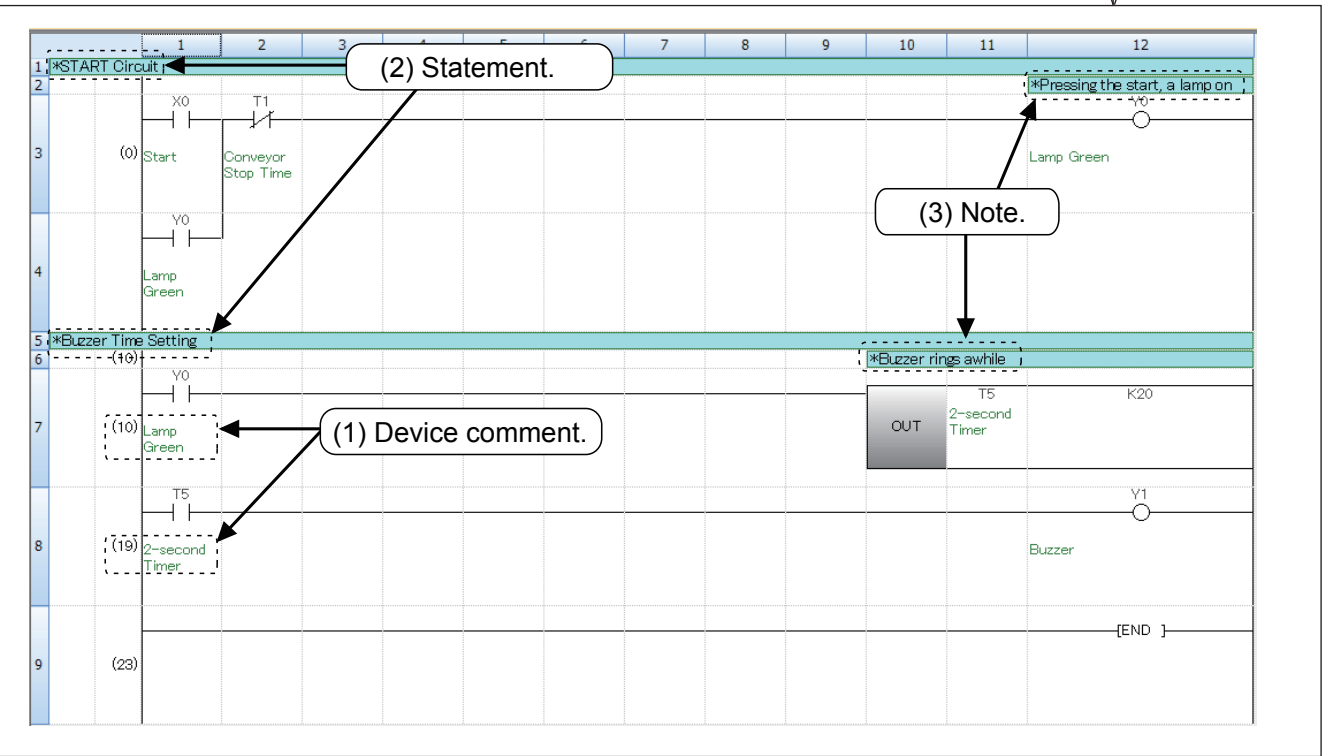


### <<Saving the program>>

Saving the program on a USB memory or hard disk (HD) using an engineering tool such as a personal computer is recommended.

### <<Documentation>>

Comments can be added to a program created with an engineering tool, such as a personal computer, and then printed with the printer. This allows the program documentation to be created at the same time as the program.



# 14.5.2 Troubleshooting

Trouble will rarely occur if the input/output wires are correctly connected to the PLC, and the PLC is installed in an appropriate environment. However, the environment is not always ideal, and troubles can occur in the handling of the PLC.

The PLC has various displays and self-diagnosis functions to simplify troubleshooting.

Power display  
"PWR"

Turns on when voltage is applied on the PLC and the control power in the PLC is operating. Turns off when the sensor power is overloaded.

Operation display  
"P.RUN"

Turns on when the PLC is in the operation status.  
If an error occurs, this display turns off and the PLC output turns "OFF". (The output holds the current state when the special relay SM8033 is driven.)

Battery display  
"BAT"

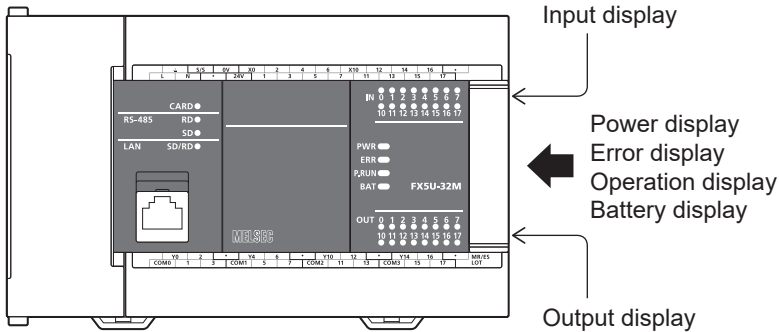
This is valid when the optional battery is used and the LED display at battery error is set to "Display" with the parameters.  
This display turns on when the battery voltage drops abnormally and when voltage is applied on the PLC.

Error display  
"ERR"

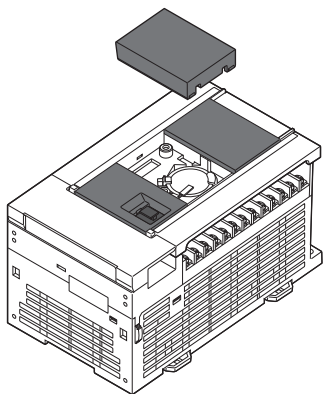
This display turns on when an error occurs.  
This display flashes when the program or parameters are not written in, when the parameters are set incorrectly, or when a watch dog timer error occurs.  
Refer to the following section "Error Codes" for details on the errors.

Input display  
Output display

The ON/OFF status of the input signal switches and the output relay drive status are displayed.



# 14.5.3 Periodic Inspections



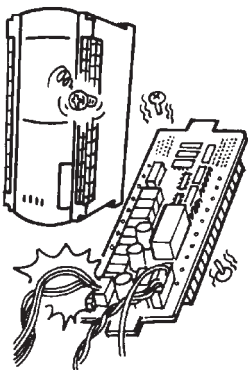
The PLC does not contain any consumable parts that could cause a short-term life. When using the optional battery, it is recommended to replace it periodically with the procedures given in the instruction manual. For the output relay, caution must be paid to the life when the relay operates at an abnormally high frequency or when switching a large capacity load.

In addition, pay attention to the following points when inspecting the other devices.

Has the temperature in the panel increased abnormally because the module is near a heating element or in direct sunlight, etc.?

Has dirt or conductive dust entered the panel.?

Are any of the terminals loose or rusted? Are any of the wires damaged, etc.?



## Contact capacity

|                 |             |
|-----------------|-------------|
| Resistance load | 2 A or less |
|-----------------|-------------|

- Circuit voltage is 250 V AC or less, 30 V DC or less
- When the DC conductive load does not have a built-in protection circuit, an external rectifying diode must be installed.

## Guide to contact life

| Load capacity (VA) | Contact life (10,000 times) |
|--------------------|-----------------------------|
| 20                 | 300                         |
| 35                 | 100                         |
| 80                 | 20                          |

# You can be a professional!

## Chapter 15

### SUMMARY OF THE POINTS

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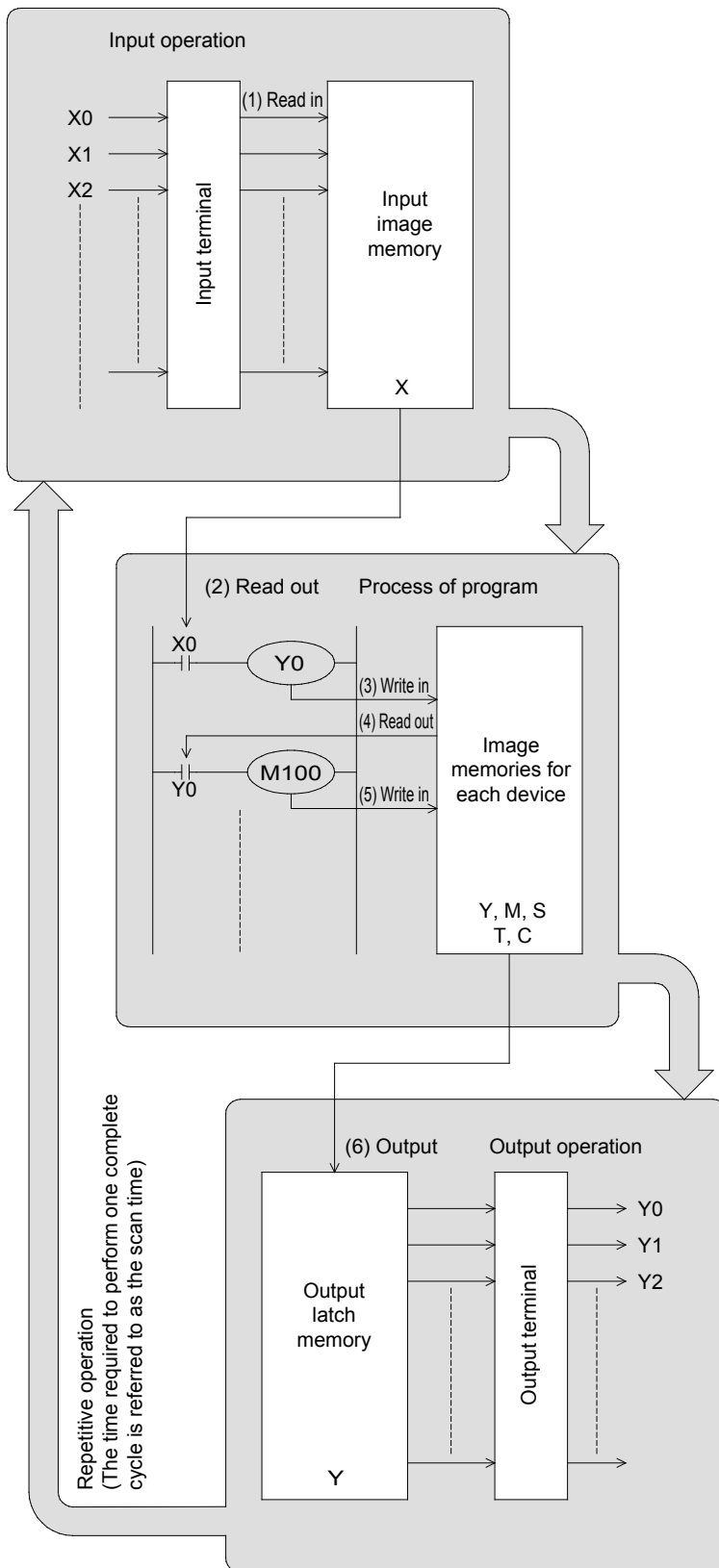
There are differences in the operating principles between PLCs and relay boards. However, there are many users who do not recognize these differences. To fully master PLC programming, it is essential to understand the differences.

#### In this chapter...

The operating principles of PLCs will be summarized, along with Internal relays, timers, and the role of the battery.

After reviewing all topics and confirming your knowledge of the points that have been covered, you will take the first step toward becoming a professional sequence circuit designer.

# 15.1 Input/output process for the PLC



## ● Input operation

Prior to execution of a program, the PLC reads all ON/OFF statuses of the input terminals into the input image memory. If an input changes its status during the execution of a program, the input image memory does not change its contents at that time. Instead, the change will be read in the next input process cycle.

## ● Process of program

The PLC reads the ON/OFF statuses of required elements from the input image memory or other element's memory, in accordance with the contents of the instructions stored in the program memory. Hence, the image memory of each element can sequentially change its content in accordance with the progress of the program.

## ● Output operation

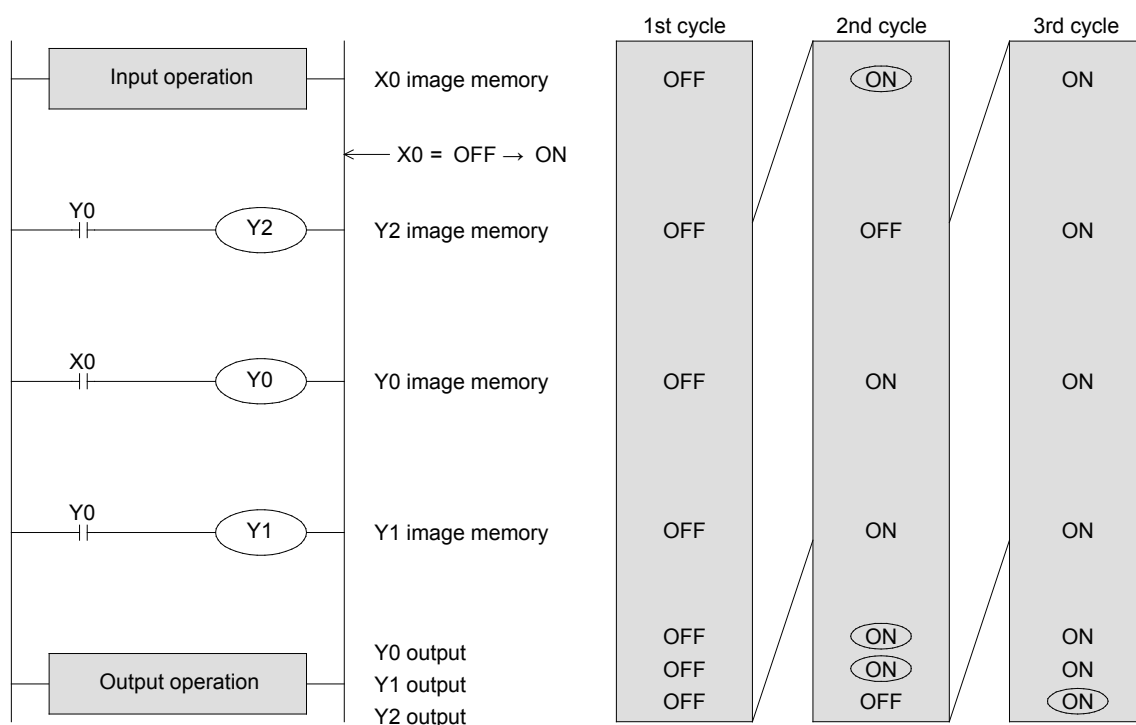
When all instructions have been executed, the PLC transfers the ON/OFF statuses of outputs Y to the output latch memory, which represent the physical outputs.

The above type of method is called the batch input/output method (or refresh method).

## 15.2 Response delay for Input/Output

There are not only electrical delays from input filters (approx. 10 ms) and mechanical response delays from output relays (approx. 10 ms), but there is also a response delay due to the affect of the scan time.

For example, assume that input X0 changes from OFF to ON just after the input process is finished, as shown in the sequence circuit below. (Note: the input switch changes to ON approximately 10 ms before the process is monitored.)



As shown above, Y0 and Y1 may have up to a 2-cycle response delay. (The output contact will be ON approximately 10 ms later.)

Y2 is energized 1 cycle later, since the contact Y0 which drives Y2 is programmed before X0.

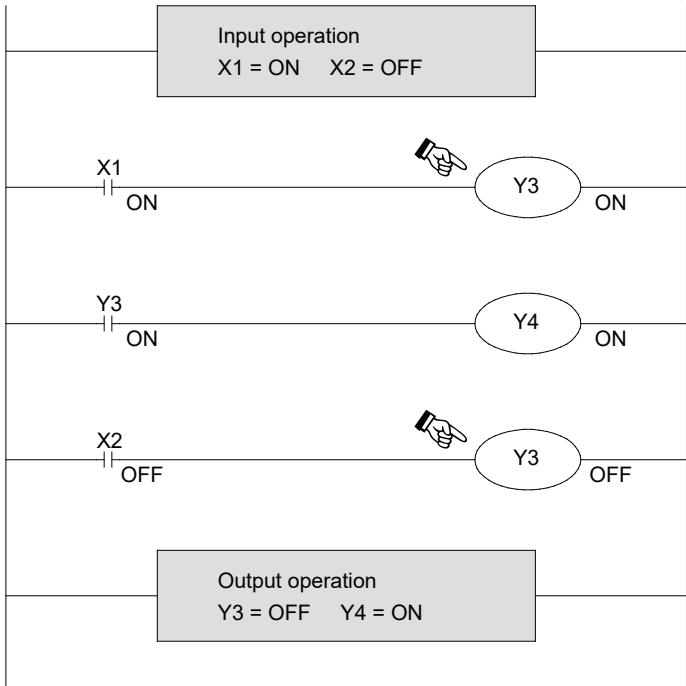
### Reference

#### Countermeasures against I/O response delay

There is an instruction (Refresh REF) which can perform input or output processing during the program execution. For transistor type output terminals, the response relay for the output is 0.2 ms or less. For inputs, the input filter's response delay can be shortened with the parameters.



# 15.3 Dual output operation



In this example, assume that coil Y3 is used in multiple locations.

Also, assume that X1 = ON and X2 = OFF.

For the first Y3, the image memory is set to ON because X1 is ON, hence output Y4 is also ON.

However, for the second Y3, the image memory is changed to OFF since input X2 is OFF.

Therefore, the output is in fact, Y3 = OFF and Y4 = ON.

As previously described, if dual output (double coil) is performed, the latter content overrides the former.

Reference

### Direct I/O Mode

The PLC has a direct access input (DX) and direct access output (DY) that performs the input process or output process simultaneously with the execution of the instruction.

In this case, the output responses for inputs become faster, but the action for dual output is different.

In addition, for the following circuit, DY35 and DY36 may change to ON at the same time.

DX3  
—| |—

DY35

(1)

DX3  
—|/|—

DY35

(2)

DX3  
—|/|—

DY36

(3)

Assume that DX3 = ON when executing this circuit. Thus, DY35 is energized.

If DX3 is not changed until executing this line of code, DY35 may become de-energized. Hence, DY35 can be ON or OFF, which may cause problems for the dual output during the scan time.

If the input DX3 is changed from ON to OFF before executing this line, DY36 will be energized. If DX003 line (2) is turned OFF then both DY35 and DY36 will turn to ON.

## 15.4 No limitation on the number of contacts

Since the PLC can use the contents of image memories for each element as many times as needed, there is no limitation to the numbers of N.O. and N.C. contacts.

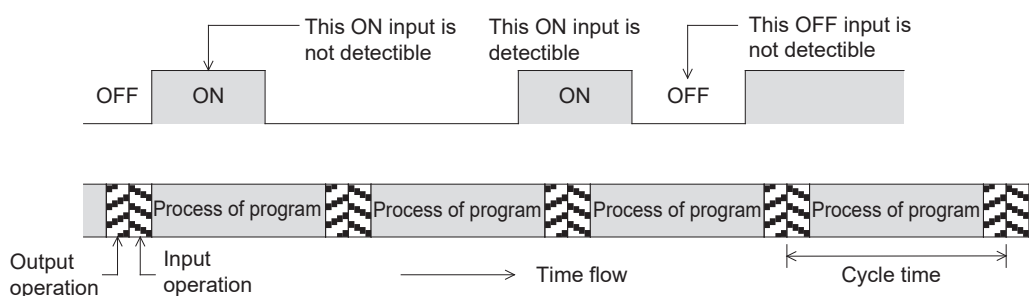
However, there is a limitation on the program capacity.

The number of serial contacts and parallel contacts is not limited, but circuit display and printer printing of engineering tool such as a personal computer, etc., may be limited.

- At the maximum, 11 contacts and 1 coil (in the case for timers or counters, 9 contacts and 1 coil) can be included in a single line on the GPP.
- For easier viewing on PC screen, it is recommended to set the display so that there is no wrapping.

### Reference

#### Narrow pulses are not detectable



In principle, the widths of input pulses (ON and OFF inputs) for a PLC must be longer than the cycle time of the PLC.

When the response delay of the input filter, 10 ms, is taken into account, the time durations for ON and OFF inputs must be 20 ms at the shortest, if the cycle time is 10 ms.

Hence, input pulses with frequencies of higher than 25 Hz ( $= 1000 / (20 + 20)$ ) cannot be read normally. However if a special function or application instruction is used, these signals can be detected.

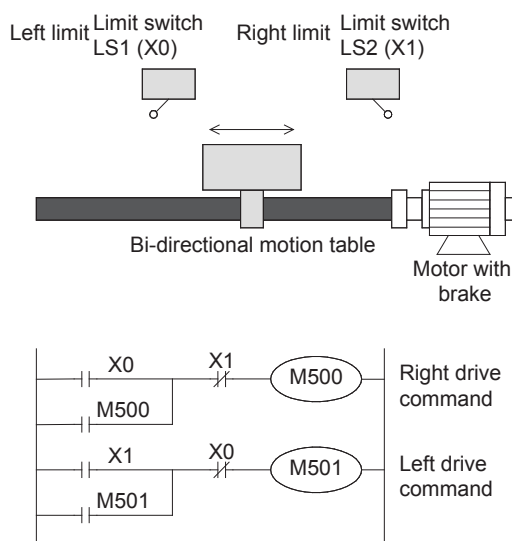
## 15.5 Role of the latch device

The FX5U CPU module does not have a battery inside when shipped from the factory.

The optional battery is used to hold (latch) the clock data in a power failure or to increase the latched devices.

The parameters must be set when using a battery.

### How to use the internal relay (latch)



In some cases, it is required to move the positioning table in the same direction after power failure.

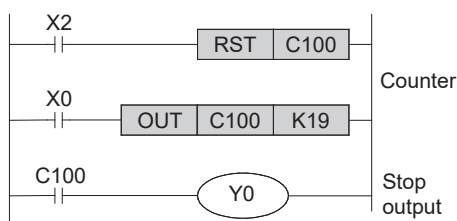
- X0=ON (Left limit)
- M500 (Right drive command) = ON
- Power failure
- Positioning table stops halfway
- Restart (M500 = ON)
- X1 = ON (Right limit)
- M500 = OFF, M501 = ON
- Left drive

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The latched internal relay may be called a latched relay.

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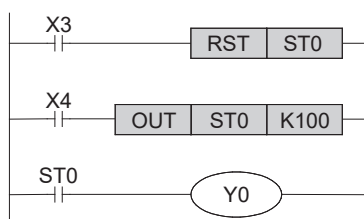
### How to use counters



This counter counts the activation of the left limit switch shown above, and stops the table after counting 19 times.

In this case, the counter keeps its counting value even if a power failure occurs during the counting.

### How to use retentive timers



The timer ST0 starts timing at the moment X4 changes to ON. The timer keeps its current value if X4 is set to OFF or if the power is turned off during timing.

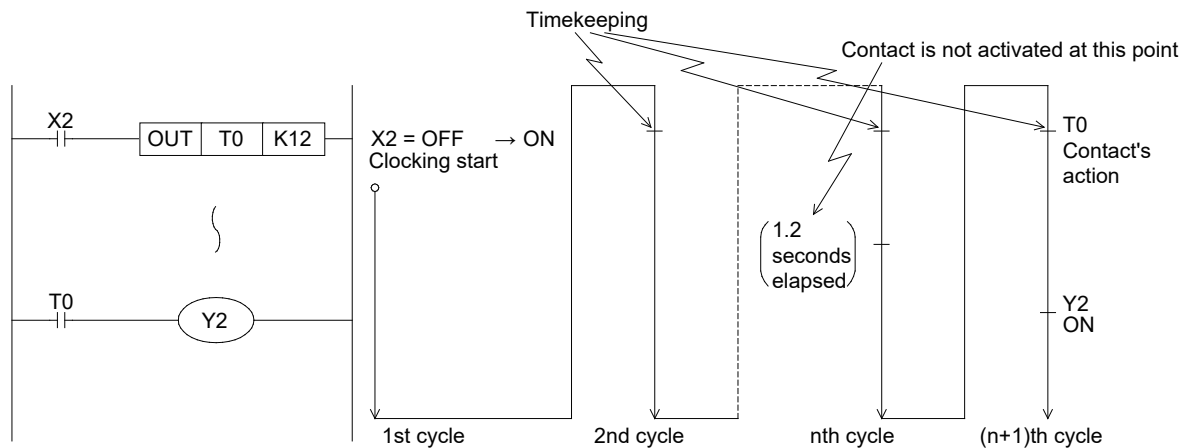
When the timer starts again, the timer clock sustains its time value and the output contact ST0 will then be energized.

When X3 is set to ON, the current value of the timer is cleared and reset to 0 and the output contact is set to OFF.

- The device latch range can be changed with the parameters.

# 15.6 Timers and their accuracy

Each timer in a PLC begins timing when its drive contact is closed, and its output contact is activated after the timer reaches its set value.



Hence, the approximate accuracy of a timer contact can be expressed with the following formula:

$$T \begin{matrix} +T_0 \\ -\alpha \end{matrix}$$

$\alpha$  : 0.001 for 1 ms timer, 0.01 for 10 ms timer, 0.1 for 100 ms timer (seconds)

$T$  : Set time of timer (seconds)

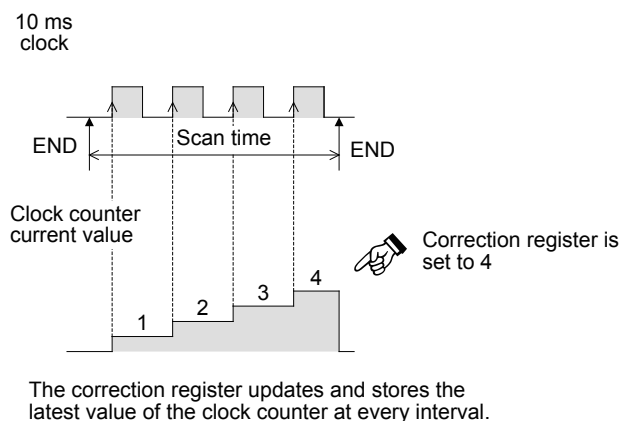
$T_0$  : Scan time (seconds)

In the worst case, if the timer drive contact is programmed prior to the timer coil, the accuracy becomes  $+2T_0$ . If the set value of the timer is 0, the output contact will be activated at the next execution of the coil instruction. When the timer setting value is 1, the accuracy above may cause the output contact to activate when the next cycle's coil instruction is executed.

## Reference

### Details on timer operation

- For 1 ms, 10 ms and 100 ms timers, the time is measured at each execution of the coil instruction, and when it reaches a set value, the output contact is energized. However, the following type of compensation is applied when using a 10 ms timer with a calculation cycle of several 10 ms.



- There is a timer correction register, which stores the previous scan time, in the PLC.
- When the OUTH T instruction is executed, the value in the correction register is added to the timer's current value register.

# MEMO

## Appendix 1

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### In this appendix...

The applied instructions, special internal relays, special data registers, and parameters that have been described in this textbook are arranged in lists. In addition, the details of the error codes are listed. Refer to these as necessary.

# Appendix 1.1 List of instructions

The applied instructions that can be used with the micro-PLC MELSEC iQ-F Series are listed below.  
Refer to the MELSEC iQ-F FX5 Programming Manual (Instructions, Standard Functions/Function Blocks).

## CPU module application instruction

| Classification              | Instruction symbol | Function  | Compatible CPU module |       |
|-----------------------------|--------------------|---|-----------------------|-------|
|                             |                    |   | FX5U                  | FX5UC |
| Rotation                    | ROR(P)             | 16-bit data right rotation                                      | ○                     | ○     |
|                             | RCR(P)             | Right rotation with 16-bit data carry                           | ○                     | ○     |
|                             | ROL(P)             | 16-bit data left rotation                                       | ○                     | ○     |
|                             | RCL(P)             | Left rotation with 16-bit data carry                            | ○                     | ○     |
|                             | DROR(P)            | 32-bit data right rotation                                      | ○                     | ○     |
|                             | DRCR(P)            | Right rotation with 32-bit data carry                           | ○                     | ○     |
|                             | DROL(P)            | 32-bit data left rotation                                       | ○                     | ○     |
|                             | DRCL(P)            | Left rotation with bit data carry                               | ○                     | ○     |
| Program branch              | CJ(P)              | Pointer branch  | ○                     | ○     |
|                             | GOEND              | Jump to END   | ○                     | ○     |
| Program execution control   | DI                 | Interrupt disable   | ○                     | ○     |
|                             | EI                 | Interrupt enable  | ○                     | ○     |
|                             | DI                 | Interrupt disable when lower than specified priority            | ○                     | ○     |
|                             | IMASK              | Interrupt program mask  | ○                     | ○     |
|                             | SIMASK             | Specified interrupt pointer disable/enable                      | ○                     | ○     |
|                             | IRET               | Return from interrupt program                                   | ○                     | ○     |
|                             | WDT(P)             | WDT reset   | ○                     | ○     |
| Structured instruction      | FOR                | Executed (n) times between ROM instruction and NEXT instruction | ○                     | ○     |
|                             | NEXT               |   | ○                     | ○     |
|                             | BREAK(P)           | FOR to NEXT forced end  | ○                     | ○     |
|                             | CALL(P)            | Subroutine program call   | ○                     | ○     |
|                             | RET                | Return from subroutine program                                  | ○                     | ○     |
|                             | SRET               |   | ○                     | ○     |
|                             | XCALL              | Subroutine program call   | ○                     | ○     |
| Data table operation        | SFRD(P)            | First-in data read from data table                              | ○                     | ○     |
|                             | POP(P)             | Last-in data read from data table                               | ○                     | ○     |
|                             | SFWR(P)            | Data write to data table  | ○                     | ○     |
|                             | FINS(P)            | Data insertion to data table                                    | ○                     | ○     |
|                             | FDEL(P)            | Data delete from data table                                     | ○                     | ○     |
| Character string processing | LD\$=              | Character string comparison LD (S1) = (S2)                      | ○                     | ○     |
|                             | LD\$<>             | Character string comparison LD (S1) <> (S2)                     | ○                     | ○     |
|                             | LD\$>              | Character string comparison LD (S1) > (S2)                      | ○                     | ○     |
|                             | LD\$<=             | Character string comparison LD (S1) <= (S2)                     | ○                     | ○     |
|                             | LD\$<              | Character string comparison LD (S1) < (S2)                      | ○                     | ○     |
|                             | LD\$>=             | Character string comparison LD (S1) >= (S2)                     | ○                     | ○     |
|                             | AND\$=             | Character string comparison AND (S1) = (S2)                     | ○                     | ○     |
|                             | AND\$<>            | Character string comparison AND (S1) <> (S2)                    | ○                     | ○     |
|                             | AND\$>             | Character string comparison AND (S1) > (S2)                     | ○                     | ○     |
|                             | AND\$<=            | Character string comparison AND (S1) <= (S2)                    | ○                     | ○     |
|                             | AND\$<             | Character string comparison AND (S1) < (S2)                     | ○                     | ○     |
|                             | AND\$>=            | Character string comparison AND (S1) >= (S2)                    | ○                     | ○     |
|                             | OR\$=              | Character string comparison OR (S1) = (S2)                      | ○                     | ○     |
|                             | OR\$<>             | Character string comparison OR (S1) <> (S2)                     | ○                     | ○     |
|                             | OR\$>              | Character string comparison OR (S1) > (S2)                      | ○                     | ○     |
|                             | OR\$<=             | Character string comparison OR (S1) <= (S2)                     | ○                     | ○     |

| Classification              | Instruction symbol | Function   | Compatible CPU module |       |
|-----------------------------|--------------------|--|-----------------------|-------|
|                             |                    |  | FX5U                  | FX5UC |
| Character string processing | OR\$<              | Character string comparison OR (S1) < (S2)                         | ○                     | ○     |
|                             | OR\$>=             | Character string comparison OR (S1) >= (S2)                        | ○                     | ○     |
|                             | \$+(P)             | Combination of character strings                                   | ○                     | ○     |
|                             | \$MOV(P)           | Transfer of character string                                       | ○                     | ○     |
|                             | BINDA(P)(U)        | BIN 16-bit data→Decimal ASCII conversion                           | ○                     | ○     |
|                             | DBINDA(P)(U)       | BIN 32-bit data→Decimal ASCII conversion                           | ○                     | ○     |
|                             | ASCI(P)            | HEX code data→ASCII conversion                                     | ○                     | ○     |
|                             | STR(P)(U)          | BIN 16-bit data→Character string conversion                        | ○                     | ○     |
|                             | DSTR(P)(U)         | BIN 32-bit data→Character string conversion                        | ○                     | ○     |
|                             | ESTR(P)            | Single precision actual number→<br>Character string conversion     | ○                     | ○     |
|                             | DESTR(P)           |  | ○                     | ○     |
|                             | LEN(P)             | Detection of character string length                               | ○                     | ○     |
|                             | RIGHT(P)           | Extraction from right side of character string                     | ○                     | ○     |
|                             | LEFT(P)            | Extraction from left side of character string                      | ○                     | ○     |
|                             | MIDR(P)            | Extraction of any part from the middle of character string         | ○                     | ○     |
|                             | MIDW(P)            | Replacement of any part in the middle of character string          | ○                     | ○     |
|                             | INSTR(P)           | Character string search  | ○                     | ○     |
|                             | STRINS(P)          | Character string insertion   | ○                     | ○     |
|                             | STRDEL(P)          | Character string deletion  | ○                     | ○     |
| Actual number               | LDE\$=             | Single precision actual number comparison LDE (S1) = (S2)          | ○                     | ○     |
|                             | LDE\$<>            | Single precision actual number comparison LDE (S1) <> (S2)         | ○                     | ○     |
|                             | LDE\$>             | Single precision actual number comparison LDE (S1) > (S2)          | ○                     | ○     |
|                             | LDE\$<=            | Single precision actual number comparison LDE (S1) <= (S2)         | ○                     | ○     |
|                             | LDE\$<             | Single precision actual number comparison LDE (S1) < (S2)          | ○                     | ○     |
|                             | LDE\$>=            | Single precision actual number comparison LDE (S1) >= (S2)         | ○                     | ○     |
|                             | ANDE\$=            | Single precision actual number comparison ANDE (S1) = (S2)         | ○                     | ○     |
|                             | ANDE\$<>           | Single precision actual number comparison ANDE (S1) <> (S2)        | ○                     | ○     |
|                             | ANDE\$>            | Single precision actual number comparison ANDE (S1) > (S2)         | ○                     | ○     |
|                             | ANDE\$<=           | Single precision actual number comparison ANDE (S1) <= (S2)        | ○                     | ○     |
|                             | ANDE\$<            | Single precision actual number comparison ANDE (S1) < (S2)         | ○                     | ○     |
|                             | ANDE\$>=           | Single precision actual number comparison ANDE (S1) >= (S2)        | ○                     | ○     |
|                             | ORE\$=             | Single precision actual number comparison ORE (S1) = (S2)          | ○                     | ○     |
|                             | ORE\$<>            | Single precision actual number comparison ORE (S1) <> (S2)         | ○                     | ○     |
|                             | ORE\$>             | Single precision actual number comparison ORE (S1) > (S2)          | ○                     | ○     |
|                             | ORE\$<=            | Single precision actual number comparison ORE (S1) <= (S2)         | ○                     | ○     |
|                             | ORE\$<             | Single precision actual number comparison ORE (S1) < (S2)          | ○                     | ○     |
|                             | ORE\$>=            | Single precision actual number comparison ORE (S1) >= (S2)         | ○                     | ○     |
|                             | DECOMP(P)          | Single precision actual number comparison                          | ○                     | ○     |
|                             | DEZCP(P)           | Binary floating point bandwidth comparison                         | ○                     | ○     |
|                             | E+(P)              | Single precision actual number addition                            | ○                     | ○     |
|                             | E-(P)              | Single precision actual number subtraction                         | ○                     | ○     |
|                             | DEADD(P)           | Single precision actual number addition                            | ○                     | ○     |
|                             | DESUB(P)           | Single precision actual number subtraction                         | ○                     | ○     |
|                             | E*(P)              | Single precision actual number multiplication                      | ○                     | ○     |
|                             | E/(P)              | Single precision actual number division                            | ○                     | ○     |
|                             | DEMUL(P)           | Single precision actual number multiplication                      | ○                     | ○     |
|                             | DEDIV(P)           | Single precision actual number division                            | ○                     | ○     |
|                             | INT2FLT(P)         | Signed BIN 16-bit data→Single precision actual number conversion   | ○                     | ○     |
|                             | UINT2FLT(P)        | Unsigned BIN 16-bit data→Single precision actual number conversion | ○                     | ○     |
|                             | DINT2FLT(P)        | Signed BIN 32-bit data→Single precision actual number conversion   | ○                     | ○     |



| Classification           | Instruction symbol | Function   | Compatible CPU module |       |
|--------------------------|--------------------|--|-----------------------|-------|
|                          |                    |  | FX5U                  | FX5UC |
| Actual number            | EVAL(P)            | Character string→Single precision actual number conversion     | ○                     | ○     |
|                          | DEVAL(P)           |  | ○                     | ○     |
|                          | DEBCD(P)           | Binary floating point→Decimal floating point conversion        | ○                     | ○     |
|                          | DEBIN(P)           | Decimal floating point→Binary floating point conversion        | ○                     | ○     |
|                          | ENEG(P)            | Reverse of single precision actual number sign                 | ○                     | ○     |
|                          | DENEG(P)           |  | ○                     | ○     |
|                          | EMOV(P)            | Transfer of single precision actual number data                | ○                     | ○     |
|                          | DEMOV(P)           |  | ○                     | ○     |
|                          | SIN(P)             | Single precision actual number SIN operation                   | ○                     | ○     |
|                          | DSIN(P)            |  | ○                     | ○     |
|                          | COS(P)             | Single precision actual number COS operation                   | ○                     | ○     |
|                          | DCOS(P)            |  | ○                     | ○     |
|                          | TAN(P)             | Single precision actual number TAN operation                   | ○                     | ○     |
|                          | DTAN(P)            |  | ○                     | ○     |
|                          | ASIN(P)            | Single precision actual number $\text{SIN}^{-1}$ operation     | ○                     | ○     |
|                          | DASIN(P)           |  | ○                     | ○     |
|                          | ACOS(P)            | Single precision actual number $\text{COS}^{-1}$ Operation     | ○                     | ○     |
|                          | DACOS(P)           |  | ○                     | ○     |
|                          | ATAN(P)            | Single precision accuracy $\text{TAN}^{-1}$ operation          | ○                     | ○     |
|                          | DATAN(P)           |  | ○                     | ○     |
|                          | RAD(P)             | Single precision actual number angle → Radian conversion       | ○                     | ○     |
|                          | DRAD(P)            |  | ○                     | ○     |
|                          | DEG(P)             | Single precision actual number radian → Angle conversion       | ○                     | ○     |
|                          | DDEG(P)            |  | ○                     | ○     |
|                          | DESQR(P)           | Square root of single precision actual number                  | ○                     | ○     |
|                          | ESQRT(P)           |  | ○                     | ○     |
|                          | EXP(P)             | Index operation of single precision actual number              | ○                     | ○     |
|                          | DEXP(P)            |  | ○                     | ○     |
|                          | LOG(P)             | Inferior logarithm operation of single precision actual number | ○                     | ○     |
|                          | DLOGE(P)           |  | ○                     | ○     |
|                          | POW(P)             | Exponentiation operation of single precision actual number     | ○                     | ○     |
|                          | LOG10(P)           | Common logarithm operation of single precision actual number   | ○                     | ○     |
|                          | DLOG10(P)          |  | ○                     | ○     |
|                          | EMAX(P)            | Search for maximum value of single precision actual number     | ○                     | ○     |
|                          | EMIN(P)            | Search for minimum value of single precision actual number     | ○                     | ○     |
| Random number            | RND(P)             | Random number generation                                       | ○                     | ○     |
| Index register operation | ZPUSH(P)           | Collective saving of index register                            | ○                     | ○     |
|                          | ZPOP(P)            | Corrective return of index register                            | ○                     | ○     |
|                          | ZPUSH(P)           | Selection and saving of index register/long index register     | ○                     | ○     |
|                          | ZPOP(P)            | Selection and return of index register/long index register     | ○                     | ○     |
| Data control             | LIMIT(P)(_U)       | BIN 16-bit data upper-/lower-limit control                     | ○                     | ○     |
|                          | DLIMIT(P)(_U)      | BIN 32-bit data upper-/lower-limit control                     | ○                     | ○     |
|                          | BAND(P)(_U)        | BIN 16-bit data dead band control                              | ○                     | ○     |
|                          | DBAND(P)(_U)       | BIN 32-bit data dead band control                              | ○                     | ○     |
|                          | ZONE(P)(_U)        | BIN 16-bit data zone control                                   | ○                     | ○     |
|                          | DZONE(P)(_U)       | BIN 32-bit data zone control                                   | ○                     | ○     |

| Classification              | Instruction symbol | Function   | Compatible CPU module |       |
|-----------------------------|--------------------|--|-----------------------|-------|
|                             |                    |  | FX5U                  | FX5UC |
| Data control                | SCL(P)_U           | BIN 16-bit unit scaling (point-specific coordinate data) | ○                     | ○     |
|                             | DSCL(P)_U          | BIN 32-bit unit scaling (point-specific coordinate data) | ○                     | ○     |
|                             | SCL2(P)_U          | BIN 16-bit unit scaling (X-/Y-specific coordinate data)  | ○                     | ○     |
|                             | DSCL2(P)_U         | BIN 32-bit unit scaling (X-/Y-specific coordinate data)  | ○                     | ○     |
| Special timer               | TTMR               | Teaching timer   | ○                     | ○     |
|                             | STMR               | Special function timer                                   | ○                     | ○     |
| Special counter             | UDCNTF             | Signed 32-bit up/down counter                            | ○                     | ○     |
| Shortcut control            | ROTC               | Rotary table shortcut control                            | ○                     | ○     |
| Inclination signal          | RAMPF              | Control inclination signal                               | ○                     | ○     |
| Pulse system                | SPD                | Measurement of BIN 16-bit pulse density                  | ○                     | ○     |
|                             | DSPD               | Measurement of BIN 32-bit pulse density                  | ○                     | ○     |
|                             | PLSY               | BIN 16-bit pulse output                                  | ○                     | ○     |
|                             | DPLSY              | BIN 32-bit pulse output                                  | ○                     | ○     |
|                             | PWM                | BIN 16 pulse width modulation                            | ○                     | ○     |
|                             | DPWM               | BIN 32-bit pulse width modulation                        | ○                     | ○     |
| Matrix input                | MTR                | Matrix input   | ○                     | ○     |
| Initial state               | IST                | Initial state  | ○                     | ○     |
| Drum sequence               | ABSD               | BIN 16-bit data absolute method                          | ○                     | ○     |
|                             | DABSD              | BIN 32-bit data absolute method                          | ○                     | ○     |
|                             | INCD               | Relative method  | ○                     | ○     |
| Check code                  | CCD(P)             | Check code   | ○                     | ○     |
| Data processing instruction | SERMM(P)           | Data processing instruction                              | ○                     | ○     |
|                             | DSERMM(P)          | 32-bit data search                                       | ○                     | ○     |
|                             | SUM(P)             | 16-bit data bit check                                    | ○                     | ○     |
|                             | DSUM(P)            | 32-bit data bit check                                    | ○                     | ○     |
|                             | BON(P)             | Bit detection of 16-bit data                             | ○                     | ○     |
|                             | DBON(P)            | Bit detection of 32-bit data                             | ○                     | ○     |
|                             | MAX(P)_U           | Search for maximum value of 16-bit data                  | ○                     | ○     |
|                             | DMAX(P)_U          | Search for maximum value of 32-bit data                  | ○                     | ○     |
|                             | MIN(P)_U           | Search for minimum value of 16-bit data                  | ○                     | ○     |
|                             | DMIN(P)_U          | Search for minimum value of 32-bit data                  | ○                     | ○     |
|                             | SORTTBL(_U)        | 16-bit data sort   | ○                     | ○     |
|                             | SORTTBL2(_U)       | 16-bit data alignment 2                                  | ○                     | ○     |
|                             | DSORTTBL2(_U)      | 32-bit data alignment 2                                  | ○                     | ○     |
|                             | WSUM(P)_U          | 16-bit data total value calculation                      | ○                     | ○     |
|                             | DWSUM(P)_U         | 32-bit data total value calculation                      | ○                     | ○     |
|                             | MEAN(P)_U          | 16-bit data average value calculation                    | ○                     | ○     |
|                             | DMEAN(P)_U         | 32-bit data average value calculation                    | ○                     | ○     |
|                             | SQRT(P)            | Calculation of 16-bit square root                        | ○                     | ○     |
|                             | DSQRT(P)           | Calculation of 32-bit square root                        | ○                     | ○     |
|                             | CRC(P)             | CRC calculation  | ○                     | ○     |
| Indirect address read       | ADRSET(P)          | Indirect address read                                    | ○                     | ○     |

| Classification | Instruction symbol | Function  | Compatible CPU module |       |
|----------------|--------------------|---|-----------------------|-------|
|                |                    |   | FX5U                  | FX5UC |
| For clock      | TRD(P)             | Clock data read   | ○                     | ○     |
|                | TWR(P)             | Clock data write  | ○                     | ○     |
|                | TADD(P)            | Addition of clock data  | ○                     | ○     |
|                | TSUB(P)            | Subtraction of clock data                                       | ○                     | ○     |
|                | HTOS(P)            | 16-bit data conversion of time data (hour/minute/second→second) | ○                     | ○     |
|                | DHTOS(P)           | 32-bit data conversion of time data (hour/minute/second→second) | ○                     | ○     |
|                | STOH(P)            | 16-bit data conversion of time data (second→hour/minute/second) | ○                     | ○     |
|                | DSTOH(P)           | 32-bit data conversion of time data (second→hour/minute/second) | ○                     | ○     |
|                | LDDT\$=            | Date comparison LDDT (S1) = (S2)                                | ○                     | ○     |
|                | LDDT\$<>           | Date comparison LDDT (S1) <> (S2)                               | ○                     | ○     |
|                | LDDT\$>            | Date comparison LDDT (S1) > (S2)                                | ○                     | ○     |
|                | LDDT\$<=           | Date comparison LDDT (S1) <= (S2)                               | ○                     | ○     |
|                | LDDT\$<            | Date comparison LDDT (S1) < (S2)                                | ○                     | ○     |
|                | LDDT\$>=           | Date comparison LDDT (S1) >= (S2)                               | ○                     | ○     |
|                | ANDDT\$=           | Date comparison ANDDT (S1) = (S2)                               | ○                     | ○     |
|                | ANDDT\$<>          | Date comparison ANDDT (S1) <> (S2)                              | ○                     | ○     |
|                | ANDDT\$>           | Date comparison ANDDT (S1) > (S2)                               | ○                     | ○     |
|                | ANDDT\$<=          | Date comparison ANDDT (S1) <= (S2)                              | ○                     | ○     |
|                | ANDDT\$<           | Date comparison ANDDT (S1) < (S2)                               | ○                     | ○     |
|                | ANDDT\$>=          | Date comparison ANDDT (S1) >= (S2)                              | ○                     | ○     |
|                | ORDT\$=            | Date comparison ORDT (S1) = (S2)                                | ○                     | ○     |
|                | ORDT\$<>           | Date comparison ORDT (S1) <> (S2)                               | ○                     | ○     |
|                | ORDT\$>            | Date comparison ORDT (S1) > (S2)                                | ○                     | ○     |
|                | ORDT\$<=           | Date comparison ORDT (S1) <= (S2)                               | ○                     | ○     |
|                | ORDT\$<            | Date comparison ORDT (S1) < (S2)                                | ○                     | ○     |
|                | ORDT\$>=           | Date comparison ORDT (S1) >= (S2)                               | ○                     | ○     |
|                | LDTM\$=            | Time comparison LDTM (S1) = (S2)                                | ○                     | ○     |
|                | LDTM\$<>           | Time comparison LDTM (S1) <> (S2)                               | ○                     | ○     |
|                | LDTM\$>            | Time comparison LDTM (S1) > (S2)                                | ○                     | ○     |
|                | LDTM\$<=           | Time comparison LDTM (S1) <= (S2)                               | ○                     | ○     |
|                | LDTM\$<            | Time comparison LDTM (S1) < (S2)                                | ○                     | ○     |
|                | LDTM\$>=           | Time comparison LDTM (S1) >= (S2)                               | ○                     | ○     |
|                | ANDTM\$=           | Time comparison ANDTM (S1) = (S2)                               | ○                     | ○     |
|                | ANDTM\$<>          | Time comparison ANDTM (S1) <> (S2)                              | ○                     | ○     |
|                | ANDTM\$>           | Time comparison ANDTM (S1) > (S2)                               | ○                     | ○     |
|                | ANDTM\$<=          | Time comparison ANDTM (S1) <= (S2)                              | ○                     | ○     |
|                | ANDTM\$<           | Time comparison ANDTM (S1) < (S2)                               | ○                     | ○     |
|                | ANDTM\$>=          | Time comparison ANDTM (S1) >= (S2)                              | ○                     | ○     |
|                | ORTM\$=            | Time comparison ORTM (S1) = (S2)                                | ○                     | ○     |
|                | ORTM\$<>           | Time comparison ORTM (S1) <> (S2)                               | ○                     | ○     |
|                | ORTM\$>            | Time comparison ORTM (S1) > (S2)                                | ○                     | ○     |
|                | ORTM\$<=           | Time comparison ORTM (S1) <= (S2)                               | ○                     | ○     |
|                | ORTM\$<            | Time comparison ORTM (S1) < (S2)                                | ○                     | ○     |
|                | ORTM\$>=           | Time comparison ORTM (S1) >= (S2)                               | ○                     | ○     |
|                | TCMP(P)            | Clock data comparison   | ○                     | ○     |
|                | TZCP(P)            | Clock data bandwidth comparison                                 | ○                     | ○     |

| Classification     | Instruction symbol | Function  | Compatible CPU module |       |
|--------------------|--------------------|---|-----------------------|-------|
|                    |                    |   | FX5U                  | FX5UC |
| Timing measurement | DUTY               | Timing pulse generation                                   | ○                     | ○     |
|                    | HOURLM             | Hour meter (BIN 16-bit data)                              | ○                     | ○     |
|                    | DHOURLM            | Hour meter (BIN 32-bit data)                              | ○                     | ○     |
| Module access      | REF(P)             | I/O refresh   | ○                     | ○     |
|                    | RFS(P)             |   | ○                     | ○     |
|                    | FROM(P)            | Read of 1-word data from other module (16-bit specified)  | ○                     | ○     |
|                    | DFROM(P)           | Read of 2-word data from other module (16-bit specified)  | ○                     | ○     |
|                    | TO(P)              | Write of 1-word data from other module (16-bit specified) | ○                     | ○     |
|                    | DTO(P)             | Write of 2-word data from other module (16-bit specified) | ○                     | ○     |
|                    | FROMD(P)           | Read of 1-word data from other module (32-bit specified)  | ○                     | ○     |
|                    | DFROMD(P)          | Read of 2-word data from other module (32-bit specified)  | ○                     | ○     |
|                    | TOD(P)             | Write of 1-word data from other module (32-bit specified) | ○                     | ○     |
|                    | DTOD(P)            | Write of 2-word data from other module (32-bit specified) | ○                     | ○     |

## Step ladder instruction

| Classification | Instruction symbol | Function             | Compatible CPU module |       |
|----------------|--------------------|----------------------|-----------------------|-------|
|                |                    |                      | FX5U                  | FX5UC |
| Step ladder    | STL                | Start of step ladder | ○                     | ○     |
|                | RETSTL             | End of step ladder   | ○                     | ○     |

## Built-in Ethernet function instruction

| Classification                          | Instruction symbol | Function  | Compatible CPU module |       |
|---|--------------------|---|-----------------------|-------|
|   |                    |   | FX5U                  | FX5UC |
| Built-in Ethernet function instruction  | SP.SOCOPEN         | Connection establishment  | ○                     | ○     |
|   | SP.SOCCLOSE        | Connection disconnection  | ○                     | ○     |
| Socket Communication function           | SP.SOCRCV          | Read of received data during END processing                                   | ○                     | ○     |
|   | SP.SOCSND          | Data transmission   | ○                     | ○     |
|   | SP.SOCCINF         | Read of connection information  | ○                     | ○     |
|   | S(P).SOCRDATA      | Read of received data of socket communication                                 | ○                     | ○     |
| Communication protocol support function | SP.ECPRTCL         | Execution of registration protocol of communication protocol support function | ○                     | ○     |

## PID control instruction

| Classification | Instruction symbol | Function      | Compatible CPU module |       |
|----------------|--------------------|---------------|-----------------------|-------|
|                |                    |               | FX5U                  | FX5UC |
| PID control    | PID                | PID operation | ○                     | ○     |

## List of module dedicated instructions

| Classification     | Instruction symbol | Function   | Compatible CPU module |       |
|--------------------|--------------------|--|-----------------------|-------|
|                    |                    |  | FX5U                  | FX5UC |
| High speed counter | DHSCS              | 32-bit data comparison set                                     | ○                     | ○     |
|                    | DHSCR              | 32-bit comparison reset  | ○                     | ○     |
|                    | DHSZ               | 32-bit data bandwidth comparison                               | ○                     | ○     |
|                    | HIOEN(P)           | Start and stop of 16-bit data high speed input/output function | ○                     | ○     |
|                    | DHIOEN(P)          | Start and stop of 32-bit data high speed input/output function | ○                     | ○     |

| Classification                          | Instruction symbol | Function   | Compatible CPU module |       |
|---|--------------------|--|-----------------------|-------|
|   |                    |  | FX5U                  | FX5UC |
| High-speed transfer of current value    | HCMOV(P)           | High-speed transfer of 16-bit data current value                   | ○                     | ○     |
|   | DHCMOV(P)          | High-speed transfer of 32-bit data current value                   | ○                     | ○     |
| External device communication           | RS2                | Serial data transfer 2   | ○                     | ○     |
| Inverter communication                  | IVCK               | Inverter operation monitor   | ○                     | ○     |
|   | IVDR               | Inverter operation control   | ○                     | ○     |
|   | IVRD               | Inverter parameter read  | ○                     | ○     |
|   | IVWR               | Inverter parameter write   | ○                     | ○     |
|   | IVBWR              | Inverter parameter batch write                                     | ○                     | ○     |
|   | IVMC               | Multiple commands of inverter                                      | ○                     | ○     |
| MODBUS <sup>®</sup>                     | ADPRW              | MODBUS data read/write   | ○                     | ○     |
| Communication protocol support function | S(P).CPRTCL        | Execution of communication protocol registered by engineering tool | ○                     | ○     |
| Positioning                             | DSZR               | Home position return with 16-bit data dog search                   | ○                     | ○     |
|   | DDSZR              | Home position return with 32-bit data dog search                   | ○                     | ○     |
|   | DVIT               | 16-bit data interrupt positioning                                  | ○                     | ○     |
|   | DDVIT              | 32-bit data interrupt positioning                                  | ○                     | ○     |
|   | TBL                | Positioning by 1-table operation                                   | ○                     | ○     |
|   | DRVITBL            | Positioning by multiple-table operation                            | ○                     | ○     |
|   | DRVMUL             | Multiple axis simultaneous drive positioning                       | ○                     | ○     |
|   | DABS               | 32-bit data ABS current value read                                 | ○                     | ○     |
|   | PLSV               | 16-bit data variable speed pulse                                   | ○                     | ○     |
|   | DPLSV              | 32-bit data variable speed pulse                                   | ○                     | ○     |
|   | DRVI               | 16-bit data relative positioning                                   | ○                     | ○     |
|   | DDRVI              | 32-bit data relative positioning                                   | ○                     | ○     |
|   | DRVA               | 16-bit data absolute positioning                                   | ○                     | ○     |
|   | DDRVA              | 32-bit data absolute positioning                                   | ○                     | ○     |
| BFM split read/write                    | RBFM               | BFM split read   | ○                     | ○     |
|   | WBFM               | BFM split write  | ○                     | ○     |

# Appendix 1.2 Special Relay List (SM)

The PLC contains internal relays with fixed specifications, so it cannot be used in the program like a conventional internal relay.

## Diagnostic information

The special relays for diagnostic information are shown below.

R: Read only, R/W: Read/Write

| No.   | Name   | Description   | R/W |
|-------|--|---|-----|
| SM0   | Latest self diagnostics error (including annunciator ON)     | OFF: No error<br>ON: Error                                    | R   |
| SM1   | Latest self diagnostics error (not including annunciator On) | OFF: No self-diagnosis errors<br>ON: Self-diagnosis error     | R   |
| SM50  | Error reset  | OFF→ON: Error reset request<br>ON→OFF: Error reset completion | R/W |
| SM51  | Battery low latch  | OFF: Normal<br>ON: Battery low                                | R   |
| SM52  | Battery low  | OFF: Normal<br>ON: Battery low                                | R   |
| SM53  | AC/DC DOWN   | OFF: No AC/DC down detection<br>ON: AC/DC down is detected    | R   |
| SM56  | Instruction execution fault                                  | OFF: Normal<br>ON: Operation error                            | R   |
| SM61  | I/O module verify error                                      | OFF: Normal<br>ON: Error                                      | R   |
| SM62  | Annunciator  | OFF: Not detected<br>ON: Detected                             | R/W |
| SM80  | Detailed information 1: Flag in use                          | OFF: Not used<br>ON: In use                                   | R   |
| SM112 | Detailed information 2: Flag in use                          | OFF: Not used<br>ON: In use                                   | R/W |

## System information

The special relays for system information are shown below.

R: Read only, R/W: Read/Write

| No.   | Name                    | Description                                    | R/W |
|-------|-------------------------|--|-----|
| SM203 | STOP contact            | OFF: Other than STOP state<br>ON: STOP state   | R   |
| SM204 | PAUSE contact           | OFF: Other than PAUSE state<br>ON: PAUSE state | R   |
| SM210 | Clock data set request  | OFF→ON: Set Request<br>ON→OFF: Set completed   | R   |
| SM211 | Clock data set error    | OFF: No error<br>ON: Error                     | R   |
| SM213 | Clock data read request | OFF: Ignored<br>ON: Read request               | R   |

## System clock

The special relay about system clock is shown below.

R: Read only, R/W: Read/Write

| No.   | Name                             | Description                               | R/W |
|-------|----------------------------------|---|-----|
| SM400 | Always ON                        | ON —————<br>OFF                           | R   |
| SM401 | Always OFF                       | ON<br>OFF —————                           | R   |
| SM402 | After RUN, ON for one scan only  | ON ———→ 1 scan<br>OFF ←——                 | R   |
| SM403 | After RUN, OFF for one scan only | ON ←—— 1 scan<br>OFF ———→                 | R   |
| SM409 | 0.01 second clock                | 0.005 s ——— 0.005 s ———                   | R   |
| SM410 | 0.1 second clock                 | 0.05 s ——— 0.05 s ———                     | R   |
| SM411 | 0.2 second clock                 | 0.1 s ——— 0.1 s ———                       | R   |
| SM412 | 1 second clock                   | 0.5 s ——— 0.5 s ———                       | R   |
| SM413 | 2 second clock                   | 1 s ——— 1 s ———                           | R   |
| SM414 | 2n second clock                  | n s ——— n s ———                           | R   |
| SM415 | 2n ms clock                      | n (ms) ——— n (ms) ———                     | R   |
| SM420 | Timing clock output 0            | ← n2 scan ——— n2 scan —→<br>← n1 scan ——— | R   |
| SM421 | Timing clock output 1            | ← n2 scan ——— n2 scan —→<br>← n1 scan ——— | R   |
| SM422 | Timing clock output 2            | ← n2 scan ——— n2 scan —→<br>← n1 scan ——— | R   |
| SM423 | Timing clock output 3            | ← n2 scan ——— n2 scan —→<br>← n1 scan ——— | R   |
| SM424 | Timing clock output 4            | ← n2 scan ——— n2 scan —→<br>← n1 scan ——— | R   |

## Drive information

The special relays for drive information are shown below.

R: Read only, R/W: Read/Write

| No.   | Name   | Description   | R/W |
|-------|--|---|-----|
| SM600 | Memory card usable                           | OFF: Unusable<br>ON: Use enabled  | R   |
| SM601 | Memory card protect                          | OFF: Not protected<br>ON: Protected   | R   |
| SM603 | Memory card insertion                        | OFF: No drive 2<br>ON: Drive 2 present  | R   |
| SM605 | Memory card interchange protect              | OFF: Remove/insert enabled<br>ON: Remove/insert prohibited  | R/W |
| SM606 | Memory card disable request                  | OFF: Clear command<br>ON: Command   | R/W |
| SM607 | Memory card disable status                   | OFF: Not disabled by SD memory card forced stop request<br>ON: Disabled by SD memory card forced stop request | R   |
| SM632 | Data memory write error detection            | OFF: Write not executed/normal<br>ON: Write error   | R   |
| SM633 | Data memory writing                          | OFF: Write not executed<br>ON: Writing  | R   |
| SM634 | Data memory write count error detection flag | OFF: Overwrite count is less than 20,000<br>ON: Overwrite count is 20,000 or more                             | R   |

## Instruction related

The special relays related to instruction execution are shown below.

R: Read only, R/W: Read/Write

| No.   | Name                                      | Description   | R/W |
|-------|---|---|-----|
| SM700 | Carry flag                                | OFF: Carry OFF<br>ON: Carry ON                                | R   |
| SM701 | Output characters selection               | OFF: NULL code output<br>ON: No change                        | R/W |
| SM703 | Sort order                                | OFF: Ascending order<br>ON: Descending order                  | R/W |
| SM704 | Block comparison                          | OFF: Non-match found<br>ON: All match                         | R   |
| SM709 | DT/TM instruction improper data detection | OFF: Improper data not detected<br>ON: Improper data detected | R/W |

## FX high-speed input/output

The special relays for FX high-speed input/output are shown below.

R: Read only, R/W: Read/Write

| No.    | Name                               | Description                   | R/W |
|--------|------------------------------------|-------------------------------|-----|
| SM4500 | High-speed counter operation (CH1) | OFF: Stopped<br>ON: Operation | R   |
| SM4501 | High-speed counter operation (CH2) | OFF: Stopped<br>ON: Operation | R   |
| SM4502 | High-speed counter operation (CH3) | OFF: Stopped<br>ON: Operation | R   |
| SM4503 | High-speed counter operation (CH4) | OFF: Stopped<br>ON: Operation | R   |
| SM4504 | High-speed counter operation (CH5) | OFF: Stopped<br>ON: Operation | R   |
| SM4505 | High-speed counter operation (CH6) | OFF: Stopped<br>ON: Operation | R   |
| SM4506 | High-speed counter operation (CH7) | OFF: Stopped<br>ON: Operation | R   |



| No.    | Name   | Description                           | R/W |
|--------|--|---------------------------------------|-----|
| SM4507 | High-speed counter operation (CH8)   | OFF: Stopped<br>ON: Operation         | R   |
| SM4516 | High-speed counter pulse density/Rotation speed measurement (CH1)                      | OFF: Stopped<br>ON: Measurement       | R   |
| SM4517 | High-speed counter pulse density/Rotation speed measurement (CH2)                      | OFF: Stopped<br>ON: Measurement       | R   |
| SM4518 | High-speed counter pulse density/Rotation speed measurement (CH3)                      | OFF: Stopped<br>ON: Measurement       | R   |
| SM4519 | High-speed counter pulse density/Rotation speed measurement (CH4)                      | OFF: Stopped<br>ON: Measurement       | R   |
| SM4520 | High-speed counter pulse density/Rotation speed measurement (CH5)                      | OFF: Stopped<br>ON: Measurement       | R   |
| SM4521 | High-speed counter pulse density/Rotation speed measurement (CH6)                      | OFF: Stopped<br>ON: Measurement       | R   |
| SM4522 | High-speed counter pulse density/Rotation speed measurement (CH7)                      | OFF: Stopped<br>ON: Measurement       | R   |
| SM4523 | High-speed counter pulse density/Rotation speed measurement (CH8)                      | OFF: Stopped<br>ON: Measurement       | R   |
| SM4532 | High-speed counter overflow (CH1)  | OFF: No error<br>ON: Overflow         | R/W |
| SM4533 | High-speed counter overflow (CH2)  | OFF: No error<br>ON: Overflow         | R/W |
| SM4534 | High-speed counter overflow (CH3)  | OFF: No error<br>ON: Overflow         | R/W |
| SM4535 | High-speed counter overflow (CH4)  | OFF: No error<br>ON: Overflow         | R/W |
| SM4536 | High-speed counter overflow (CH5)  | OFF: No error<br>ON: Overflow         | R/W |
| SM4537 | High-speed counter overflow (CH6)  | OFF: No error<br>ON: Overflow         | R/W |
| SM4538 | High-speed counter overflow (CH7)  | OFF: No error<br>ON: Overflow         | R/W |
| SM4539 | High-speed counter overflow (CH8)  | OFF: No error<br>ON: Overflow         | R/W |
| SM4548 | High-speed counter underflow (CH1)   | OFF: No error<br>ON: Underflow        | R/W |
| SM4549 | High-speed counter underflow (CH2)   | OFF: No error<br>ON: Underflow        | R/W |
| SM4550 | High-speed counter underflow (CH3)   | OFF: No error<br>ON: Underflow        | R/W |
| SM4551 | High-speed counter underflow (CH4)   | OFF: No error<br>ON: Underflow        | R/W |
| SM4552 | High-speed counter underflow (CH5)   | OFF: No error<br>ON: Underflow        | R/W |
| SM4553 | High-speed counter underflow (CH6)   | OFF: No error<br>ON: Underflow        | R/W |
| SM4554 | High-speed counter underflow (CH7)   | OFF: No error<br>ON: Underflow        | R/W |
| SM4555 | High-speed counter underflow (CH8)   | OFF: No error<br>ON: Underflow        | R/W |
| SM4564 | High-speed counter count direction monitor (CH1)<br>(1-phase 2-input, 2-phase 2-input) | OFF: Up-counting<br>ON: Down-counting | R   |
| SM4565 | High-speed counter count direction monitor (CH2)<br>(1-phase 2-input, 2-phase 2-input) | OFF: Up-counting<br>ON: Down-counting | R   |
| SM4566 | High-speed counter count direction monitor (CH3)<br>(1-phase 2-input, 2-phase 2-input) | OFF: Up-counting<br>ON: Down-counting | R   |
| SM4567 | High-speed counter count direction monitor (CH4)<br>(1-phase 2-input, 2-phase 2-input) | OFF: Up-counting<br>ON: Down-counting | R   |
| SM4568 | High-speed counter count direction monitor (CH5)<br>(1-phase 2-input, 2-phase 2-input) | OFF: Up-counting<br>ON: Down-counting | R   |

| No.    | Name   | Description                               | R/W |
|--------|--|---|-----|
| SM4569 | High-speed counter count direction monitor (CH6)<br>(1-phase 2-input, 2-phase 2-input) | OFF: Up-counting<br>ON: Down-counting     | R   |
| SM4570 | High-speed counter count direction monitor (CH7)<br>(1-phase 2-input, 2-phase 2-input) | OFF: Up-counting<br>ON: Down-counting     | R   |
| SM4571 | High-speed counter count direction monitor (CH8)<br>(1-phase 2-input, 2-phase 2-input) | OFF: Up-counting<br>ON: Down-counting     | R   |
| SM4580 | High-speed counter count switching (CH1)<br>(1-phase 1-input S/W)                      | OFF: Up-counting<br>ON: Down-counting     | R/W |
| SM4581 | High-speed counter count switching (CH2)<br>(1-phase 1-input S/W)                      | OFF: Up-counting<br>ON: Down-counting     | R/W |
| SM4582 | High-speed counter count switching (CH3)<br>(1-phase 1-input S/W)                      | OFF: Up-counting<br>ON: Down-counting     | R/W |
| SM4583 | High-speed counter count switching (CH4)<br>(1-phase 1-input S/W)                      | OFF: Up-counting<br>ON: Down-counting     | R/W |
| SM4584 | High-speed counter count switching (CH5)<br>(1-phase 1-input S/W)                      | OFF: Up-counting<br>ON: Down-counting     | R/W |
| SM4585 | High-speed counter count switching (CH6)<br>(1-phase 1-input S/W)                      | OFF: Up-counting<br>ON: Down-counting     | R/W |
| SM4586 | High-speed counter count switching (CH7)<br>(1-phase 1-input S/W)                      | OFF: Up-counting<br>ON: Down-counting     | R/W |
| SM4587 | High-speed counter count switching (CH8)<br>(1-phase 1-input S/W)                      | OFF: Up-counting<br>ON: Down-counting     | R/W |
| SM4596 | High-speed counter preset input logic (CH1)  | OFF: Positive logic<br>ON: Negative logic | R/W |
| SM4597 | High-speed counter preset input logic (CH2)  | OFF: Positive logic<br>ON: Negative logic | R/W |
| SM4598 | High-speed counter preset input logic (CH3)  | OFF: Positive logic<br>ON: Negative logic | R/W |
| SM4599 | High-speed counter preset input logic (CH4)  | OFF: Positive logic<br>ON: Negative logic | R/W |
| SM4600 | High-speed counter preset input logic (CH5)  | OFF: Positive logic<br>ON: Negative logic | R/W |
| SM4601 | High-speed counter preset input logic (CH6)  | OFF: Positive logic<br>ON: Negative logic | R/W |
| SM4602 | High-speed counter preset input logic (CH7)  | OFF: Positive logic<br>ON: Negative logic | R/W |
| SM4603 | High-speed counter preset input logic (CH8)  | OFF: Positive logic<br>ON: Negative logic | R/W |
| SM4612 | High-speed counter preset input comparison (CH1)                                       | OFF: Disabled<br>ON: Enabled              | R/W |
| SM4613 | High-speed counter preset input comparison (CH2)                                       | OFF: Disabled<br>ON: Enabled              | R/W |
| SM4614 | High-speed counter preset input comparison (CH3)                                       | OFF: Disabled<br>ON: Enabled              | R/W |
| SM4615 | High-speed counter preset input comparison (CH4)                                       | OFF: Disabled<br>ON: Enabled              | R/W |
| SM4616 | High-speed counter preset input comparison (CH5)                                       | OFF: Disabled<br>ON: Enabled              | R/W |
| SM4617 | High-speed counter preset input comparison (CH6)                                       | OFF: Disabled<br>ON: Enabled              | R/W |
| SM4618 | High-speed counter preset input comparison (CH7)                                       | OFF: Disabled<br>ON: Enabled              | R/W |
| SM4619 | High-speed counter preset input comparison (CH8)                                       | OFF: Disabled<br>ON: Enabled              | R/W |
| SM4628 | High-speed counter enable input logic (CH1)  | OFF: Positive logic<br>ON: Negative logic | R/W |
| SM4629 | High-speed counter enable input logic (CH2)  | OFF: Positive logic<br>ON: Negative logic | R/W |
| SM4630 | High-speed counter enable input logic (CH3)  | OFF: Positive logic<br>ON: Negative logic | R/W |

| No.    | Name  | Description  | R/W |
|--------|---|--|-----|
| SM4631 | High-speed counter enable input logic (CH4)                                   | OFF: Positive logic<br>ON: Negative logic  | R/W |
| SM4632 | High-speed counter enable input logic (CH5)                                   | OFF: Positive logic<br>ON: Negative logic  | R/W |
| SM4633 | High-speed counter enable input logic (CH6)                                   | OFF: Positive logic<br>ON: Negative logic  | R/W |
| SM4634 | High-speed counter enable input logic (CH7)                                   | OFF: Positive logic<br>ON: Negative logic  | R/W |
| SM4635 | High-speed counter enable input logic (CH8)                                   | OFF: Positive logic<br>ON: Negative logic  | R/W |
| SM4644 | High-speed counter ring length (CH1)  | OFF: Disabled<br>ON: Enabled   | R/W |
| SM4645 | High-speed counter ring length (CH2)  | OFF: Disabled<br>ON: Enabled   | R/W |
| SM4646 | High-speed counter ring length (CH3)  | OFF: Disabled<br>ON: Enabled   | R/W |
| SM4647 | High-speed counter ring length (CH4)  | OFF: Disabled<br>ON: Enabled   | R/W |
| SM4648 | High-speed counter ring length (CH5)  | OFF: Disabled<br>ON: Enabled   | R/W |
| SM4649 | High-speed counter ring length (CH6)  | OFF: Disabled<br>ON: Enabled   | R/W |
| SM4650 | High-speed counter ring length (CH7)  | OFF: Disabled<br>ON: Enabled   | R/W |
| SM4651 | High-speed counter ring length (CH8)  | OFF: Disabled<br>ON: Enabled   | R/W |
| SM4980 | High-speed comparison table (high-speed compare instruction) operation        | OFF: Stopped<br>ON: Operation  | R   |
| SM4982 | High-speed comparison table (high-speed compare instruction) error occurrence | OFF: No error<br>ON: Error   | R/W |
| SM5000 | Multi-point output high-speed comparison table operation                      | OFF: Stopped<br>ON: Operation  | R   |
| SM5001 | Multi-point output high-speed comparison table completion                     | OFF: Not completed<br>ON: Completion   | R/W |
| SM5020 | Pulse width measurement operation (CH1)                                       | OFF: Stopped<br>ON: Operation  | R   |
| SM5021 | Pulse width measurement operation (CH2)                                       | OFF: Stopped<br>ON: Operation  | R   |
| SM5022 | Pulse width measurement operation (CH3)                                       | OFF: Stopped<br>ON: Operation  | R   |
| SM5023 | Pulse width measurement operation (CH4)                                       | OFF: Stopped<br>ON: Operation  | R   |
| SM5036 | Pulse width measurement period measurement complete (CH1)                     | OFF: Cycle measurement not completed<br>ON: Cycle measurement completion             | R   |
| SM5037 | Pulse width measurement period measurement complete (CH2)                     | OFF: Cycle measurement not completed<br>ON: Cycle measurement completion             | R   |
| SM5038 | Pulse width measurement period measurement complete (CH3)                     | OFF: Cycle measurement not completed<br>ON: Cycle measurement completion             | R   |
| SM5039 | Pulse width measurement period measurement complete (CH4)                     | OFF: Cycle measurement not completed<br>ON: Cycle measurement completion             | R   |
| SM5052 | Pulse width measurement pulse width measurement complete (CH1)                | OFF: Pulse width measurement not completed<br>ON: Pulse width measurement completion | R   |
| SM5053 | Pulse width measurement pulse width measurement complete (CH2)                | OFF: Pulse width measurement not completed<br>ON: Pulse width measurement completion | R   |
| SM5054 | Pulse width measurement pulse width measurement complete (CH3)                | OFF: Pulse width measurement not completed<br>ON: Pulse width measurement completion | R   |
| SM5055 | Pulse width measurement pulse width measurement complete (CH4)                | OFF: Pulse width measurement not completed<br>ON: Pulse width measurement completion | R   |
| SM5068 | Pulse width measurement mode (CH1)  | OFF: Always measurement mode<br>ON: 1 time measurement mode                          | R/W |

| No.    | Name  | Description  | R/W |
|--------|---|--|-----|
| SM5069 | Pulse width measurement mode (CH2)                        | OFF: Always measurement mode<br>ON: 1 time measurement mode                            | R/W |
| SM5070 | Pulse width measurement mode (CH3)                        | OFF: Always measurement mode<br>ON: 1 time measurement mode                            | R/W |
| SM5071 | Pulse width measurement mode (CH4)                        | OFF: Always measurement mode<br>ON: 1 time measurement mode                            | R/W |
| SM5300 | PWM function operation (CH1)                              | OFF: Stopped<br>ON: Operation  | R   |
| SM5301 | PWM function operation (CH2)                              | OFF: Stopped<br>ON: Operation  | R   |
| SM5302 | PWM function operation (CH3)                              | OFF: Stopped<br>ON: Operation  | R   |
| SM5303 | PWM function operation (CH4)                              | OFF: Stopped<br>ON: Operation  | R   |
| SM5500 | Positioning instruction activation (axis 1)               | OFF: Stopped<br>ON: Operation  | R   |
| SM5501 | Positioning instruction activation (axis 2)               | OFF: Stopped<br>ON: Operation  | R   |
| SM5502 | Positioning instruction activation (axis 3)               | OFF: Stopped<br>ON: Operation  | R   |
| SM5503 | Positioning instruction activation (axis 4)               | OFF: Stopped<br>ON: Operation  | R   |
| SM5516 | Positioning pulse output monitor (axis 1)                 | OFF: Stopped<br>ON: Output   | R   |
| SM5517 | Positioning pulse output monitor (axis 2)                 | OFF: Stopped<br>ON: Output   | R   |
| SM5518 | Positioning pulse output monitor (axis 3)                 | OFF: Stopped<br>ON: Output   | R   |
| SM5519 | Positioning pulse output monitor (axis 4)                 | OFF: Stopped<br>ON: Output   | R   |
| SM5532 | Positioning error (axis 1)                                | OFF: No error<br>ON: Error   | R/W |
| SM5533 | Positioning error (axis 2)                                | OFF: No error<br>ON: Error   | R/W |
| SM5534 | Positioning error (axis 3)                                | OFF: No error<br>ON: Error   | R/W |
| SM5535 | Positioning error (axis 4)                                | OFF: No error<br>ON: Error   | R/W |
| SM5580 | Positioning table shift instructions (axis 1)             | OFF: No table shift<br>ON: Table shift start   | R/W |
| SM5581 | Positioning table shift instructions (axis 2)             | OFF: No table shift<br>ON: Table shift start   | R/W |
| SM5582 | Positioning table shift instructions (axis 3)             | OFF: No table shift<br>ON: Table shift start   | R/W |
| SM5583 | Positioning table shift instructions (axis 4)             | OFF: No table shift<br>ON: Table shift start   | R/W |
| SM5596 | Positioning remaining distance operation enabled (axis 1) | OFF: Remaining distance operation disabled<br>ON: Remaining distance operation enabled | R/W |
| SM5597 | Positioning remaining distance operation enabled (axis 2) | OFF: Remaining distance operation disabled<br>ON: Remaining distance operation enabled | R/W |
| SM5598 | Positioning remaining distance operation enabled (axis 3) | OFF: Remaining distance operation disabled<br>ON: Remaining distance operation enabled | R/W |
| SM5599 | Positioning remaining distance operation enabled (axis 4) | OFF: Remaining distance operation disabled<br>ON: Remaining distance operation enabled | R/W |
| SM5612 | Positioning remaining distance operation start (axis 1)   | OFF: Remaining distance operation standby<br>ON: Remaining distance operation start    | R/W |
| SM5613 | Positioning remaining distance operation start (axis 2)   | OFF: Remaining distance operation standby<br>ON: Remaining distance operation start    | R/W |
| SM5614 | Positioning remaining distance operation start (axis 3)   | OFF: Remaining distance operation standby<br>ON: Remaining distance operation start    | R/W |

| No.    | Name   | Description   | R/W |
|--------|--|---|-----|
| SM5615 | Positioning remaining distance operation start (axis 4)                                    | OFF: Remaining distance operation standby<br>ON: Remaining distance operation start                       | R/W |
| SM5628 | Positioning pulse output stop command (axis 1)   | OFF: Pulse output is not stopped<br>ON: Pulse output immediate stop                                       | R/W |
| SM5629 | Positioning pulse output stop command (axis 2)   | OFF: Pulse output is not stopped<br>ON: Pulse output immediate stop                                       | R/W |
| SM5630 | Positioning pulse output stop command (axis 3)   | OFF: Pulse output is not stopped<br>ON: Pulse output immediate stop                                       | R/W |
| SM5631 | Positioning pulse output stop command (axis 4)   | OFF: Pulse output is not stopped<br>ON: Pulse output immediate stop                                       | R/W |
| SM5644 | Positioning pulse decelerates stop command (axis 1)<br>(With remaining distance operation) | OFF: Pulse output is not stopped<br>ON: Pulse output decelerates stop                                     | R/W |
| SM5645 | Positioning pulse decelerates stop command (axis 2)<br>(With remaining distance operation) | OFF: Pulse output is not stopped<br>ON: Pulse output decelerates stop                                     | R/W |
| SM5646 | Positioning pulse decelerates stop command (axis 3)<br>(With remaining distance operation) | OFF: Pulse output is not stopped<br>ON: Pulse output decelerates stop                                     | R/W |
| SM5647 | Positioning pulse decelerates stop command (axis 4)<br>(With remaining distance operation) | OFF: Pulse output is not stopped<br>ON: Pulse output decelerates stop                                     | R/W |
| SM5660 | Positioning forward rotation limit (axis 1)  | OFF: Forward rotation limit OFF<br>ON: Forward rotation limit ON  | R/W |
| SM5661 | Positioning forward rotation limit (axis 2)  | OFF: Forward rotation limit OFF<br>ON: Forward rotation limit ON  | R/W |
| SM5662 | Positioning forward rotation limit (axis 3)  | OFF: Forward rotation limit OFF<br>ON: Forward rotation limit ON  | R/W |
| SM5663 | Positioning forward rotation limit (axis 4)  | OFF: Forward rotation limit OFF<br>ON: Forward rotation limit ON  | R/W |
| SM5676 | Positioning reverse rotation limit (axis 1)  | OFF: Reverse rotation limit OFF<br>ON: Reverse rotation limit ON  | R/W |
| SM5677 | Positioning reverse rotation limit (axis 2)  | OFF: Reverse rotation limit OFF<br>ON: Reverse rotation limit ON  | R/W |
| SM5678 | Positioning reverse rotation limit (axis 3)  | OFF: Reverse rotation limit OFF<br>ON: Reverse rotation limit ON  | R/W |
| SM5679 | Positioning reverse rotation limit (axis 4)  | OFF: Reverse rotation limit OFF<br>ON: Reverse rotation limit ON  | R/W |
| SM5772 | Positioning rotational direction (axis 1)  | OFF: Forward rotation (Current address increases)<br>ON: Reverse rotation (Current address increases)     | R/W |
| SM5773 | Positioning rotational direction (axis 2)  | OFF: Forward rotation (Current address increases)<br>ON: Reverse rotation (Current address increases)     | R/W |
| SM5774 | Positioning rotational direction (axis 3)  | OFF: Forward rotation (Current address increases)<br>ON: Reverse rotation (Current address increases)     | R/W |
| SM5775 | Positioning rotational direction (axis 4)  | OFF: Forward rotation (Current address increases)<br>ON: Reverse rotation (Current address increases)     | R/W |
| SM5804 | Positioning zero return direction (axis 1)   | OFF: Zero return start (Reverse rotation direction)<br>ON: Zero return start (Forward rotation direction) | R/W |
| SM5805 | Positioning zero return direction (axis 2)   | OFF: Zero return start (Reverse rotation direction)<br>ON: Zero return start (Forward rotation direction) | R/W |
| SM5806 | Positioning zero return direction (axis 3)   | OFF: Zero return start (Reverse rotation direction)<br>ON: Zero return start (Forward rotation direction) | R/W |
| SM5807 | Positioning zero return direction (axis 4)   | OFF: Zero return start (Reverse rotation direction)<br>ON: Zero return start (Forward rotation direction) | R/W |
| SM5820 | Positioning clear signal function (axis 1)   | OFF: Clear signal disabled<br>ON: Clear signal enabled  | R/W |
| SM5821 | Positioning clear signal function (axis 2)   | OFF: Clear signal disabled<br>ON: Clear signal enabled  | R/W |
| SM5822 | Positioning clear signal function (axis 3)   | OFF: Clear signal disabled<br>ON: Clear signal enabled  | R/W |
| SM5823 | Positioning clear signal function (axis 4)   | OFF: Clear signal disabled<br>ON: Clear signal enabled  | R/W |
| SM5868 | Positioning zero-point signal count start (axis 1)   | OFF: Near point DOG backward end<br>ON: Near point DOG forward end  | R/W |

| No.    | Name   | Description  | R/W |
|--------|--|--|-----|
| SM5869 | Positioning zero-point signal count start (axis 2) | OFF: Near point DOG backward end<br>ON: Near point DOG forward end | R/W |
| SM5870 | Positioning zero-point signal count start (axis 3) | OFF: Near point DOG backward end<br>ON: Near point DOG forward end | R/W |
| SM5871 | Positioning zero-point signal count start (axis 4) | OFF: Near point DOG backward end<br>ON: Near point DOG forward end | R/W |

## Built-in analog

The special relays for built-in analog are shown below.

R: Read only, R/W: Read/Write

| No.    | Name   | Description   | R/W |
|--------|--|---|-----|
| SM6020 | CH1 A/D conversion completed flag                    | OFF: A/D conversion not completed<br>ON: A/D conversion completed | R   |
| SM6021 | CH1 A/D conversion enable/disable setting            | OFF: A/D conversion enable<br>ON: A/D conversion disable          | R/W |
| SM6022 | CH1 Over scaling detection flag                      | OFF: No over scaling<br>ON: Over Scaling                          | R   |
| SM6024 | CH1 Over scaling over detection setting              | OFF: Enable<br>ON: Disable  | R/W |
| SM6025 | CH1 Maximum value/minimum value reset completed flag | OFF: Reset not completed<br>ON: Reset completed                   | R   |
| SM6026 | CH1 Maximum value reset request                      | OFF: No reset request<br>ON: Reset request                        | R   |
| SM6027 | CH1 Minimum value reset request                      | OFF: No reset request<br>ON: Reset request                        | R   |
| SM6028 | CH1 A/D scaling enable/disable setting               | OFF: Enable<br>ON: Disable  | R/W |
| SM6029 | CH1 Digital clipping enable/disable setting          | OFF: Enable<br>ON: Disable  | R/W |
| SM6031 | CH1 Warning output flag (Process alarm upper limit)  | OFF: No alarm<br>ON: Alarm  | R   |
| SM6032 | CH1 Warning output flag (Process alarm lower limit)  | OFF: No alarm<br>ON: Alarm  | R   |
| SM6033 | CH1 Warning output setting (Process alarm)           | OFF: Enabled<br>ON: Disabled                                      | R/W |
| SM6057 | CH1 A/D alarm clear request                          | OFF: No clear request<br>ON: Clear request                        | R/W |
| SM6058 | CH1 A/D alarm flag                                   | OFF: No alarm<br>ON: Alarm  | R   |
| SM6059 | CH1 A/D error flag                                   | OFF: No error<br>ON: Error  | R   |
| SM6060 | CH2 A/D conversion completed flag                    | OFF: A/D conversion not completed<br>ON: A/D conversion completed | R   |
| SM6061 | CH2 A/D conversion enable/disable setting            | OFF: A/D conversion enable<br>ON: A/D conversion disable          | R/W |
| SM6062 | CH2 Over scaling detection flag                      | OFF: No over scaling<br>ON: Over scaling                          | R   |
| SM6064 | CH2 Over scaling over detection                      | OFF: Enable<br>ON: Disable  | R/W |
| SM6065 | CH2 Maximum value/minimum value reset completed flag | OFF: Reset not completed<br>ON: Reset completed                   | R   |
| SM6066 | CH2 Maximum value reset request                      | OFF: No reset request<br>ON: Reset request                        | R   |
| SM6067 | CH2 Minimum value reset request                      | OFF: No reset request<br>ON: Reset request                        | R   |
| SM6068 | CH2 A/D scaling enable/disable setting               | OFF: Enable<br>ON: Disable  | R/W |
| SM6069 | CH2 Digital clipping enable/disable setting          | OFF: Enable<br>ON: Disable  | R/W |

| No.    | Name  | Description  | R/W |
|--------|---|--|-----|
| SM6071 | CH2 Warning output flag (Process alarm upper limit) | OFF: No alarm<br>ON: Alarm                               | R   |
| SM6072 | CH2 Warning output flag (Process alarm lower limit) | OFF: No alarm<br>ON: Alarm                               | R   |
| SM6073 | CH2 Warning output setting (Process alarm)          | OFF: Enabled<br>ON: Disabled                             | R/W |
| SM6097 | CH2 A/D alarm clear request                         | OFF: No clear request<br>ON: Clear request               | R/W |
| SM6098 | CH2 A/D alarm flag                                  | OFF: No alarm<br>ON: Alarm                               | R/W |
| SM6099 | CH2 A/D error flag                                  | OFF: No error<br>ON: Error                               | R/W |
| SM6180 | D/A conversion enable/disable setting               | OFF: D/A conversion enable<br>ON: D/A conversion disable | R/W |
| SM6181 | D/A output enable/disable                           | OFF: Output enable<br>ON: Output disable                 | R/W |
| SM6188 | D/A scaling enable/disable setting                  | OFF: Enable<br>ON: Disable                               | R/W |
| SM6191 | Warning output upper limit value flag               | OFF: No alarm<br>ON: Alarm                               | R   |
| SM6192 | Warning output lower limit value flag               | OFF: No alarm<br>ON: Alarm                               | R   |
| SM6193 | Warning output setting                              | OFF: Disabled<br>ON: Enabled                             | R/W |
| SM6217 | D/A alarm clear request                             | OFF: No clear request<br>ON: Clear request               | R/W |
| SM6218 | D/A alarm flag                                      | OFF: No alarm<br>ON: Alarm                               | R   |
| SM6219 | D/A error flag                                      | OFF: No error<br>ON: Error                               | R   |

## FX compatible area

The special relays of FX compatible area are shown below.

R: Read only, R/W: Read/Write

| No.    | Name                     | Description   | R/W |
|--------|--------------------------|---|-----|
| SM8000 | RUN monitor NO contact   | OFF: STOP<br>ON: RUN  | R   |
| SM8001 | RUN monitor NC contact   | OFF: RUN<br>ON: STOP  | R   |
| SM8002 | Initial pulse NO contact | OFF: SM8002 turns off except during 1 scan at the time of RUN<br>ON: SM8002 turns on during 1 scan at the time of RUN | R   |
| SM8003 | Initial pulse NC contact | OFF: SM8003 turns on during 1 scan at the time of RUN<br>ON: SM8003 turns off except during 1 scan at the time of RUN | R   |
| SM8004 | Error occurrence         | OFF: No error<br>ON: Error  | R   |
| SM8005 | Battery voltage low      | OFF: Battery normal<br>ON: Battery voltage low  | R   |
| SM8006 | Battery error latch      | OFF: Battery normal<br>ON: Battery voltage low latch  | R   |
| SM8007 | Momentary power failure  | OFF: No momentary power failure<br>ON: Momentary power failure detected   | R   |
| SM8008 | Power failure detected   | OFF: No momentary power failure<br>ON: During momentary power failure   | R   |
| SM8011 | 10 msec clock pulse      | ON and OFF in 10 ms cycles<br>OFF: 5 ms<br>ON: 5 ms   | R   |
| SM8012 | 100 msec clock pulse     | ON and OFF in 100 ms cycles<br>OFF: 50 ms<br>ON: 50 ms  | R   |



| No.    | Name                           | Description   | R/W |
|--------|--------------------------------|---|-----|
| SM8013 | 1 sec clock pulse              | ON and OFF in 1 sec cycles<br>OFF: 500 ms<br>ON: 500 ms   | R   |
| SM8014 | 1 min clock pulse              | ON and OFF in 1 min cycles<br>OFF: 30 s<br>ON: 30 s   | R   |
| SM8015 | Clock stop and preset          | When SM8015 turns ON, the real time clock is stopped.<br>At the edge from ON to OFF, the time from SD8013 to SD8019 is written to the PLC and the clock is started again.   | R/W |
| SM8016 | Time read display is stopped   | When SM8016 turns ON, the time display is stopped.  | R/W |
| SM8017 | ±30 seconds correction         | At the edge from OFF to ON, the RTC is set to the nearest minute.<br>(When the second data is from 0 to 29, it is set to 0. When the second data is from 30 to 59, it is set to 0 and the minute data is incremented by "1".) | R/W |
| SM8019 | Real time clock error          | When the data stored in special registers is outside the allowable time setting range, this device turns ON.  | R   |
| SM8020 | Zero                           | OFF: Carry flag OFF<br>ON: Carry flag ON  | R   |
| SM8021 | Borrow                         | OFF: Borrow flag OFF<br>ON: Borrow flag ON  | R   |
| SM8022 | Carry                          | OFF: Carry flag OFF<br>ON: Carry flag ON  | R   |
| SM8023 | Real time clock access error   | SM8023 turns ON at the time of RTC access (reading/writing) error occurrence.   | R   |
| SM8026 | RAMP mode                      | OFF: Standard mode<br>ON: RAMP mode   | R   |
| SM8029 | Instruction execution complete | OFF: Instruction execution not complete<br>ON: Instruction execution complete   | R   |
| SM8031 | Non-latch memory all clear     | OFF: No clear<br>ON: Non-latch memory all clear   | R   |
| SM8032 | Latch memory all clear         | OFF: No clear<br>ON: Latch memory all clear   | R   |
| SM8033 | Memory hold stop               | OFF: Clear<br>ON: Hold  | R   |
| SM8034 | All output disable             | OFF: Normal operation<br>ON: All output disable   | R   |
| SM8039 | Constant scan mode             | OFF: Normal operation<br>ON: Constant scan mode   | R/W |
| SM8040 | STL transfer disable           | OFF: Normal operation<br>ON: Transfer disable   | R/W |
| SM8041 | Transfer start                 | Transfer from initial state is enabled in automatic operation mode  | R   |
| SM8042 | Transfer start                 | Pulse output is given in response to a start input  | R   |
| SM8043 | Zero return complete           | Set this in the last state of zero return mode  | R/W |
| SM8044 | Zero point condition           | Set this when machine zero return is detected   | R/W |
| SM8045 | All output reset disable       | Disables the 'all output reset' function when the operation mode is changed   | R/W |
| SM8046 | STL state ON                   | ON when SM8047 is ON and any state (S) is active  | R/W |
| SM8047 | Enable STL monitoring          | SD8040 to SD8047 are enabled when SM8047 is ON  | R/W |
| SM8048 | Annunciator ON                 | ON when SM8049 is ON and any state (S900 to S999) is active   | R/W |
| SM8049 | Enable annunciator monitoring  | SD8049 is enabled when SM8049 is ON.  | R/W |
| SM8050 | I00□ disable                   | OFF: Interrupt enabled<br>ON: Interrupt disabled  | R/W |
| SM8051 | I10□ disable                   | OFF: Interrupt enabled<br>ON: Interrupt disabled  | R/W |
| SM8052 | I20□ disable                   | OFF: Interrupt enabled<br>ON: Interrupt disabled  | R/W |
| SM8053 | I30□ disable                   | OFF: Interrupt enabled<br>ON: Interrupt disabled  | R/W |
| SM8054 | I40□ disable                   | OFF: Interrupt enabled<br>ON: Interrupt disabled  | R/W |



| No.    | Name  | Description  | R/W |
|--------|---|--|-----|
| SM8055 | I50□ disable                                  | OFF: Interrupt enabled<br>ON: Interrupt disabled   | R/W |
| SM8056 | I60□ disable                                  | OFF: Interrupt enabled<br>ON: Interrupt disabled   | R/W |
| SM8057 | I70□ disable                                  | OFF: Interrupt enabled<br>ON: Interrupt disabled   | R/W |
| SM8058 | I80□ disable                                  | OFF: Interrupt enabled<br>ON: Interrupt disabled   | R/W |
| SM8059 | I0□0 disable (Counter interrupt disable)      | OFF: Interrupt enabled<br>ON: Interrupt disabled   | R/W |
| SM8063 | Serial communication error1 (ch1)             | OFF: No error<br>ON: Error   | R   |
| SM8067 | Operation error                               | OFF: No error<br>ON: Error   | R   |
| SM8068 | Operation error latch                         | OFF: No error<br>ON: Error (latch)   | R   |
| SM8090 | Block comparison signal                       | Block comparison signal ON when all comparison results are ON.                                       | R   |
| SM8099 | High-speed ring counter                       | OFF: High-speed ring counter stop<br>ON: High-speed ring counter start                               | R/W |
| SM8151 | Inverter communication (ch1)                  | ON during inverter communication.  | R   |
| SM8152 | Inverter communication error (ch1)            | OFF: No error<br>ON: Error   | R   |
| SM8153 | Inverter communication error latch (ch1)      | OFF: No error<br>ON: Error (latch)   | R   |
| SM8154 | IVBWR instruction error (ch1)                 | OFF: No error<br>ON: Error   | R   |
| SM8156 | Inverter communication (ch2)                  | ON during inverter communication.  | R   |
| SM8157 | Inverter communication error (ch2)            | OFF: No error<br>ON: Error   | R   |
| SM8158 | Inverter communication error latch (ch2)      | OFF: No error<br>ON: Error (latch)   | R   |
| SM8159 | IVBWR instruction error (ch2)                 | OFF: No error<br>ON: Error   | R   |
| SM8161 | 8 bit operation mode                          | OFF: 16 bit operation mode<br>ON: 8 bit operation mode   | R/W |
| SM8168 | SMOV data mode                                | BIN→BCD conversion will not be performed, if a SMOV instruction is executed after turning on SM8168. | R/W |
| SM8170 | X0 pulse catch                                | Pulse catch ON when X0 is OFF→ON   | R/W |
| SM8171 | X1 pulse catch                                | Pulse catch ON when X1 is OFF→ON   | R/W |
| SM8172 | X2 pulse catch                                | Pulse catch ON when X2 is OFF→ON   | R/W |
| SM8173 | X3 pulse catch                                | Pulse catch ON when X3 is OFF→ON   | R/W |
| SM8174 | X4 pulse catch                                | Pulse catch ON when X4 is OFF→ON   | R/W |
| SM8175 | X5 pulse catch                                | Pulse catch ON when X5 is OFF→ON   | R/W |
| SM8176 | X6 pulse catch                                | Pulse catch ON when X6 is OFF→ON   | R/W |
| SM8177 | X7 pulse catch                                | Pulse catch ON when X7 is OFF→ON   | R/W |
| SM8183 | Data communication error (Master station)     | OFF: No error<br>ON: Error   | R   |
| SM8184 | Data communication error (Slave station No.1) | OFF: No error<br>ON: Error   | R   |
| SM8185 | Data communication error (Slave station No.2) | OFF: No error<br>ON: Error   | R   |
| SM8186 | Data communication error (Slave station No.3) | OFF: No error<br>ON: Error   | R   |
| SM8187 | Data communication error (Slave station No.4) | OFF: No error<br>ON: Error   | R   |
| SM8188 | Data communication error (Slave station No.5) | OFF: No error<br>ON: Error   | R   |
| SM8189 | Data communication error (Slave station No.6) | OFF: No error<br>ON: Error   | R   |
| SM8190 | Data communication error (Slave station No.7) | OFF: No error<br>ON: Error   | R   |

| No.    | Name   | Description   | R/W |
|--------|--|---|-----|
| SM8191 | Data communication in execution                                  | OFF: Data communication in execution<br>ON: Data communication in nonexecution      | R   |
| SM8246 | LC46 counting direction monitoring                               | OFF: Down count operation<br>ON: Up count operation                                 | R   |
| SM8247 | LC47 counting direction monitoring                               | OFF: Down count operation<br>ON: Up count operation                                 | R   |
| SM8248 | LC48 counting direction monitoring                               | OFF: Down count operation<br>ON: Up count operation                                 | R   |
| SM8249 | LC49 counting direction monitoring                               | OFF: Down count operation<br>ON: Up count operation                                 | R   |
| SM8250 | LC50 counting direction monitoring                               | OFF: Down count operation<br>ON: Up count operation                                 | R   |
| SM8251 | LC51 counting direction monitoring                               | OFF: Down count operation<br>ON: Up count operation                                 | R   |
| SM8252 | LC52 counting direction monitoring                               | OFF: Down count operation<br>ON: Up count operation                                 | R   |
| SM8253 | LC53 counting direction monitoring                               | OFF: Down count operation<br>ON: Up count operation                                 | R   |
| SM8254 | LC54 counting direction monitoring                               | OFF: Down count operation<br>ON: Up count operation                                 | R   |
| SM8255 | LC55 counting direction monitoring                               | OFF: Down count operation<br>ON: Up count operation                                 | R   |
| SM8304 | Zero   | OFF: Zero flag OFF<br>ON: Zero flag ON  | R   |
| SM8306 | Carry  | OFF: Carry flag OFF<br>ON: Carry flag ON  | R   |
| SM8329 | Instruction execution error                                      | OFF: Instruction execution normal<br>ON: Instruction execution error complete       | R   |
| SM8330 | Timing clock output 1  | DUTY instruction: Timing clock output 1   | R   |
| SM8331 | Timing clock output 2  | DUTY instruction: Timing clock output 2   | R   |
| SM8332 | Timing clock output 3  | DUTY instruction: Timing clock output 3   | R   |
| SM8333 | Timing clock output 4  | DUTY instruction: Timing clock output 4   | R   |
| SM8334 | Timing clock output 5  | DUTY instruction: Timing clock output 5   | R   |
| SM8340 | Axis 1 pulse output monitor                                      | OFF: Stopped<br>ON: Pulse output  | R   |
| SM8348 | Axis 1 positioning instruction executing                         | OFF: Positioning instruction not executing<br>ON: Positioning instruction executing | R   |
| SM8350 | Axis 2 pulse output monitor                                      | OFF: Stopped<br>ON: Output  | R   |
| SM8358 | Axis 2 positioning instruction executing                         | OFF: Positioning instruction not executing<br>ON: Positioning instruction executing | R   |
| SM8360 | Axis 3 pulse output monitor                                      | OFF: Stopped<br>ON: Output  | R   |
| SM8368 | Axis 3 positioning instruction executing                         | OFF: Positioning instruction not executing<br>ON: Positioning instruction executing | R   |
| SM8370 | Axis 4 pulse output monitor                                      | OFF: Stopped<br>ON: Output  | R   |
| SM8378 | Axis 4 positioning instruction executing                         | OFF: Positioning instruction not executing<br>ON: Positioning instruction executing | R   |
| SM8401 | RS2 Send wait flag (ch1)/MODBUS request in process (ch1)         | ON during send wait or MODBUS communication.  | R   |
| SM8402 | MODBUS communication error (ch1)                                 | OFF: No error<br>ON: Error  | R   |
| SM8403 | MODBUS communication error (latched) (ch1)                       | OFF: No error<br>ON: Error (latch)  | R   |
| SM8404 | RS2 Carrier detection flag (ch1)/MODBUS communication mode (ch1) | ON when carrier detection or listen only mode                                       | R   |
| SM8405 | RS2 Data set ready (DSR) flag (ch1)                              | OFF: DSR not detected<br>ON: DSR detected   | R   |
| SM8408 | MODBUS retry (ch1)   | OFF: Not retry<br>ON: Retry   | R   |
| SM8409 | RS2 Time-out check flag (ch1)/MODBUS Timeout (ch1)               | ON when time-out occurs.  | R   |

| No.    | Name   | Description  | R/W |
|--------|--|--|-----|
| SM8421 | RS2 Send wait flag (ch2)/MODBUS request in process (ch2)         | ON during send wait or MODBUS communication  | R   |
| SM8422 | MODBUS communication error (ch2)                                 | OFF: No error<br>ON: Error   | R   |
| SM8423 | MODBUS communication error (latched) (ch2)                       | OFF: No error<br>ON: Error (latch)   | R   |
| SM8424 | RS2 Carrier detection flag (ch2)/MODBUS communication mode (ch2) | Carrier detection flag or listen only mode ON when operating.  | R   |
| SM8425 | RS2 Data set ready (DSR) flag (ch2)                              | OFF: DSR not detected<br>ON: DSR detected  | R   |
| SM8428 | MODBUS retry (ch2)   | OFF: No retry<br>ON: Retry   | R   |
| SM8429 | RS2 Time-out check flag (ch2)/MODBUS Timeout (ch2)               | ON when timeout occurs.  | R   |
| SM8438 | Serial communication error 2 (ch2)                               | OFF: No error<br>ON: Error   | R   |
| SM8492 | IP address storage area write request                            | If OFF to ON, the IP address setting stored in SD8492 to SD8497 will be written in the IP address storage area.  | R/W |
| SM8493 | IP address storage area write completed                          | <ul style="list-style-type: none"> <li>It turns on, if the write to the IP address storage area is completed. Moreover, it turns on also at the time of the write-in failure.</li> <li>Turns OFF when IP address storage area write request (SM8492) turns from ON to OFF.</li> </ul>  | R   |
| SM8494 | IP address storage area write error                              | <ul style="list-style-type: none"> <li>Turns ON when writing to IP address storage area is failed.</li> <li>Turns ON if there is a problem in contents of IP address storage area, when PLC power supply is turned from OFF to ON.</li> <li>Turns OFF when IP address storage area write request (SM8492) turns from ON to OFF.</li> </ul> | R   |
| SM8495 | IP address storage area clear request                            | Contents of IP address storage area are cleared when this device turns from OFF to ON.   | R/W |
| SM8496 | IP address storage area clear completed                          | <ul style="list-style-type: none"> <li>It turns on, if the clear to the IP address storage area is completed. Moreover, it turns on also at the time of the clear-in failure.</li> <li>Turns OFF when IP address storage area clear request (SM8495) turns from ON to OFF.</li> </ul>  | R   |
| SM8497 | IP address storage area clear error                              | <ul style="list-style-type: none"> <li>Turns ON when clear to IP address storage area is failed.</li> <li>Turns OFF when IP address storage area clear request (SM8495) turns from ON to OFF.</li> </ul>   | R   |
| SM8498 | IP address change function enable flag                           | Turns ON when IP address is changed by IP address change function  | R   |

## Serial communication

The special relays for serial communication are shown below.

R: Read only, R/W: Read/Write

| No.    | Name                             | Description   | R/W |
|--------|----------------------------------|---|-----|
| SM8500 | Serial communication error (ch1) | OFF: No error<br>ON: Error  | R   |
| SM8510 | Serial communication error (ch2) | OFF: No error<br>ON: Error  | R   |
| SM8520 | Serial communication error (ch3) | OFF: No error<br>ON: Error  | R   |
| SM8530 | Serial communication error (ch4) | OFF: No error<br>ON: Error  | R   |
| SM8560 | Data transfer delayed (ch1)      | This device remains ON while the PLC is waiting to send.  | R   |
| SM8561 | Data transfer flag (ch1)         | When this device is set to ON, the PLC starts to send.  | R   |
| SM8562 | Receive completion flag (ch1)    | This device turns ON when receiving is completed.   | R   |
| SM8563 | Carrier detection flag (ch1)     | This device turns ON in synchronization with the CD (DCD) signal.   | R   |
| SM8564 | Data set ready flag (ch1)        | This device turns ON in synchronization with the DR (DSR) signal.   | R   |
| SM8565 | Time-out check flag (ch1)        | This device turns ON when data receiving is suspended and the next set of receive data is not given within the time set by the timeout time setting device. | R   |
| SM8570 | Data transfer delayed (ch2)      | This device remains ON while the PLC is waiting to send.  | R   |

| No.    | Name  | Description   | R/W |
|--------|---|---|-----|
| SM8571 | Data transfer flag (ch2)                        | When this device is set to ON, the PLC starts to send.  | R   |
| SM8572 | Receive completion flag (ch2)                   | This device turns ON when receiving is completed.   | R   |
| SM8573 | Carrier detection flag (ch2)                    | This device turns ON in synchronization with the CD (DCD) signal.   | R   |
| SM8574 | Data set ready flag (ch2)                       | This device turns ON in synchronization with the DR (DSR) signal.   | R   |
| SM8575 | Time-out check flag (ch2)                       | This device turns ON when data receiving is suspended and the next set of receive data is not given within the time set by the timeout time setting device. | R   |
| SM8580 | Data transfer delayed (ch3)                     | This device remains ON while the PLC is waiting to send.  | R   |
| SM8581 | Data transfer flag (ch3)                        | When this device is set to ON, the PLC starts to send.  | R   |
| SM8582 | Receive completion flag (ch3)                   | This device turns ON when receiving is completed.   | R   |
| SM8583 | Carrier detection flag (ch3)                    | This device turns ON in synchronization with the CD (DCD) signal.   | R   |
| SM8584 | Data set ready flag (ch3)                       | This device turns ON in synchronization with the DR (DSR) signal.   | R   |
| SM8585 | Time-out check flag (ch3)                       | This device turns ON when data receiving is suspended and the next set of receive data is not given within the time set by the timeout time setting device  | R   |
| SM8590 | Data transfer delayed (ch4)                     | This device remains ON while the PLC is waiting to send   | R   |
| SM8591 | Data transfer flag (ch4)                        | When this device is set to ON, the PLC starts to send   | R   |
| SM8592 | Receive completion flag (ch4)                   | This device turns ON when receiving is completed  | R   |
| SM8593 | Carrier detection flag (ch4)                    | This device turns ON in synchronization with the CD (DCD) signal  | R   |
| SM8594 | Data set ready flag (ch4)                       | This device turns ON in synchronization with the DR (DSR) signal  | R   |
| SM8595 | Time-out check flag (ch4)                       | This device turns ON when data receiving is suspended and the next set of receive data is not given within the time set by the timeout time setting device  | R   |
| SM8740 | Station No. setting SD latch enabled (ch1)      | OFF: Latch disabled<br>ON: Latch enabled  | R   |
| SM8750 | Station No. setting SD latch enabled (ch2)      | OFF: Latch disabled<br>ON: Latch enabled  | R   |
| SM8760 | Station No. setting SD latch enabled (ch3)      | OFF: Latch disabled<br>ON: Latch enabled  | R   |
| SM8770 | Station No. setting SD latch enabled (ch4)      | OFF: Latch disabled<br>ON: Latch enabled  | R   |
| SM8800 | MODBUS RTU communication (ch1)                  | OFF: Communication stop<br>ON: Communication  | R   |
| SM8801 | Retry (ch1)                                     | OFF: No retry<br>ON: Retry  | R   |
| SM8802 | Timeout (ch1)                                   | OFF: No timeout<br>ON: Timeout  | R   |
| SM8810 | MODBUS RTU communication (ch2)                  | OFF: Communication stop<br>ON: Communication  | R   |
| SM8811 | Retry (ch2)                                     | OFF: No retry<br>ON: Retry  | R   |
| SM8812 | Timeout (ch2)                                   | OFF: Not timeout<br>ON: Timeout   | R   |
| SM8820 | MODBUS RTU communication (ch3)                  | OFF: Communication stop<br>ON: Communication  | R   |
| SM8821 | Retry (ch3)                                     | OFF: No retry<br>ON: Retry  | R   |
| SM8822 | Timeout (ch3)                                   | OFF: No timeout<br>ON: Timeout  | R   |
| SM8830 | MODBUS RTU communication (ch4)                  | OFF: Communication stop<br>ON: Communication  | R   |
| SM8831 | Retry (ch4)                                     | OFF: No retry<br>ON: Retry  | R   |
| SM8832 | Timeout (ch4)                                   | OFF: No timeout<br>ON: Timeout  | R   |
| SM8861 | Host station No. setting SD latch enabled (ch1) | OFF: Latch disabled<br>ON: Latch enabled  | R   |
| SM8871 | Host station No. setting SD latch enabled (ch2) | OFF: Latch disabled<br>ON: Latch enabled  | R   |
| SM8881 | Host station No. setting SD latch enabled (ch3) | OFF: Latch disabled<br>ON: Latch enabled  | R   |

| No.    | Name  | Description  | R/W |
|--------|---|--|-----|
| SM8891 | Host station No. setting SD latch enabled (ch4)     | OFF: Latch disabled<br>ON: Latch enabled                                       | R   |
| SM8920 | Inverter communication (ch1)                        | OFF: No communication<br>ON: Communication                                     | R   |
| SM8921 | IVBWR instruction error (ch1)                       | OFF: No error<br>ON: Error   | R   |
| SM8930 | Inverter communication (ch2)                        | OFF: No communication<br>ON: Communication                                     | R   |
| SM8931 | IVBWR instruction error (ch2)                       | OFF: No error<br>ON: Error   | R   |
| SM8940 | Inverter communication (ch3)                        | OFF: No communication<br>ON: Communication                                     | R   |
| SM8941 | IVBWR instruction error (ch3)                       | OFF: No error<br>ON: Error   | R   |
| SM8950 | Inverter communication (ch4)                        | OFF: No communication<br>ON: Communication                                     | R   |
| SM8951 | IVBWR instruction error (ch4)                       | OFF: No error<br>ON: Error   | R   |
| SM9040 | Data communication error (Master station)           | OFF: No error<br>ON: Error   | R   |
| SM9041 | Data communication error (Slave station No.1)       | OFF: No error<br>ON: Error   | R   |
| SM9042 | Data communication error (Slave station No.2)       | OFF: No error<br>ON: Error   | R   |
| SM9043 | Data communication error (Slave station No.3)       | OFF: No error<br>ON: Error   | R   |
| SM9044 | Data communication error (Slave station No.4)       | OFF: No error<br>ON: Error   | R   |
| SM9045 | Data communication error (Slave station No.5)       | OFF: No error<br>ON: Error   | R   |
| SM9046 | Data communication error (Slave station No.6)       | OFF: No error<br>ON: Error   | R   |
| SM9047 | Data communication error (Slave station No.7)       | OFF: No error<br>ON: Error   | R   |
| SM9056 | Data communication in execution                     | OFF: Data communication in execution<br>ON: Data communication in nonexecution | R   |
| SM9080 | Station No. setting SD latch enabled                | OFF: Latch disabled<br>ON: Latch enabled                                       | R   |
| SM9081 | Slave station total number setting SD latch enabled | OFF: Latch disabled<br>ON: Latch enabled                                       | R   |

# Appendix 1.3 Special Register List (SD)

The PLC contains internal register with fixed specifications, so it cannot be used in the program like a conventional internal register.

## Diagnostic information

The special register for diagnostic information are shown below.

R: Read only, R/W: Read/Write

| No.          | Name  | Description  | R/W |
|--------------|---|--|-----|
| SD0          | Latest self diagnostics error code                        | This register stores the latest self-diagnosis error code.   | R   |
| SD1          | Clock time for self diagnosis error occurrence (Year)     | This register stores the latest self-diagnosis error time (Year).  | R   |
| SD2          | Clock time for self diagnosis error occurrence (Month)    | This register stores the latest self-diagnosis error time (Month).   | R   |
| SD3          | Clock time for self diagnosis error occurrence (Day)      | This register stores the latest self-diagnosis error time (Day).   | R   |
| SD4          | Clock time for self diagnosis error occurrence (Hour)     | This register stores the latest self-diagnosis error time (Hour).  | R   |
| SD5          | Clock time for self diagnosis error occurrence (Minute)   | This register stores the latest self-diagnosis error time (Minute).  | R   |
| SD6          | Clock time for self diagnosis error occurrence (Second)   | This register stores the latest self-diagnosis error time (Second).  | R   |
| SD7          | Clock time for self diagnosis error occurrence (Day Week) | This register stores the latest self-diagnosis error time (Day Week).  | R   |
| SD10         | Self diagnostics error code 1                             | This register stores the self-diagnosis error code.  | R   |
| SD11         | Self diagnostics error code 2                             | This register stores the self-diagnosis error code.  | R   |
| SD12         | Self diagnostics error code 3                             | This register stores the self-diagnosis error code.  | R   |
| SD13         | Self diagnostics error code 4                             | This register stores the self-diagnosis error code.  | R   |
| SD14         | Self diagnostics error code 5                             | This register stores the self-diagnosis error code.  | R   |
| SD15         | Self diagnostics error code 6                             | This register stores the self-diagnosis error code.  | R   |
| SD16         | Self diagnostics error code 7                             | This register stores the self-diagnosis error code.  | R   |
| SD17         | Self diagnostics error code 8                             | This register stores the self-diagnosis error code.  | R   |
| SD18         | Self diagnostics error code 9                             | This register stores the self-diagnosis error code.  | R   |
| SD19         | Self diagnostics error code 10                            | This register stores the self-diagnosis error code.  | R   |
| SD20         | Self diagnostics error code 11                            | This register stores the self-diagnosis error code.  | R   |
| SD21         | Self diagnostics error code 12                            | This register stores the self-diagnosis error code.  | R   |
| SD22         | Self diagnostics error code 13                            | This register stores the self-diagnosis error code.  | R   |
| SD23         | Self diagnostics error code 14                            | This register stores the self-diagnosis error code.  | R   |
| SD24         | Self diagnostics error code 15                            | This register stores the self-diagnosis error code.  | R   |
| SD25         | Self diagnostics error code 16                            | This register stores the self-diagnosis error code.  | R   |
| SD53         | The number of AC/DC DOWN detections                       | This register stores the number of times of momentary power failure.   | R   |
| SD61         | I/O Module Verify Error Module No.                        | This register stores the I/O module verify error module No.  | R   |
| SD62         | Annunciator (F) Detection No.                             | This register stores the earliest detected annunciator (F) No.   | R   |
| SD63         | Annunciator (F) Detection Number                          | This register stores the number of annunciator (F) detections.   | R   |
| SD64 to SD79 | Annunciator (F) Detection No. table                       | This register stores the annunciator (F) detection No.   | R   |
| SD80         | Detailed information 1 information category               | <ul style="list-style-type: none"> <li>Detailed information 1 information category code is stored.</li> </ul> <div> <div>b15 to b8</div> <div>b7 to b0</div> <div>Not used (fixed to 0)</div> <div>Information category code</div> </div> <ul style="list-style-type: none"> <li>The following codes are stored into the information category code.</li> </ul> <p>0: N/A<br/> 1: Program position information<br/> 2: Drive number and file name<br/> 4: Parameter information<br/> 5: System configuration information<br/> 6: Number of times information<br/> 7: Time information</p> | R   |

| No.           | Name                   | Description   | R/W |
|---------------|------------------------|---|-----|
| SD81 to SD111 | Detailed information 1 | <ul style="list-style-type: none"> <li>Detailed information 1 corresponding to the error code (SD0) is stored.</li> <li>There are six types of information to be stored as shown in the following figures.</li> <li>The type of detailed information 1 can be obtained using SD80 (the value of the "Detailed information 1 information category code" stored in SD80 corresponds to the following figures (1), (2), (4) to (7)).</li> </ul> <p>(1) Program location information</p> <p>SD81 With or without specification<br/> SD82 Argument No.<br/> SD83 Fixed to 0<br/> SD84 Fixed to 0<br/> SD85 Fixed to 0<br/> SD86 Fixed to 0<br/> SD87 Step No.<br/> SD88 FB No.<br/> SD89 File name (first 8 characters of Unicode character string)<br/> SD90 1st character<br/> SD91 2nd character<br/> SD92 3rd character<br/> SD93 4th character<br/> SD94 5th character<br/> SD95 6th character<br/> SD96 7th character<br/> SD97 8th character</p> <p>(2) Drive number and file name</p> <p>SD81 With or without specification<br/> SD82 Drive No.<br/> SD83 File name (first 8 characters of Unicode character string)<br/> SD84 1st character<br/> SD85 2nd character<br/> SD86 3rd character<br/> SD87 4th character<br/> SD88 5th character<br/> SD89 6th character<br/> SD90 7th character<br/> SD91 8th character</p> <p>(4) Parameter information</p> <p>SD81 With or without specification<br/> SD82 Parameter storage destination<br/> SD83 Parameter type<br/> SD84 Module position<br/> SD85 Parameter No.<br/> SD86 Network No.<br/> SD87 Station No.<br/> SD88 System information<br/> SD89 System information<br/> SD90 System information<br/> SD91 System information<br/> SD92 System information<br/> SD93 System information<br/> SD94 System information<br/> SD95 System information<br/> SD96 System information<br/> SD97 System information</p> <p>Parameter storage destination: 1: System parameter, 2: CPU parameter, 3: Module parameter, 4: Module extension parameter, 5: Memory card parameter<br/> Parameter type: 1: System parameter, 2: CPU parameter, 3: Module parameter, 4: Module extension parameter, 5: Memory card parameter<br/> Parameter storage destination: 2: SD memory card, 4: Data memory<br/> CPU module: 0H<br/> Extension module 1 to 16: 1H to 10H<br/> Built-in RS-485: 41H<br/> Built-in analog: 42H<br/> Expansion board: 60H<br/> Expansion adapter 1 to 6: 71H to 76H</p> | R   |

| No.           | Name  | Description   | R/W |
|---------------|---|---|-----|
| SD81 to SD111 | Detailed information 1                      | <p>(5) System configuration information</p> <p>(6) Number of times information</p> <p>(7) Time information</p>  | R   |
| SD112         | Detailed information 2 information category | <ul style="list-style-type: none"> <li>Detailed information 2 information category code is stored.</li> </ul> <ul style="list-style-type: none"> <li>The following codes are stored into the information category code.</li> <li>0: N/A</li> <li>2: Drive number and file name</li> <li>3: Annunciator number</li> <li>4: Parameter information</li> <li>5: System configuration information</li> </ul> | R   |



| No.            | Name                   | Description  | R/W |
|----------------|------------------------|--|-----|
| SD113 to SD143 | Detailed information 2 | <ul style="list-style-type: none"> <li>Detailed information 2 corresponding to the error code (SD0) is stored.</li> <li>There are four types of information to be stored as shown in the following figures.</li> <li>The type of detailed information 2 can be obtained using SD112 (the value of the "Detailed information 2 information category code" stored in SD112 corresponds to the following figures (2) to (5)).</li> </ul> <p>(2) Drive number and file name</p> <p>(3) Annunciator number</p> <p>(4) Parameter information</p> <p>(5) System configuration information</p> | R   |

## System information

The special registers for system information are shown below.

R: Read only, R/W: Read/Write

| No.   | Name                    | Description   | R/W |
|-------|-------------------------|---|-----|
| SD200 | Switch Status           | This register stores the CPU switch status.<br>0: RUN<br>1: STOP  | R   |
| SD201 | LED Status              | This register stores the LED status.  | R   |
| SD203 | CPU Status              | This register stores the CPU Status.<br>b0: RUN<br>b2: STOP<br>b3: PAUSE                                  | R   |
| SD210 | Clock Data (Year)       | This register stores the clock data (Year).   | R   |
| SD211 | Clock Data (Month)      | This register stores the clock data (Month).  | R   |
| SD212 | Clock Data (Day)        | This register stores the clock data (Day).  | R   |
| SD213 | Clock Data (Hour)       | This register stores the clock data (Hour).   | R   |
| SD214 | Clock Data (Minute)     | This register stores the clock data (Minute).   | R   |
| SD215 | Clock Data (Second)     | This register stores the clock data (Second).   | R   |
| SD216 | Clock Data (Day Week)   | This register stores the clock data (Day of the Week).  | R   |
| SD218 | Time zone setting value | The time zone setting value specified in the parameter is stored in increments of minutes.                | R   |
| SD250 | Loaded Max I/O          | This register stores high-order 2 digits of the final I/O number of connected modules +1 in 8-bit binary. | R   |
| SD260 | X Device Size [Lower]   | This register stores the number of X device points used as 32-bit value.                                  | R   |
| SD261 | X Device Size [Upper]   |   |     |
| SD262 | Y Device Size [Lower]   | This register stores the number of Y device points used as 32-bit value.                                  | R   |
| SD263 | Y Device Size [Upper]   |   |     |
| SD264 | M Device Size [Lower]   | This register stores the number of M device points used as 32-bit value.                                  | R   |
| SD265 | M Device Size [Upper]   |   |     |
| SD266 | B Device Size [Lower]   | This register stores the number of B device points used as 32-bit value.                                  | R   |
| SD267 | B Device Size [Upper]   |   |     |
| SD268 | SB Device Size [Lower]  | This register stores the number of SB device points used as 32-bit value.                                 | R   |
| SD269 | SB Device Size [Upper]  |   |     |
| SD270 | F Device Size [Lower]   | This register stores the number of F device points used as 32-bit value.                                  | R   |
| SD271 | F Device Size [Upper]   |   |     |
| SD274 | L Device Size [Lower]   | This register stores the number of L device points used as 32-bit value.                                  | R   |
| SD275 | L Device Size [Upper]   |   |     |
| SD280 | D Device Size [Lower]   | This register stores the number of D device points used as 32-bit value.                                  | R   |
| SD281 | D Device Size [Upper]   |   |     |
| SD282 | W Device Size [Lower]   | This register stores the number of W device points used as 32-bit value.                                  | R   |
| SD283 | W Device Size [Upper]   |   |     |
| SD284 | SW Device Size [Lower]  | This register stores the number of SW device points used as 32-bit value.                                 | R   |
| SD285 | SW Device Size [Upper]  |   |     |
| SD288 | T Device Size [Lower]   | This register stores the number of T device points used as 32-bit value.                                  | R   |
| SD289 | T Device Size [Upper]   |   |     |
| SD290 | ST Device Size [Lower]  | This register stores the number of ST device points used as 32-bit value.                                 | R   |
| SD291 | ST Device Size [Upper]  |   |     |
| SD292 | C Device Size [Lower]   | This register stores the number of C device points used as 32-bit value.                                  | R   |
| SD293 | C Device Size [Upper]   |   |     |
| SD298 | LC Device Size [Lower]  | This register stores the number of LC device points used as 32-bit value.                                 | R   |
| SD299 | LC Device Size [Upper]  |   |     |
| SD300 | Z Device Size           | This register stores the number of Z device points used.  | R   |
| SD302 | LZ Device Size          | This register stores the number of LZ device points used.   | R   |
| SD304 | R Device Size [Lower]   | This register stores the number of R device points used as 32-bit value.                                  | R   |
| SD305 | R Device Size [Upper]   |   |     |

## System clock

The special registers for system clock are shown below.

R: Read only, R/W: Read/Write

| No.   | Name                      | Description  | R/W |
|-------|---------------------------|--|-----|
| SD412 | One second counter        | <ul style="list-style-type: none"><li>This register is incremented by 1 for each second after the CPU module is set to RUN.</li><li>A counting cycle from 0 to 32767 to -32768 to 0 is repeated.</li></ul>   | R   |
| SD414 | 2n second clock setting   | <ul style="list-style-type: none"><li>Stores value n of 2n second clock (Default is 30)</li><li>Setting can be made between 1 and 32767.</li></ul>   | R/W |
| SD415 | 2nms second clock setting | <ul style="list-style-type: none"><li>Stores value n of 2n ms clock (Default is 30)</li><li>Setting can be made between 1 and 32767.</li></ul>   | R/W |
| SD420 | Scan counter              | <ul style="list-style-type: none"><li>This register is incremented by 1 each scan after the CPU module is set to RUN. (Not incremented for each scan of an initial execution type program.)</li><li>A counting cycle from 0 to 32767 to -32768 to 0 is repeated.</li></ul> | R   |

## Scan information

The special registers for scan information are shown below.

R: Read only, R/W: Read/Write

| No.   | Name                             | Description   | R/W |
|-------|----------------------------------|---|-----|
| SD500 | Execution program number         | Program number of program currently being executed is stored. | R   |
| SD518 | Initial scan time (ms)           | This register stores the initial scan time (ms).              | R   |
| SD519 | Initial scan time (μs)           | This register stores the initial scan time (μs).              | R   |
| SD520 | Current scan time (ms)           | This register stores the current scan time (ms).              | R   |
| SD521 | Current scan time (μs)           | This register stores the current scan time (μs).              | R   |
| SD522 | Minimum scan time (ms)           | This register stores the minimum scan time (ms).              | R   |
| SD523 | Minimum scan time(μs)            | This register stores the minimum scan time (μs).              | R   |
| SD524 | Maximum scan time (ms)           | This register stores the maximum scan time (ms).              | R   |
| SD525 | Maximum scan time (μs)           | This register stores the maximum scan time (μs).              | R   |
| SD526 | END processing time (ms)         | This register stores the END processing time (ms).            | R   |
| SD527 | END processing time (μs)         | This register stores the END processing time (μs).            | R   |
| SD528 | Constant scan waiting time (ms)  | This register stores the constant scan wait time (ms).        | R   |
| SD529 | Constant scan waiting time (μs)  | This register stores the constant scan wait time (μs).        | R   |
| SD530 | Scan program execution time (ms) | This register stores the scan program execution time (ms).    | R   |
| SD531 | Scan program execution time (μs) | This register stores the scan program execution time (μs).    | R   |

## Drive information

The special registers for drive information are shown below.

R: Read only, R/W: Read/Write

| No.   | Name                               | Description  | R/W |
|-------|------------------------------------|--|-----|
| SD600 | Memory Card Installation           | This register stores the enable/disable classification of the inserted SD memory card.                             | R   |
| SD604 | SD memory card usage status        | This register stores the memory card usage condition.  | R   |
| SD606 | SD memory card capacity            | This register stores the drive 2 storage capacity (unit: 1 K byte). (Free space value after formatting is stored.) | R   |
| SD607 | SD memory card capacity            | This register stores the drive 2 storage capacity (unit: 1 K byte). (Free space value after formatting is stored.) | R   |
| SD608 | SD memory card capacity            | This register stores the drive 2 storage capacity (unit: 1 K byte). (Free space value after formatting is stored.) | R   |
| SD609 | SD memory card capacity            | This register stores the drive 2 storage capacity (unit: 1 K byte). (Free space value after formatting is stored.) | R   |
| SD610 | SD memory card free space capacity | This register stores the free space value in drive 2 (unit: 1 K byte).   | R   |
| SD611 | SD memory card free space capacity | This register stores the free space value in drive 2 (unit: 1 K byte).   | R   |
| SD612 | SD memory card free space capacity | This register stores the free space value in drive 2 (unit: 1 K byte).   | R   |
| SD613 | SD memory card free space capacity | This register stores the free space value in drive 2 (unit: 1 K byte).   | R   |

| No.   | Name   | Description   | R/W |
|-------|--|---|-----|
| SD634 | Index for the number of data memory write operations | Stores an index for the number of write operations to data memory currently. However, the index does not equal the actual number of write operations. | R   |
| SD635 |  |   |     |

## Instruction related

R: Read only, R/W: Read/Write

| No.   | Name  | Description   | R/W |
|-------|---|---|-----|
| SD757 | Current interrupt priority                          | This register stores the interrupt priority of the interrupt program being executed.<br>1 to 3: The interrupt priority of interrupt program executed.<br>0: The interrupt is not executed. (default value)  | R   |
| SD758 | Interrupt disabling for each priority setting value | This register stores the disable interrupt priority according to the disable interrupt instruction (DI), disable interrupt after the setting priority instruction (DI), and enable interrupt instruction (EI).<br>1: Disable interrupt priority 1 or less. (Disable interrupt of all priority) (default value)<br>2: Disable interrupt priority 2 or 3.<br>3: Disable interrupt priority 3.<br>0: No priority. (Enable interrupt of all priority) | R   |

## Mask pattern of interrupt pointers

The special registers for the mask pattern of interrupt pointers are shown below.  
R: Read only, R/W: Read/Write

| No.    | Name           | Description   | R/W |
|--------|----------------|---|-----|
| SD1400 | Mask pattern I | This register stores the IMASK instruction mask pattern I.<br>b15 to b0: I15 to I0  | R/W |
| SD1401 | Mask pattern I | This register stores the IMASK instruction mask pattern I.<br>b15 to b0: I31 to I16 | R/W |

## FX dedicated

The special registers dedicated to FX are shown below.  
R: Read only, R/W: Read/Write

| No.    | Name                         | Description  | R/W |
|--------|------------------------------|--|-----|
| SD4110 | Error code 1 details         | This register stores the self-diagnosis error code details.<br>• Module position [Low order 8 bit]<br><br>0H: CPU module<br>41H: Built-in RS-485<br>42H: Built-in analog<br>60H: Expansion board<br>71H to 76H: Expansion adapter<br>• Function No. [Higher order 8 bit]<br><br>0: System/Sequence operation<br>1: Analog input<br>2: Analog output<br>10: Positioning, PWM<br>20: High-speed counter, Pulse width measurement | R   |
| SD4111 | Error code 2 details         |  |     |
| SD4112 | Error code 3 details         |  |     |
| SD4113 | Error code 4 details         |  |     |
| SD4114 | Error code 5 details         |  |     |
| SD4115 | Error code 6 details         |  |     |
| SD4116 | Error code 7 details         |  |     |
| SD4117 | Error code 8 details         |  |     |
| SD4118 | Error code 9 details         |  |     |
| SD4119 | Error code 10 details        |  |     |
| SD4120 | Error code 11 details        |  |     |
| SD4121 | Error code 12 details        |  |     |
| SD4122 | Error code 13 details        |  |     |
| SD4123 | Error code 14 details        |  |     |
| SD4124 | Error code 15 details        |  |     |
| SD4125 | Error code 16 details        |  |     |
| SD4150 | Module 1 status information  | This register stores the module 1 status information.  | R   |
| SD4151 | Module 1 error information   | This register stores the module 1 error information.   | R   |
| SD4152 | Module 2 status information  | This register stores the module 2 status information.  | R   |
| SD4153 | Module 2 error information   | This register stores the module 2 error information.   | R   |
| SD4154 | Module 3 status information  | This register stores the module 3 status information.  | R   |
| SD4155 | Module 3 error information   | This register stores the module 3 error information.   | R   |
| SD4156 | Module 4 status information  | This register stores the module 4 status information.  | R   |
| SD4157 | Module 4 error information   | This register stores the module 4 error information.   | R   |
| SD4158 | Module 5 status information  | This register stores the module 5 status information.  | R   |
| SD4159 | Module 5 error information   | This register stores the module 5 error information.   | R   |
| SD4160 | Module 6 status information  | This register stores the module 6 status information.  | R   |
| SD4161 | Module 6 error information   | This register stores the module 6 error information.   | R   |
| SD4162 | Module 7 status information  | This register stores the module 7 status information.  | R   |
| SD4163 | Module 7 error information   | This register stores the module 7 error information.   | R   |
| SD4164 | Module 8 status information  | This register stores the module 8 status information.  | R   |
| SD4165 | Module 8 error information   | This register stores the module 8 error information.   | R   |
| SD4166 | Module 9 status information  | This register stores the module 9 status information.  | R   |
| SD4167 | Module 9 error information   | This register stores the module 9 error information.   | R   |
| SD4168 | Module 10 status information | This register stores the module 10 status information.   | R   |
| SD4169 | Module 10 error information  | This register stores the module 10 error information.  | R   |
| SD4170 | Module 11 status information | This register stores the module 11 status information.   | R   |
| SD4171 | Module 11 error information  | This register stores the module 11 error information.  | R   |
| SD4172 | Module 12 status information | This register stores the module 12 status information.   | R   |
| SD4173 | Module 12 error information  | This register stores the module 12 error information.  | R   |

| No.    | Name                         | Description  | R/W |
|--------|------------------------------|--|-----|
| SD4174 | Module 13 status information | This register stores the module 13 status information. | R   |
| SD4175 | Module 13 error information  | This register stores the module 13 error information.  | R   |
| SD4176 | Module 14 status information | This register stores the module 14 status information. | R   |
| SD4177 | Module 14 error information  | This register stores the module 14 error information.  | R   |
| SD4178 | Module 15 status information | This register stores the module 15 status information. | R   |
| SD4179 | Module 15 error information  | This register stores the module 15 error information.  | R   |
| SD4180 | Module 16 status information | This register stores the module 16 status information. | R   |
| SD4181 | Module 16 error information  | This register stores the module 16 error information.  | R   |

## FX high-speed input/output

The special registers for FX high-speed input/output are shown below.

R: Read only, R/W: Read/Write

| No.    | Name   | Description  | R/W |
|--------|--|--|-----|
| SD4500 | High-speed counter current value [Low-order] (CH1)                 | This register stores the high-speed counter current value (CH1).                 | R/W |
| SD4501 | High-speed counter current value [High-order] (CH1)                |  |     |
| SD4502 | High-speed counter maximum value [Low-order] (CH1)                 | This register stores the high-speed counter maximum value (CH1).                 | R/W |
| SD4503 | High-speed counter maximum value [High-order] (CH1)                |  |     |
| SD4504 | High-speed counter minimum value [Low-order] (CH1)                 | This register stores the high-speed counter minimum value (CH1).                 | R/W |
| SD4505 | High-speed counter minimum value [High-order] (CH1)                |  |     |
| SD4506 | High-speed counter pulse density [Low-order] (CH1)                 | This register stores the high-speed counter pulse density (CH1).                 | R/W |
| SD4507 | High-speed counter pulse density [High-order] (CH1)                |  |     |
| SD4508 | High-speed counter rotation speed [Low-order] (CH1)                | This register stores the high-speed counter rotation speed (CH1).                | R/W |
| SD4509 | High-speed counter rotation speed [High-order] (CH1)               |  |     |
| SD4510 | High-speed counter preset control switch (CH1)                     | This register stores the high-speed counter preset control switch (CH1).         | R/W |
| SD4512 | High-speed counter preset value [Low-order] (CH1)                  | This register stores the high-speed counter preset value (CH1).                  | R/W |
| SD4513 | High-speed counter preset value [High-order] (CH1)                 |  |     |
| SD4514 | High-speed counter ring length [Low-order] (CH1)                   | This register stores the high-speed counter ring length (CH1).                   | R/W |
| SD4515 | High-speed counter ring length [High-order] (CH1)                  |  |     |
| SD4516 | High-speed counter measurement-unit time [Low-order] (CH1)         | This register stores the high-speed counter measurement-unit time (CH1).         | R/W |
| SD4517 | High-speed counter measurement-unit time [High-order] (CH1)        |  |     |
| SD4518 | High-speed counter number of pulses per rotation [Loworder] (CH1)  | This register stores the high-speed counter number of pulses per rotation (CH1). | R/W |
| SD4519 | High-speed counter number of pulses per rotation [Highorder] (CH1) |  |     |
| SD4530 | High-speed counter current value [Low-order] (CH2)                 | This register stores the high-speed counter current value (CH2).                 | R/W |
| SD4531 | High-speed counter current value [High-order] (CH2)                |  |     |
| SD4532 | High-speed counter maximum value [Low-order] (CH2)                 | This register stores the high-speed counter maximum value (CH2).                 | R/W |
| SD4533 | High-speed counter maximum value [High-order] (CH2)                |  |     |
| SD4534 | High-speed counter minimum value [Low-order] (CH2)                 | This register stores the high-speed counter minimum value (CH2).                 | R/W |
| SD4535 | High-speed counter minimum value [High-order] (CH2)                |  |     |
| SD4536 | High-speed counter pulse density [Low-order] (CH2)                 | This register stores the high-speed counter pulse density (CH2).                 | R/W |
| SD4537 | High-speed counter pulse density [High-order] (CH2)                |  |     |
| SD4538 | High-speed counter rotation speed [Low-order] (CH2)                | This register stores the high-speed counter rotation speed (CH2).                | R/W |
| SD4539 | High-speed counter rotation speed [High-order] (CH2)               |  |     |
| SD4540 | High-speed counter preset control switch (CH2)                     | This register stores the high-speed counter preset control switch (CH2).         | R/W |
| SD4542 | High-speed counter preset value [Low-order] (CH2)                  | This register stores the high-speed counter preset value (CH2).                  | R/W |
| SD4543 | High-speed counter preset value [High-order] (CH2)                 |  |     |
| SD4544 | High-speed counter ring length [Low-order] (CH2)                   | This register stores the high-speed counter ring length (CH2).                   | R/W |
| SD4545 | High-speed counter ring length [High-order] (CH2)                  |  |     |

| No.    | Name   | Description  | R/W |
|--------|--|--|-----|
| SD4546 | High-speed counter measurement-unit time [Low-order] (CH2)         | This register stores the high-speed counter measurement-unit time (CH2).         | R/W |
| SD4547 | High-speed counter measurement-unit time [High-order] (CH2)        |  |     |
| SD4548 | High-speed counter number of pulses per rotation [Loworder] (CH2)  | This register stores the high-speed counter number of pulses per rotation (CH2). | R/W |
| SD4549 | High-speed counter number of pulses per rotation [Highorder] (CH2) |  |     |
| SD4560 | High-speed counter current value [Low-order] (CH3)                 | This register stores the high-speed counter current value (CH3).                 | R/W |
| SD4561 | High-speed counter current value [High-order] (CH3)                |  |     |
| SD4562 | High-speed counter maximum value [Low-order] (CH3)                 | This register stores the high-speed counter maximum value (CH3).                 | R/W |
| SD4563 | High-speed counter maximum value [High-order] (CH3)                |  |     |
| SD4564 | High-speed counter minimum value [Low-order] (CH3)                 | This register stores the high-speed counter minimum value (CH3).                 | R/W |
| SD4565 | High-speed counter minimum value [High-order] (CH3)                |  |     |
| SD4566 | High-speed counter pulse density [Low-order] (CH3)                 | This register stores the high-speed counter pulse density (CH3).                 | R/W |
| SD4567 | High-speed counter pulse density [High-order] (CH3)                |  |     |
| SD4568 | High-speed counter rotation speed [Low-order] (CH3)                | This register stores the high-speed counter rotation speed (CH3).                | R/W |
| SD4569 | High-speed counter rotation speed [High-order] (CH3)               |  |     |
| SD4570 | High-speed counter preset control switch (CH3)                     | This register stores the high-speed counter preset control switch (CH3).         | R/W |
| SD4572 | High-speed counter preset value [Low-order] (CH3)                  | This register stores the high-speed counter preset value (CH3).                  | R/W |
| SD4573 | High-speed counter preset value [High-order] (CH3)                 |  |     |
| SD4574 | High-speed counter ring length [Low-order] (CH3)                   | This register stores the high-speed counter ring length (CH3).                   | R/W |
| SD4575 | High-speed counter ring length [High-order] (CH3)                  |  |     |
| SD4576 | High-speed counter measurement-unit time [Low-order] (CH3)         | This register stores the high-speed counter measurement-unit time (CH3).         | R/W |
| SD4577 | High-speed counter measurement-unit time [High-order] (CH3)        |  |     |
| SD4578 | High-speed counter number of pulses per rotation [Loworder] (CH3)  | This register stores the high-speed counter number of pulses per rotation (CH3). | R/W |
| SD4579 | High-speed counter number of pulses per rotation [Highorder] (CH3) |  |     |
| SD4590 | High-speed counter current value [Low-order] (CH4)                 | This register stores the high-speed counter current value (CH4).                 | R/W |
| SD4591 | High-speed counter current value [High-order] (CH4)                |  |     |
| SD4592 | High-speed counter maximum value [Low-order] (CH4)                 | This register stores the high-speed counter maximum value (CH4).                 | R/W |
| SD4593 | High-speed counter maximum value [High-order] (CH4)                |  |     |
| SD4594 | High-speed counter minimum value [Low-order] (CH4)                 | This register stores the high-speed counter minimum value (CH4).                 | R/W |
| SD4595 | High-speed counter minimum value [High-order] (CH4)                |  |     |
| SD4596 | High-speed counter pulse density [Low-order] (CH4)                 | This register stores the high-speed counter pulse density (CH4).                 | R/W |
| SD4597 | High-speed counter pulse density [High-order] (CH4)                |  |     |
| SD4598 | High-speed counter rotation speed [Low-order] (CH4)                | This register stores the high-speed counter rotation speed (CH4).                | R/W |
| SD4599 | High-speed counter rotation speed [High-order] (CH4)               |  |     |
| SD4600 | High-speed counter preset control switch (CH4)                     | This register stores the high-speed counter preset control switch (CH4).         | R/W |
| SD4602 | High-speed counter preset value [Low-order] (CH4)                  | This register stores the high-speed counter preset value (CH4).                  | R/W |
| SD4603 | High-speed counter preset value [High-order] (CH4)                 |  |     |
| SD4604 | High-speed counter ring length [Low-order] (CH4)                   | This register stores the high-speed counter ring length (CH4).                   | R/W |
| SD4605 | High-speed counter ring length [High-order] (CH4)                  |  |     |
| SD4606 | High-speed counter measurement-unit time [Low-order] (CH4)         | This register stores the high-speed counter measurement-unit time (CH4).         | R/W |
| SD4607 | High-speed counter measurement-unit time [High-order] (CH4)        |  |     |
| SD4608 | High-speed counter number of pulses per rotation [Loworder] (CH4)  | This register stores the high-speed counter number of pulses per rotation (CH4). | R/W |
| SD4609 | High-speed counter number of pulses per rotation [Highorder] (CH4) |  |     |



| No.    | Name   | Description  | R/W |
|--------|--|--|-----|
| SD4620 | High-speed counter current value [Low-order] (CH5)                 | This register stores the high-speed counter current value (CH5).                 | R/W |
| SD4621 | High-speed counter current value [High-order] (CH5)                |  |     |
| SD4622 | High-speed counter maximum value [Low-order] (CH5)                 | This register stores the high-speed counter maximum value (CH5).                 | R/W |
| SD4623 | High-speed counter maximum value [High-order] (CH5)                |  |     |
| SD4624 | High-speed counter minimum value [Low-order] (CH5)                 | This register stores the high-speed counter minimum value (CH5).                 | R/W |
| SD4625 | High-speed counter minimum value [High-order] (CH5)                |  |     |
| SD4626 | High-speed counter pulse density [Low-order] (CH5)                 | This register stores the high-speed counter pulse density (CH5).                 | R/W |
| SD4627 | High-speed counter pulse density [High-order] (CH5)                |  |     |
| SD4628 | High-speed counter rotation speed [Low-order] (CH5)                | This register stores the high-speed counter rotation speed (CH5).                | R/W |
| SD4629 | High-speed counter rotation speed [High-order] (CH5)               |  |     |
| SD4630 | High-speed counter preset control switch (CH5)                     | This register stores the high-speed counter preset control switch (CH5).         | R/W |
| SD4632 | High-speed counter preset value [Low-order] (CH5)                  | This register stores the high-speed counter preset value (CH5).                  | R/W |
| SD4633 | High-speed counter preset value [High-order] (CH5)                 |  |     |
| SD4634 | High-speed counter ring length [Low-order] (CH5)                   | This register stores the high-speed counter ring length (CH5).                   | R/W |
| SD4635 | High-speed counter ring length [High-order] (CH5)                  |  |     |
| SD4636 | High-speed counter measurement-unit time [Low-order] (CH5)         | This register stores the high-speed counter measurement-unit time (CH5).         | R/W |
| SD4637 | High-speed counter measurement-unit time [High-order] (CH5)        |  |     |
| SD4638 | High-speed counter number of pulses per rotation [Loworder] (CH5)  | This register stores the high-speed counter number of pulses per rotation (CH5). | R/W |
| SD4639 | High-speed counter number of pulses per rotation [Highorder] (CH5) |  |     |
| SD4650 | High-speed counter current value [Low-order] (CH6)                 | This register stores the high-speed counter current value (CH6).                 | R/W |
| SD4651 | High-speed counter current value [High-order] (CH6)                |  |     |
| SD4652 | High-speed counter maximum value [Low-order] (CH6)                 | This register stores the high-speed counter maximum value (CH6).                 | R/W |
| SD4653 | High-speed counter maximum value [High-order] (CH6)                |  |     |
| SD4654 | High-speed counter minimum value [Low-order] (CH6)                 | This register stores the high-speed counter minimum value (CH6).                 | R/W |
| SD4655 | High-speed counter minimum value [High-order] (CH6)                |  |     |
| SD4656 | High-speed counter pulse density [Low-order] (CH6)                 | This register stores the high-speed counter pulse density (CH6).                 | R/W |
| SD4657 | High-speed counter pulse density [High-order] (CH6)                |  |     |
| SD4658 | High-speed counter rotation speed [Low-order] (CH6)                | This register stores the high-speed counter rotation speed (CH6).                | R/W |
| SD4659 | High-speed counter rotation speed [High-order] (CH6)               |  |     |
| SD4660 | High-speed counter preset control switch (CH6)                     | This register stores the high-speed counter preset control switch (CH6).         | R/W |
| SD4662 | High-speed counter preset value [Low-order] (CH6)                  | This register stores the high-speed counter preset value (CH6).                  | R/W |
| SD4663 | High-speed counter preset value [High-order] (CH6)                 |  |     |
| SD4664 | High-speed counter ring length [Low-order] (CH6)                   | This register stores the high-speed counter ring length (CH6).                   | R/W |
| SD4665 | High-speed counter ring length [High-order] (CH6)                  |  |     |
| SD4666 | High-speed counter measurement-unit time [Low-order] (CH6)         | This register stores the high-speed counter measurement-unit time (CH6).         | R/W |
| SD4667 | High-speed counter measurement-unit time [High-order] (CH6)        |  |     |
| SD4668 | High-speed counter number of pulses per rotation [Loworder] (CH6)  | This register stores the high-speed counter number of pulses per rotation (CH6). | R/W |
| SD4669 | High-speed counter number of pulses per rotation [Highorder] (CH6) |  |     |
| SD4680 | High-speed counter current value [Low-order] (CH7)                 | This register stores the high-speed counter current value (CH7).                 | R/W |
| SD4681 | High-speed counter current value [High-order] (CH7)                |  |     |
| SD4682 | High-speed counter maximum value [Low-order] (CH7)                 | This register stores the high-speed counter maximum value (CH7).                 | R/W |
| SD4683 | High-speed counter maximum value [High-order] (CH7)                |  |     |
| SD4684 | High-speed counter minimum value [Low-order] (CH7)                 | This register stores the high-speed counter minimum value (CH7).                 | R/W |
| SD4685 | High-speed counter minimum value [High-order] (CH7)                |  |     |
| SD4686 | High-speed counter pulse density [Low-order] (CH7)                 | This register stores the high-speed counter pulse density (CH7).                 | R/W |
| SD4687 | High-speed counter pulse density [High-order] (CH7)                |  |     |



| No.    | Name   | Description   | R/W |
|--------|--|---|-----|
| SD4688 | High-speed counter rotation speed [Low-order] (CH7)                                  | This register stores the high-speed counter rotation speed (CH7).                                 | R/W |
| SD4689 | High-speed counter rotation speed [High-order] (CH7)                                 |   |     |
| SD4690 | High-speed counter preset control switch (CH7)                                       | This register stores the high-speed counter preset control switch (CH7).                          | R/W |
| SD4692 | High-speed counter preset value [Low-order] (CH7)                                    | This register stores the high-speed counter preset value (CH7).                                   | R/W |
| SD4693 | High-speed counter preset value [High-order] (CH7)                                   |   |     |
| SD4694 | High-speed counter ring length [Low-order] (CH7)                                     | This register stores the high-speed counter ring length (CH7).                                    | R/W |
| SD4695 | High-speed counter ring length [High-order] (CH7)                                    |   |     |
| SD4696 | High-speed counter measurement-unit time [Low-order] (CH7)                           | This register stores the high-speed counter measurement-unit time (CH7).                          | R/W |
| SD4697 | High-speed counter measurement-unit time [High-order] (CH7)                          |   |     |
| SD4698 | High-speed counter number of pulses per rotation [Loworder] (CH7)                    | This register stores the high-speed counter number of pulses per rotation (CH7).                  | R/W |
| SD4699 | High-speed counter number of pulses per rotation [Highorder] (CH7)                   |   |     |
| SD4710 | High-speed counter current value [Low-order] (CH8)                                   | This register stores the high-speed counter current value (CH8).                                  | R/W |
| SD4711 | High-speed counter current value [High-order] (CH8)                                  |   |     |
| SD4712 | High-speed counter maximum value [Low-order] (CH8)                                   | This register stores the high-speed counter maximum value (CH8).                                  | R/W |
| SD4713 | High-speed counter maximum value [High-order] (CH8)                                  |   |     |
| SD4714 | High-speed counter minimum value [Low-order] (CH8)                                   | This register stores the high-speed counter minimum value (CH8).                                  | R/W |
| SD4715 | High-speed counter minimum value [High-order] (CH8)                                  |   |     |
| SD4716 | High-speed counter pulse density [Low-order] (CH8)                                   | This register stores the high-speed counter pulse density (CH8).                                  | R/W |
| SD4717 | High-speed counter pulse density [High-order] (CH8)                                  |   |     |
| SD4718 | High-speed counter rotation speed [Low-order] (CH8)                                  | This register stores the high-speed counter rotation speed (CH8).                                 | R/W |
| SD4719 | High-speed counter rotation speed [High-order] (CH8)                                 |   |     |
| SD4720 | High-speed counter preset control switch (CH8)                                       | This register stores the high-speed counter preset control switch (CH8).                          | R/W |
| SD4722 | High-speed counter preset value [Low-order] (CH8)                                    | This register stores the high-speed counter preset value (CH8).                                   | R/W |
| SD4723 | High-speed counter preset value [High-order] (CH8)                                   |   |     |
| SD4724 | High-speed counter ring length [Low-order] (CH8)                                     | This register stores the high-speed counter ring length (CH8).                                    | R/W |
| SD4725 | High-speed counter ring length [High-order] (CH8)                                    |   |     |
| SD4726 | High-speed counter measurement-unit time [Low-order] (CH8)                           | This register stores the high-speed counter measurement-unit time (CH8).                          | R/W |
| SD4727 | High-speed counter measurement-unit time [High-order] (CH8)                          |   |     |
| SD4728 | High-speed counter number of pulses per rotation [Loworder] (CH8)                    | This register stores the high-speed counter number of pulses per rotation (CH8).                  | R/W |
| SD4729 | High-speed counter number of pulses per rotation [Highorder] (CH8)                   |   |     |
| SD4982 | High-speed comparison table (high-speed compare instruction) error code (CPU module) | This register stores the high-speed comparison table (high-speed compare instruction) error code. | R/W |
| SD5000 | Multi-point output high-speed comparison table comparison number                     | This register stores the multi-point output high-speed comparison table comparison number         | R   |
| SD5020 | Pulse width measurement rising ring counter value [Loworder] (CH1)                   | This register stores the pulse width measurement rising ring counter value (CH1).                 | R   |
| SD5021 | Pulse width measurement rising ring counter value [Highorder] (CH1)                  |   |     |
| SD5022 | Pulse width measurement falling ring counter value [Loworder] (CH1)                  | This register stores the pulse width measurement falling ring counter value (CH1).                | R   |
| SD5023 | Pulse width measurement falling ring counter value [Highorder] (CH1)                 |   |     |
| SD5024 | Pulse width measurement latest value [Low-order] (CH1)                               | This register stores the pulse width measurement latest value (CH1).                              | R   |
| SD5025 | Pulse width measurement latest value [High-order] (CH1)                              |   |     |
| SD5026 | Pulse width measurement maximum value [Low-order] (CH1)                              | This register stores the pulse width measurement maximum value (CH1).                             | R/W |
| SD5027 | Pulse width measurement maximum value [High-order] (CH1)                             |   |     |

| No.    | Name   | Description  | R/W |
|--------|--|--|-----|
| SD5028 | Pulse width measurement minimum value [Low-order] (CH1)              | This register stores the pulse width measurement minimum value (CH1).              | R/W |
| SD5029 | Pulse width measurement minimum value [High-order] (CH1)             |  |     |
| SD5030 | Pulse width measurement cycle latest value [Low-order] (CH1)         | This register stores the pulse width measurement cycle latest value (CH1).         | R/W |
| SD5031 | Pulse width measurement cycle latest value [High-order] (CH1)        |  |     |
| SD5032 | Pulse width measurement cycle maximum value [Loworder] (CH1)         | This register stores the pulse width measurement cycle maximum value (CH1).        | R/W |
| SD5033 | Pulse width measurement cycle maximum value [Highorder] (CH1)        |  |     |
| SD5034 | Pulse width measurement cycle minimum value [Loworder] (CH1)         | This register stores the pulse width measurement cycle minimum value (CH1).        | R/W |
| SD5035 | Pulse width measurement cycle minimum value [Highorder] (CH1)        |  |     |
| SD5040 | Pulse width measurement rising ring counter value [Loworder] (CH2)   | This register stores the pulse width measurement rising ring counter value (CH2).  | R/W |
| SD5041 | Pulse width measurement rising ring counter value [Highorder] (CH2)  |  |     |
| SD5042 | Pulse width measurement falling ring counter value [Loworder] (CH2)  | This register stores the pulse width measurement falling ring counter value (CH2). | R/W |
| SD5043 | Pulse width measurement falling ring counter value [Highorder] (CH2) |  |     |
| SD5044 | Pulse width measurement latest value [Low-order] (CH2)               | This register stores the pulse width measurement latest value (CH2).               | R/W |
| SD5045 | Pulse width measurement latest value [High-order] (CH2)              |  |     |
| SD5046 | Pulse width measurement maximum value [Low-order] (CH2)              | This register stores the pulse width measurement maximum value (CH2).              | R/W |
| SD5047 | Pulse width measurement maximum value [High-order] (CH2)             |  |     |
| SD5048 | Pulse width measurement minimum value [Low-order] (CH2)              | This register stores the pulse width measurement minimum value (CH2).              | R/W |
| SD5049 | Pulse width measurement minimum value [High-order] (CH2)             |  |     |
| SD5050 | Pulse width measurement cycle latest value [Low-order] (CH2)         | This register stores the pulse width measurement cycle latest value (CH2).         | R/W |
| SD5051 | Pulse width measurement cycle latest value [High-order] (CH2)        |  |     |
| SD5052 | Pulse width measurement cycle maximum value [Loworder] (CH2)         | This register stores the pulse width measurement cycle maximum value (CH2).        | R/W |
| SD5053 | Pulse width measurement cycle maximum value [Highorder] (CH2)        |  |     |
| SD5054 | Pulse width measurement cycle minimum value [Loworder] (CH2)         | This register stores the pulse width measurement cycle minimum value (CH2).        | R/W |
| SD5055 | Pulse width measurement cycle minimum value [Highorder] (CH2)        |  |     |
| SD5060 | Pulse width measurement rising ring counter value [Loworder] (CH3)   | This register stores the pulse width measurement rising ring counter value (CH3).  | R/W |
| SD5061 | Pulse width measurement rising ring counter value [Highorder] (CH3)  |  |     |
| SD5062 | Pulse width measurement falling ring counter value [Loworder] (CH3)  | This register stores the pulse width measurement falling ring counter value (CH3). | R/W |
| SD5063 | Pulse width measurement falling ring counter value [Highorder] (CH3) |  |     |
| SD5064 | Pulse width measurement latest value [Low-order] (CH3)               | This register stores the pulse width measurement latest value (CH3).               | R/W |
| SD5065 | Pulse width measurement latest value [High-order] (CH3)              |  |     |
| SD5066 | Pulse width measurement maximum value [Low-order] (CH3)              | This register stores the pulse width measurement maximum value (CH3).              | R/W |
| SD5067 | Pulse width measurement maximum value [High-order] (CH3)             |  |     |

| No.    | Name   | Description  | R/W |
|--------|--|--|-----|
| SD5068 | Pulse width measurement minimum value [Low-order] (CH3)              | This register stores the pulse width measurement minimum value (CH3).              | R/W |
| SD5069 | Pulse width measurement minimum value [High-order] (CH3)             |  |     |
| SD5070 | Pulse width measurement cycle latest value [Low-order] (CH3)         | This register stores the pulse width measurement cycle latest value (CH3).         | R/W |
| SD5071 | Pulse width measurement cycle latest value [High-order] (CH3)        |  |     |
| SD5072 | Pulse width measurement cycle maximum value [Loworder] (CH3)         | This register stores the pulse width measurement cycle maximum value (CH3).        | R/W |
| SD5073 | Pulse width measurement cycle maximum value [Highorder] (CH3)        |  |     |
| SD5074 | Pulse width measurement cycle minimum value [Loworder] (CH3)         | This register stores the pulse width measurement cycle minimum value (CH3).        | R/W |
| SD5075 | Pulse width measurement cycle minimum value [Highorder] (CH3)        |  |     |
| SD5080 | Pulse width measurement rising ring counter value [Loworder] (CH4)   | This register stores the pulse width measurement rising ring counter value (CH4).  | R/W |
| SD5081 | Pulse width measurement rising ring counter value [Highorder] (CH4)  |  |     |
| SD5082 | Pulse width measurement falling ring counter value [Loworder] (CH4)  | This register stores the pulse width measurement falling ring counter value (CH4). | R/W |
| SD5083 | Pulse width measurement falling ring counter value [Highorder] (CH4) |  |     |
| SD5084 | Pulse width measurement latest value [Low-order] (CH4)               | This register stores the pulse width measurement latest value (CH4).               | R/W |
| SD5085 | Pulse width measurement latest value [High-order] (CH4)              |  |     |
| SD5086 | Pulse width measurement maximum value [Low-order] (CH4)              | This register stores the pulse width measurement maximum value (CH4).              | R/W |
| SD5087 | Pulse width measurement maximum value [High-order] (CH4)             |  |     |
| SD5088 | Pulse width measurement minimum value [Low-order] (CH4)              | This register stores the pulse width measurement minimum value (CH4).              | R/W |
| SD5089 | Pulse width measurement minimum value [High-order] (CH4)             |  |     |
| SD5090 | Pulse width measurement cycle latest value [Low-order] (CH4)         | This register stores the pulse width measurement cycle latest value (CH4).         | R/W |
| SD5091 | Pulse width measurement cycle latest value [High-order] (CH4)        |  |     |
| SD5092 | Pulse width measurement cycle maximum value [Loworder] (CH4)         | This register stores the pulse width measurement cycle maximum value (CH4).        | R/W |
| SD5093 | Pulse width measurement cycle maximum value [Highorder] (CH4)        |  |     |
| SD5094 | Pulse width measurement cycle minimum value [Loworder] (CH4)         | This register stores the pulse width measurement cycle minimum value (CH4).        | R/W |
| SD5095 | Pulse width measurement cycle minimum value [Highorder] (CH4)        |  |     |
| SD5300 | PWM pulse output number [Low-order] (CH1)                            | This register stores the PWM pulse output number (CH1).                            | R/W |
| SD5301 | PWM pulse output number [High-order] (CH1)                           |  |     |
| SD5302 | PWM pulse width [Low-order] (CH1)                                    | This register stores the PWM pulse width (CH1).                                    | R/W |
| SD5303 | PWM pulse width [High-order] (CH1)                                   |  |     |
| SD5304 | PWM cycle [Low-order] (CH1)  | This register stores the PWM cycle (CH1).  | R/W |
| SD5305 | PWM cycle [High-order] (CH1)   |  |     |
| SD5306 | PWM Number of output pulses current value monitor [Low-order] (CH1)  | This register stores the PWM pulse output number current value (CH1).              | R/W |
| SD5307 | PWM Number of output pulses current value monitor [High-order] (CH1) |  |     |
| SD5316 | PWM pulse output number [Low-order] (CH2)                            | This register stores the PWM pulse output number (CH2).                            | R/W |
| SD5317 | PWM pulse output number [High-order] (CH2)                           |  |     |
| SD5318 | PWM pulse width [Low-order] (CH2)                                    | This register stores the PWM pulse width (CH2).                                    | R/W |
| SD5319 | PWM pulse width [High-order] (CH2)                                   |  |     |

| No.    | Name   | Description   | R/W |
|--------|--|---|-----|
| SD5320 | PWM cycle [Low-order] (CH2)  | This register stores the PWM cycle (CH2).   | R/W |
| SD5321 | PWM cycle [High-order] (CH2)   |   |     |
| SD5322 | PWM Number of output pulses current value monitor [Low-order] (CH2)  | This register stores the PWM pulse output number current value (CH2).                         | R   |
| SD5323 | PWM Number of output pulses current value monitor [High-order] (CH2) |   |     |
| SD5332 | PWM pulse output number [Low-order] (CH3)                            | This register stores the PWM pulse output number (CH3).                                       | R/W |
| SD5333 | PWM pulse output number [High-order] (CH3)                           |   |     |
| SD5334 | PWM pulse width [Low-order] (CH3)                                    | This register stores the PWM pulse width (CH3).   | R/W |
| SD5335 | PWM pulse width [High-order] (CH3)                                   |   |     |
| SD5336 | PWM cycle [Low-order] (CH3)  | This register stores the PWM cycle (CH3).   | R/W |
| SD5337 | PWM cycle [High-order] (CH3)   |   |     |
| SD5338 | PWM Number of output pulses current value monitor [Low-order] (CH3)  | This register stores the PWM pulse output number current value (CH3).                         | R   |
| SD5339 | PWM Number of output pulses current value monitor [High-order] (CH3) |   |     |
| SD5348 | PWM pulse output number [Low-order] (CH4)                            | This register stores the PWM pulse output number (CH4).                                       | R/W |
| SD5349 | PWM pulse output number [High-order] (CH4)                           |   |     |
| SD5350 | PWM pulse width [Low-order] (CH4)                                    | This register stores the PWM pulse width (CH4).   | R/W |
| SD5351 | PWM pulse width [High-order] (CH4)                                   |   |     |
| SD5352 | PWM cycle [Low-order] (CH4)  | This register stores the PWM cycle (CH4).   | R/W |
| SD5353 | PWM cycle [High-order] (CH4)   |   |     |
| SD5354 | PWM Number of output pulses current value monitor [Low-order] (CH4)  | This register stores the PWM pulse output number current value (CH4).                         | R   |
| SD5355 | PWM Number of output pulses current value monitor [High-order] (CH4) |   |     |
| SD5500 | Positioning current address (user unit) [Low-order] (axis 1)         | This register stores the current address (user unit) of positioning (axis 1).                 | R/W |
| SD5501 | Positioning current address (user unit) [High-order] (axis 1)        |   |     |
| SD5502 | Positioning current address (pulse unit) [Low-order] (axis 1)        | This register stores the current address (pulse unit) of positioning (axis 1).                | R/W |
| SD5503 | Positioning current address (pulse unit) [High-order] (axis 1)       |   |     |
| SD5504 | Positioning current speed (user unit) [Low-order] (axis 1)           | This register stores the current speed (user unit) of positioning (axis 1).                   | R   |
| SD5505 | Positioning current speed (user unit) [High-order] (axis 1)          |   |     |
| SD5506 | Positioning execution table number (axis 1)                          | This register stores the execution table number of positioning (axis 1).                      | R   |
| SD5510 | Positioning error code (axis 1)                                      | This register stores the error code of positioning (axis 1).                                  | R/W |
| SD5511 | Positioning error table number (axis 1)                              | This register stores the error table number of positioning (axis 1).                          | R/W |
| SD5516 | Positioning maximum speed [Low-order] (axis 1)                       | This register stores the maximum speed of positioning (axis 1).                               | R/W |
| SD5517 | Positioning maximum speed [High-order] (axis 1)                      |   |     |
| SD5518 | Positioning bias speed [Low-order] (axis 1)                          | This register stores the bias speed of positioning (axis 1).                                  | R/W |
| SD5519 | Positioning bias speed [High-order] (axis 1)                         |   |     |
| SD5520 | Positioning acceleration time (axis 1)                               | This register stores the acceleration time of positioning (axis 1).                           | R/W |
| SD5521 | Positioning deceleration time (axis 1)                               | This register stores the deceleration time of positioning (axis 1).                           | R/W |
| SD5526 | Positioning zero-return speed [Low-order] (axis 1)                   | This register stores the zero-return speed of positioning (axis 1).                           | R/W |
| SD5527 | Positioning zero-return speed [High-order] (axis 1)                  |   |     |
| SD5528 | Positioning creep speed [Low-order] (axis 1)                         | This register stores the creep speed of positioning (axis 1).                                 | R/W |
| SD5529 | Positioning creep speed [High-order] (axis 1)                        |   |     |
| SD5530 | Positioning zero-point address [Low-order] (axis 1)                  | This register stores the zero-point address of positioning (axis 1).                          | R/W |
| SD5531 | Positioning zero-point address [High-order] (axis 1)                 |   |     |
| SD5532 | Positioning number of zero-point signal for zero return              | This register stores the number of zero-point signal for zero return of positioning (axis 1). | R/W |
| SD5533 | Positioning zero-return dwell time (axis 1)                          | This register stores the zero-return dwell time of positioning (axis 1).                      | R/W |

| No.    | Name   | Description   | R/W |
|--------|--|---|-----|
| SD5540 | Positioning current address (user unit) [Low-order] (axis 2)     | This register stores the current address (user unit) of positioning (axis 2).                 | R/W |
| SD5541 | Positioning current address (user unit) [High-order] (axis 2)    |   |     |
| SD5542 | Positioning current address (pulse unit) [Low-order] (axis 2)    | This register stores the current address (pulse unit) of positioning (axis 2).                | R/W |
| SD5543 | Positioning current address (pulse unit) [High-order] (axis 2)   |   |     |
| SD5544 | Positioning current speed (user unit) [Low-order] (axis 2)       | This register stores the current speed (user unit) of positioning (axis 2).                   | R   |
| SD5545 | Positioning current speed (user unit) [High-order] (axis 2)      |   |     |
| SD5546 | Positioning execution table number (axis 2)                      | This register stores the execution table number of positioning (axis 2).                      | R   |
| SD5550 | Positioning error code (axis 2)                                  | This register stores the error code of positioning (axis 2).                                  | R/W |
| SD5551 | Positioning error table number (axis 2)                          | This register stores the error table number of positioning (axis 2).                          | R/W |
| SD5556 | Positioning maximum speed [Low-order] (axis 2)                   | This register stores the maximum speed of positioning (axis 2).                               | R/W |
| SD5557 | Positioning maximum speed [High-order] (axis 2)                  |   |     |
| SD5558 | Positioning bias speed [Low-order] (axis 2)                      | This register stores the bias speed of positioning (axis 2).                                  | R/W |
| SD5559 | Positioning bias speed [High-order] (axis 2)                     |   |     |
| SD5560 | Positioning acceleration time (axis 2)                           | This register stores the acceleration time of positioning (axis 2).                           | R/W |
| SD5561 | Positioning deceleration time (axis 2)                           | This register stores the deceleration time of positioning (axis 2).                           | R/W |
| SD5566 | Positioning zero-return speed [Low-order] (axis 2)               | This register stores the zero-return speed of positioning (axis 2).                           | R/W |
| SD5567 | Positioning zero-return speed [High-order] (axis 2)              |   |     |
| SD5568 | Positioning creep speed [Low-order] (axis 2)                     | This register stores the creep speed of positioning (axis 2).                                 | R/W |
| SD5569 | Positioning creep speed [High-order] (axis 2)                    |   |     |
| SD5570 | Positioning zero-point address [Low-order] (axis 2)              | This register stores the zero-point address of positioning (axis 2).                          | R/W |
| SD5571 | Positioning zero-point address [High-order] (axis 2)             |   |     |
| SD5572 | Positioning number of zero-point signal for zero return (axis 2) | This register stores the number of zero-point signal for zero return of positioning (axis 2). | R/W |
| SD5573 | Positioning zero-return dwell time (axis 2)                      | This register stores the zero-return dwell time of positioning (axis 2).                      | R/W |
| SD5580 | Positioning current address (user unit) [Low-order] (axis 3)     | This register stores the current address (user unit) of positioning (axis 3).                 | R/W |
| SD5581 | Positioning current address (user unit) [High-order] (axis 3)    |   |     |
| SD5582 | Positioning current address (pulse unit) [Low-order] (axis 3)    | This register stores the current address (pulse unit) of positioning (axis 3).                | R/W |
| SD5583 | Positioning current address (pulse unit) [High-order] (axis 3)   |   |     |
| SD5584 | Positioning current speed (user unit) [Low-order] (axis 3)       | This register stores the current speed (user unit) of positioning (axis 3).                   | R   |
| SD5585 | Positioning current speed (user unit) [High-order] (axis 3)      |   |     |
| SD5586 | Positioning execution table number (axis 3)                      | This register stores the execution table number of positioning (axis 3).                      | R   |
| SD5590 | Positioning error code (axis 3)                                  | This register stores the error code of positioning (axis 3).                                  | R/W |
| SD5591 | Positioning error table number (axis 3)                          | This register stores the error table number of positioning (axis 3).                          | R/W |
| SD5596 | Positioning maximum speed [Low-order] (axis 3)                   | This register stores the maximum speed of positioning (axis 3).                               | R/W |
| SD5597 | Positioning maximum speed [High-order] (axis 3)                  |   |     |
| SD5598 | Positioning bias speed [Low-order] (axis 3)                      | This register stores the bias speed of positioning (axis 3).                                  | R/W |
| SD5599 | Positioning bias speed [High-order] (axis 3)                     |   |     |
| SD5600 | Positioning acceleration time (axis 3)                           | This register stores the acceleration time of positioning (axis 3).                           | R/W |
| SD5601 | Positioning deceleration time (axis 3)                           | This register stores the deceleration time of positioning (axis 3).                           | R/W |
| SD5606 | Positioning zero-return speed [Low-order] (axis 3)               | This register stores the zero-return speed of positioning (axis 3).                           | R/W |
| SD5607 | Positioning zero-return speed [High-order] (axis 3)              |   |     |
| SD5608 | Positioning creep speed [Low-order] (axis 3)                     | This register stores the creep speed of positioning (axis 3).                                 | R/W |
| SD5609 | Positioning creep speed [High-order] (axis 3)                    |   |     |
| SD5610 | Positioning zero-point address [Low-order] (axis 3)              | This register stores the zero-point address of positioning (axis 3).                          | R/W |
| SD5611 | Positioning zero-point address [High-order] (axis 3)             |   |     |
| SD5612 | Positioning number of zero-point signal for zero return (axis 3) | This register stores the number of zero-point signal for zero return of positioning (axis 3). | R/W |

| No.    | Name   | Description   | R/W |
|--------|--|---|-----|
| SD5613 | Positioning zero-return dwell time (axis 3)                      | This register stores the zero-return dwell time of positioning (axis 3).                      | R/W |
| SD5620 | Positioning current address (user unit) [Low-order] (axis 4)     | This register stores the current address (user unit) of positioning (axis 4).                 | R/W |
| SD5621 | Positioning current address (user unit) [High-order] (axis 4)    |   |     |
| SD5622 | Positioning current address (pulse unit) [Low-order] (axis 4)    | This register stores the current address (pulse unit) of positioning (axis 4).                | R/W |
| SD5623 | Positioning current address (pulse unit) [High-order] (axis 4)   |   |     |
| SD5624 | Positioning current speed (user unit) [Low-order] (axis 4)       | This register stores the current speed (user unit) of positioning (axis 4).                   | R   |
| SD5625 | Positioning current speed (user unit) [High-order] (axis 4)      |   |     |
| SD5626 | Positioning execution table number (axis 4)                      | This register stores the execution table number of positioning (axis 4).                      | R   |
| SD5630 | Positioning error code (axis 4)                                  | This register stores the error code of positioning (axis 4).                                  | R/W |
| SD5631 | Positioning error table number (axis 4)                          | This register stores the error table number of positioning (axis 4).                          | R/W |
| SD5636 | Positioning maximum speed [Low-order] (axis 4)                   | This register stores the maximum speed of positioning (axis 4).                               | R/W |
| SD5637 | Positioning maximum speed [High-order] (axis 4)                  |   |     |
| SD5638 | Positioning bias speed [Low-order] (axis 4)                      | This register stores the bias speed of positioning (axis 4).                                  | R/W |
| SD5639 | Positioning bias speed [High-order] (axis 4)                     |   |     |
| SD5640 | Positioning acceleration time (axis 4)                           | This register stores the acceleration time of positioning (axis 4).                           | R/W |
| SD5641 | Positioning deceleration time (axis 4)                           | This register stores the deceleration time of positioning (axis 4).                           | R/W |
| SD5646 | Positioning zero-return speed [Low-order] (axis 4)               | This register stores the zero-return speed of positioning (axis 4).                           | R/W |
| SD5647 | Positioning zero-return speed [High-order] (axis 4)              |   |     |
| SD5648 | Positioning creep speed [Low-order] (axis 4)                     | This register stores the creep speed of positioning (axis 4).                                 | R/W |
| SD5649 | Positioning creep speed [High-order] (axis 4)                    |   |     |
| SD5650 | Positioning zero-point address [Low-order] (axis 4)              | This register stores the zero-point address of positioning (axis 4).                          | R/W |
| SD5651 | Positioning zero-point address [High-order] (axis 4)             |   |     |
| SD5652 | Positioning number of zero-point signal for zero return (axis 4) | This register stores the number of zero-point signal for zero return of positioning (axis 4). | R/W |
| SD5653 | Positioning zero-return dwell time (axis 4)                      | This register stores the zero-return dwell time of positioning (axis 4).                      | R/W |

## Built-in analog

The special registers for built-in analog are shown below.  
R: Read only, R/W: Read/Write

| No.    | Name  | Description   | R/W |
|--------|---|---|-----|
| SD6020 | CH1 Digital output value                          | This register stores the digital output value.                          | R   |
| SD6021 | CH1 Digital operation value                       | This register stores the digital operation value.                       | R   |
| SD6022 | CH1 Analog input voltage monitor                  | This register stores the analog input voltage value.                    | R   |
| SD6023 | CH1 Averaging process setting                     | This register stores the averaging process setting.                     | R/W |
| SD6024 | CH1 Time Average/Frequency Average/Moving Average | This register stores the time average/frequency average/moving average. | R/W |
| SD6026 | CH1 Maximum value                                 | This register stores the maximum value.                                 | R   |
| SD6027 | CH1 Minimum value                                 | This register stores the minimum value.                                 | R   |
| SD6028 | CH1 Scaling upper limit value                     | This register stores the scaling upper limit value.                     | R/W |
| SD6029 | CH1 Scaling lower limit value                     | This register stores the scaling lower limit value.                     | R/W |
| SD6030 | CH1 Shifting amount to conversion value           | This register stores the shifting amount of conversion value.           | R/W |
| SD6031 | CH1 Process alarm upper upper limit value         | This register stores the process alarm upper upper limit value.         | R/W |
| SD6032 | CH1 Process alarm upper lower limit value         | This register stores the process alarm upper lower limit value.         | R/W |
| SD6033 | CH1 Process alarm lower upper limit value         | This register stores the process alarm lower upper limit value.         | R/W |
| SD6034 | CH1 Process alarm lower lower limit value         | This register stores the process alarm lower lower limit value.         | R/W |
| SD6058 | CH1 Latest alarm code                             | This register stores the latest alarm code.                             | R   |
| SD6059 | CH1 Latest error code                             | This register stores the latest error code.                             | R   |
| SD6060 | Ch2 Digital output value                          | This register stores the digital output value.                          | R   |
| SD6061 | CH2 Digital operation value                       | This register stores the digital operation value.                       | R   |



| No.    | Name  | Description   | R/W |
|--------|---|---|-----|
| SD6062 | CH2 Analog input voltage monitor                  | This register stores the analog input voltage value.                    | R   |
| SD6063 | CH2 Averaging process setting                     | This register stores the averaging process setting.                     | R/W |
| SD6064 | CH2 Time Average/Frequency Average/Moving Average | This register stores the time average/frequency average/moving average. | R/W |
| SD6066 | CH2 Maximum value                                 | This register stores the maximum value.                                 | R   |
| SD6067 | CH2 Minimum value                                 | This register stores the minimum value.                                 | R   |
| SD6068 | CH2 Scaling upper limit value                     | This register stores the scaling upper limit value.                     | R/W |
| SD6069 | CH2 Scaling lower limit value                     | This register stores the scaling lower limit value.                     | R/W |
| SD6070 | CH2 Shifting amount to conversion value           | This register stores the shifting amount of conversion value.           | R/W |
| SD6071 | CH2 Process alarm upper upper limit value         | This register stores the process alarm upper upper limit value.         | R/W |
| SD6072 | CH2 Process alarm upper lower limit value         | This register stores the process alarm upper lower limit value.         | R/W |
| SD6073 | CH2 Process alarm lower upper limit value         | This register stores the process alarm lower upper limit value.         | R/W |
| SD6074 | CH2 Process alarm lower lower limit value         | This register stores the process alarm lower lower limit value.         | R/W |
| SD6098 | CH2 Latest alarm code                             | This register stores the latest alarm code.                             | R   |
| SD6099 | CH2 Latest error code                             | This register stores the latest error code.                             | R   |
| SD6180 | Digital input value                               | This register stores the digital input value.                           | R/W |
| SD6181 | Digital operation value                           | This register stores the digital operation value.                       | R   |
| SD6182 | Analog output voltage monitor                     | This register stores the analog output voltage value.                   | R   |
| SD6183 | HOLD/CLEAR setting                                | This register stores the HOLD/CLEAR setting.                            | R/W |
| SD6184 | HOLD setting value                                | This register stores the HOLD setting value.                            | R/W |
| SD6188 | Scaling upper limit value                         | This register stores the scaling upper limit value.                     | R/W |
| SD6189 | Scaling lower limit value                         | This register stores the scaling lower limit value.                     | R/W |
| SD6190 | Input value shift amount                          | This register stores the input value shift amount.                      | R/W |
| SD6191 | Warning output upper limit value                  | This register stores the warning output upper limit value.              | R/W |
| SD6192 | Warning output lower limit value                  | This register stores the warning output lower limit value.              | R/W |
| SD6218 | Latest alarm code                                 | This register stores the latest alarm code.                             | R   |
| SD6219 | Latest error code                                 | This register stores the latest error code.                             | R   |

## FX Compatible area

The special registers for FX compatible area are shown below.

R: Read only, R/W: Read/Write

| No.    | Name                           | Description  | R/W |
|--------|--------------------------------|--|-----|
| SD8000 | Watchdog timer                 | This register stores the watchdog timer.   | R/W |
| SD8001 | PLC type and system version    | This register stores the PLC type and system version.  | R   |
| SD8005 | Battery voltage                | This register stores the battery voltage.  | R   |
| SD8006 | Low battery voltage            | This register stores the low battery voltage.(units: 0.1 V)  | R/W |
| SD8007 | Power failure count            | This register stores the power failure count.  | R   |
| SD8008 | Power failure detection period | This register stores the power failure detection period.<br>When the power supply voltage is 200 V AC, the time can be change to 10 to 100 ms. | R/W |
| SD8010 | Current scan time              | This register stores the current scan time.  | R   |
| SD8011 | Minimum scan time              | This register stores the minimum scan time.  | R   |
| SD8012 | Maximum scan time              | This register stores the maximum scan time.  | R   |
| SD8013 | RTC: Seconds                   | This register stores the seconds data.   | R   |
| SD8014 | RTC: Minute data               | This register stores the minute data.  | R   |
| SD8015 | RTC: Hour data                 | This register stores the hour data.  | R   |
| SD8016 | RTC: Day data                  | This register stores the day data.   | R   |
| SD8017 | RTC: Month data                | This register stores the month data.   | R   |
| SD8018 | RTC: Year data                 | This register stores the year data.  | R   |
| SD8019 | RTC: Day of week data          | This register stores the day of week data.   | R   |
| SD8039 | Constant scan duration         | This register stores the constant scan duration.   | R/W |
| SD8040 | ON state number 1              | This register stores the ON state number 1.  | R/W |
| SD8041 | ON state number 2              | This register stores the ON state number 2.  | R/W |

| No.    | Name  | Description  | R/W |
|--------|---|--|-----|
| SD8042 | ON state number 3   | This register stores the ON state number 3.  | R/W |
| SD8043 | ON state number 4   | This register stores the ON state number 4.  | R/W |
| SD8044 | ON state number 5   | This register stores the ON state number 5.  | R/W |
| SD8045 | ON state number 6   | This register stores the ON state number 6.  | R/W |
| SD8046 | ON state number 7   | This register stores the ON state number 7.  | R/W |
| SD8047 | ON state number 8   | This register stores the ON state number 8.  | R/W |
| SD8049 | Lowest active Annunciator   | This register stores the lowest active annunciator.  | R/W |
| SD8063 | Serial communication error code (ch1)                             | This register stores the serial communication error code (ch1).                            | R   |
| SD8067 | Operation error   | This register stores the error code number of operation error.                             | R   |
| SD8099 | High speed ring counter   | This register stores the high speed ring counter count value.<br>(units: 0.1 ms)           | R/W |
| SD8136 | PLSY Output number [Low-order]                                    | This register stores the PLSY instruction output pulse number.                             | R   |
| SD8137 | PLSY Output number [High-order]                                   |  |     |
| SD8140 | PLSY Accumulated number of pulses output [Low-order]<br>(axis 1)  | This register stores the PLSY instruction accumulated number of pulses output (to axis 1). | R   |
| SD8141 | PLSY Accumulated number of pulses output [High-order]<br>(axis 1) |  |     |
| SD8142 | PLSY Accumulated number of pulses output [Low-order]<br>(axis 2)  | This register stores the PLSY instruction accumulated number of pulses output (to axis 2). | R   |
| SD8143 | PLSY Accumulated number of pulses output [High-order]<br>(axis 2) |  |     |
| SD8152 | Error No. of Inverter communication (ch1)                         | This register stores the error code of Inverter communication (ch1).                       | R   |
| SD8154 | Error parameter No. of IVBWR (ch1)                                | This register stores the error parameter No. of IVBWR instruction (ch1).                   | R   |
| SD8157 | Error No. of Inverter communication (ch2)                         | This register stores the error code of Inverter communication (ch2).                       | R   |
| SD8159 | Error parameter No. of IVBWR (ch2)                                | This register stores the error parameter No. of IVBWR instruction (ch2).                   | R   |
| SD8173 | Station number  | This register stores the station number.   | R/W |
| SD8174 | Total number of slave stations                                    | This register stores the total number of slave stations.                                   | R/W |
| SD8175 | Refresh range   | This register stores the refresh range.  | R   |
| SD8201 | Current link scan time  | This register stores the current link scan time.   | R   |
| SD8202 | Maximum link scan time  | This register stores the maximum link scan time.   | R   |
| SD8203 | Number of communication error at master station                   | This register stores the number of communication error at master station.                  | R   |
| SD8204 | Number of communication error at slave station No.1               | This register stores the number of communication error at slave station No.1.              | R   |
| SD8205 | Number of communication error at slave station No.2               | This register stores the number of communication error at slave station No.2.              | R   |
| SD8206 | Number of communication error at slave station No.3               | This register stores the number of communication error at slave station No.3.              | R   |
| SD8207 | Number of communication error at slave station No.4               | This register stores the number of communication error at slave station No.4.              | R   |
| SD8208 | Number of communication error at slave station No.5               | This register stores the number of communication error at slave station No.5.              | R   |
| SD8209 | Number of communication error at slave station No.6               | This register stores the number of communication error at slave station No.6.              | R   |
| SD8210 | Number of communication error at slave station No.7               | This register stores the number of communication error at slave station No.7.              | R   |
| SD8211 | Code of communication error at master station                     | This register stores the code of communication error at master station.                    | R   |
| SD8212 | Code of communication error at slave station No.1                 | This register stores the code of communication error at slave station No.1.                | R   |
| SD8213 | Code of communication error at slave station No.2                 | This register stores the code of communication error at slave station No.2.                | R   |
| SD8214 | Code of communication error at slave station No.3                 | This register stores the code of communication error at slave station No.3.                | R   |



| No.    | Name  | Description   | R/W |
|--------|---|---|-----|
| SD8215 | Code of communication error at slave station No.4                                   | This register stores the code of communication error at slave station No.4.                               | R   |
| SD8216 | Code of communication error at slave station No.5                                   | This register stores the code of communication error at slave station No.5.                               | R   |
| SD8217 | Code of communication error at slave station No.6                                   | This register stores the code of communication error at slave station No.6.                               | R   |
| SD8218 | Code of communication error at slave station No.7                                   | This register stores the code of communication error at slave station No.7.                               | R   |
| SD8230 | Number of communication error at master station                                     | This register stores the number of communication error at master station.                                 | R   |
| SD8231 | Number of communication error at slave station No.1                                 | This register stores the number of communication error at slave station No.1.                             | R   |
| SD8232 | Number of communication error at slave station No.2                                 | This register stores the number of communication error at slave station No.2.                             | R   |
| SD8233 | Number of communication error at slave station No.3                                 | This register stores the number of communication error at slave station No.3.                             | R   |
| SD8234 | Number of communication error at slave station No.4                                 | This register stores the number of communication error at slave station No.4.                             | R   |
| SD8235 | Number of communication error at slave station No.5                                 | This register stores the number of communication error at slave station No.5.                             | R   |
| SD8236 | Number of communication error at slave station No.6                                 | This register stores the number of communication error at slave station No.6.                             | R   |
| SD8237 | Number of communication error at slave station No.7                                 | This register stores the number of communication error at slave station No.7.                             | R   |
| SD8310 | RND Random number generation [Low-order]  | This register stores the RND random number generation data.   | R   |
| SD8311 | RND Random number generation [High-order]   |   |     |
| SD8330 | Counted number of scans for timing clock output 1                                   | This register stores the scan count for timing clock output 1.  | R   |
| SD8331 | Counted number of scans for timing clock output 2                                   | This register stores the scan count for timing clock output 2.  | R   |
| SD8332 | Counted number of scans for timing clock output 3                                   | This register stores the scan count for timing clock output 3.  | R   |
| SD8333 | Counted number of scans for timing clock output 4                                   | This register stores the scan count for timing clock output 4.  | R   |
| SD8334 | Counted number of scans for timing clock output 5                                   | This register stores the scan count for timing clock output 5.  | R   |
| SD8340 | Current address [Low-order] (axis 1: pulse units)                                   | This register stores the current address (axis 1: pulse units).   | R   |
| SD8341 | Current address [High-order] (axis 1: pulse units)                                  |   |     |
| SD8350 | Current address [Low-order] (axis 2: pulse units)                                   | This register stores the current address (axis 2: pulse units).   | R   |
| SD8351 | Current address [High-order] (axis 2: pulse units)                                  |   |     |
| SD8360 | Current address [Low-order] (axis 3: pulse units)                                   | This register stores the current address (axis 3: pulse units).   | R   |
| SD8361 | Current address [High-order] (axis 3: pulse units)                                  |   |     |
| SD8370 | Current address [Low-order] (axis 4: pulse units)                                   | This register stores the current address (axis 4: pulse units).   | R   |
| SD8371 | Current address [High-order] (axis 4: pulse units)                                  |   |     |
| SD8398 | 1 ms ring counter [Low-order]   | This register stores the 1 ms ring counter.   | R   |
| SD8399 | 1 ms ring counter [High-order]  |   |     |
| SD8402 | RS2 amount of remaining data (ch1)/MODBUS communication error code (ch1)            | This register stores the amount of remaining data(ch1)/MODBUS communication error code (ch1).             | R   |
| SD8403 | RS2 receive data points (ch1)/MODBUS communication error details (ch1)              | This register stores the receive data points (ch1)/MODBUS communication error details (ch1).              | R   |
| SD8405 | RS2 communication parameter display (ch1)/MODBUS communication format display (ch1) | This register stores the communication parameter display (ch1)/MODBUS communication format display (ch1). | R   |
| SD8408 | MODBUS communication retry times (ch1)  | This register stores the MODBUS communication current retry times (ch1).                                  | R   |
| SD8414 | RS2 receive sum (received data) (ch1)   | This register stores the ch1 receive sum (received data).   | R   |
| SD8415 | RS2 receive sum (calculated result) (ch1)   | This register stores the ch1 receive sum (calculated result) .  | R   |
| SD8416 | RS2 send sum (ch1)  | This register stores the send sum (ch1).  | R   |
| SD8419 | Operation mode (ch1)  | This register stores the operation mode (ch1).  | R   |
| SD8422 | RS2 amount of remaining data (ch2)/MODBUS communication error code (ch2)            | This register stores the amount of remaining data (ch2)/MODBUS communication error code (ch2).            | R   |
| SD8423 | RS2 receive data points (ch2)/MODBUS communication error details (ch2)              | This register stores the receive data points (ch2)/MODBUS communication error details (ch2).              | R   |

| No.    | Name  | Description   | R/W |
|--------|---|---|-----|
| SD8425 | RS2 receive sum (calculated result) (ch2)       | This register stores the receive sum (calculated result).                         | R   |
| SD8428 | MODBUS communication retry times (ch2)          | This register stores the MODBUS communication current retry times (ch2).          | R   |
| SD8434 | RS2 receive sum (received data) (ch2)           | This register stores the ch2 receive sum (received data).                         | R   |
| SD8435 | RS2 receive sum (calculated result) (ch2)       | This register stores the ch2 receive sum (calculated result).                     | R   |
| SD8436 | RS2 send sum (ch2)                              | This register stores the send sum (ch2).  | R   |
| SD8438 | Serial communication error code (ch2)           | This register stores the serial communication error code (ch2).                   | R   |
| SD8439 | Operation mode (ch2)                            | This register stores the operation mode (ch2).                                    | R   |
| SD8492 | IP address setting [Low-order]                  | This register stores the IP address.  | R/W |
| SD8493 | IP address setting [High-order]                 |   |     |
| SD8494 | Subnet mask setting [Low-order]                 | This register stores the subnet mask.   | R/W |
| SD8495 | Subnet mask setting [High-order]                |   |     |
| SD8496 | Default gateway IP address setting [Low-order]  | This register stores the default gateway IP address.                              | R/W |
| SD8497 | Default gateway IP address setting [High-order] |   |     |
| SD8498 | IP address storage area write error code        | This register stores error codes if writing to IP address storage area is failed. | R   |
| SD8499 | IP address storage area clear error code        | This register stores error codes if clear to IP address storage area is failed.   | R   |

## Serial communication

The special registers for serial communication are shown below.

R: Read only, R/W: Read/Write

| No.    | Name  | Description   | R/W |
|--------|---|---|-----|
| SD8500 | Serial communication error code (ch1)       | This register stores the serial communication error code 1 (ch1).       | R   |
| SD8501 | Serial communication error details (ch1)    | This register stores the serial communication error details 1 (ch1).    | R   |
| SD8502 | Serial communication setting (ch1)          | This register stores the serial communication setting (ch1).            | R   |
| SD8503 | Serial communication operational mode (ch1) | This register stores the serial communication operational mode 1 (ch1). | R   |
| SD8510 | Serial communication error code (ch2)       | This register stores the serial communication error code 2 (ch2).       | R   |
| SD8511 | Serial communication error details (ch2)    | This register stores the serial communication error details 2 (ch2).    | R   |
| SD8512 | Serial communication setting (ch2)          | This register stores the serial communication setting (ch2).            | R   |
| SD8513 | Serial communication operational mode (ch2) | This register stores the serial communication operational mode 2 (ch2). | R   |
| SD8520 | Serial communication error code (ch3)       | This register stores the serial communication error code 3 (ch3).       | R   |
| SD8521 | Serial communication error details (ch3)    | This register stores the serial communication error details 3 (ch3).    | R   |
| SD8522 | Serial communication setting (ch3)          | This register stores the serial communication setting (ch3).            | R   |
| SD8523 | Serial communication operational mode (ch3) | This register stores the serial communication operational mode 3 (ch3). | R   |
| SD8530 | Serial communication error code (ch4)       | This register stores the serial communication error code 4 (ch4).       | R   |
| SD8531 | Serial communication error details (ch4)    | This register stores the serial communication error details 4 (ch4).    | R   |
| SD8532 | Serial communication setting (ch4)          | This register stores the serial communication setting (ch4).            | R   |
| SD8533 | Serial communication operational mode (ch4) | This register stores the serial communication operational mode 4 (ch4). | R   |
| SD8560 | Remaining points of send data (ch1)         | This register stores the remaining points of send data (ch1).           | R   |
| SD8561 | Receive data points monitor (ch1)           | This register stores the receive data points monitor (ch1).             | R   |
| SD8563 | Receive sum (received data) (ch1)           | This register stores the receive sum (received data) (ch1).             | R   |
| SD8564 | Receive sum (received result) (ch1)         | This register stores the receive sum (received result) (ch1).           | R   |
| SD8565 | Send sum (ch1)                              | This register stores the send sum (ch1).                                | R   |
| SD8570 | Remaining points of send data (ch2)         | This register stores the remaining points of send data (ch2).           | R   |
| SD8571 | Receive data points monitor (ch2)           | This register stores the receive data points monitor (ch2).             | R   |
| SD8573 | Receive sum (received data) (ch2)           | This register stores the receive sum (received data) (ch2).             | R   |
| SD8574 | Receive sum (received result) (ch2)         | This register stores the receive sum (received result) (ch2).           | R   |
| SD8575 | Send sum (ch2)                              | This register stores the send sum (ch2).                                | R   |
| SD8580 | Remaining points of send data (ch3)         | This register stores the remaining points of send data (ch3).           | R   |

| No.    | Name                                | Description   | R/W |
|--------|-------------------------------------|---|-----|
| SD8581 | Receive data points monitor (ch3)   | This register stores the receive data points monitor (ch3).   | R   |
| SD8583 | Receive sum (received data) (ch3)   | This register stores the receive sum (received data) (ch3).   | R   |
| SD8584 | Receive sum (received result) (ch3) | This register stores the receive sum (received result) (ch3). | R   |
| SD8585 | Send sum (ch3)                      | This register stores the send sum (ch3).                      | R   |
| SD8590 | Remaining points of send data (ch4) | This register stores the remaining points of send data (ch4). | R   |
| SD8591 | Receive data points monitor (ch4)   | This register stores the receive data points monitor (ch4).   | R   |
| SD8593 | Receive sum (received data) (ch4)   | This register stores the receive sum (received data) (ch4).   | R   |
| SD8594 | Receive sum (received result) (ch4) | This register stores the receive sum (received result) (ch4). | R   |
| SD8595 | Send sum (ch4)                      | This register stores the send sum (ch4).                      | R   |
| SD8621 | Timeout time (ch1)                  | This register stores the timeout time (ch1).                  | R   |
| SD8622 | 8-bit processing mode (ch1)         | This register stores the 8-bit processing mode (ch1).         | R   |
| SD8623 | Header 1 and 2 (ch1)                | This register stores the header 1 and 2 (ch1).                | R   |
| SD8624 | Header 3 and 4 (ch1)                | This register stores the header 3 and 4 (ch1).                | R   |
| SD8625 | Terminator 1 and 2 (ch1)            | This register stores the terminator 1 and 2 (ch1).            | R   |
| SD8626 | Terminator 3 and 4 (ch1)            | This register stores the terminator 3 and 4 (ch1).            | R   |
| SD8631 | Timeout time (ch2)                  | This register stores the timeout time (ch2).                  | R   |
| SD8632 | 8-bit processing mode (ch2)         | This register stores the 8-bit processing mode (ch2).         | R   |
| SD8633 | Header 1 and 2 (ch2)                | This register stores the header 1 and 2 (ch2).                | R   |
| SD8634 | Header 3 and 4 (ch2)                | This register stores the header 3 and 4 (ch2).                | R   |
| SD8635 | Terminator 1 and 2 (ch2)            | This register stores the terminator 1 and 2 (ch2).            | R   |
| SD8636 | Terminator 3 and 4 (ch2)            | This register stores the terminator 3 and 4 (ch2).            | R   |
| SD8641 | Timeout time (ch3)                  | This register stores the timeout time (ch3).                  | R   |
| SD8642 | 8-bit processing mode (ch3)         | This register stores the 8-bit processing mode (ch3).         | R   |
| SD8643 | Header 1 and 2 (ch3)                | This register stores the header 1 and 2 (ch3).                | R   |
| SD8644 | Header 3 and 4 (ch3)                | This register stores the header 3 and 4 (ch3).                | R   |
| SD8645 | Terminator 1 and 2 (ch3)            | This register stores the terminator 1 and 2 (ch3).            | R   |
| SD8646 | Terminator 3 and 4 (ch3)            | This register stores the terminator 3 and 4 (ch3).            | R   |
| SD8651 | Timeout time (ch4)                  | This register stores the timeout time (ch4).                  | R   |
| SD8652 | 8-bit processing mode (ch4)         | This register stores the 8-bit processing mode (ch4).         | R   |
| SD8653 | Header 1 and 2 (ch4)                | This register stores the header 1 and 2 (ch4).                | R   |
| SD8654 | Header 3 and 4 (ch4)                | This register stores the header 3 and 4 (ch4).                | R   |
| SD8655 | Terminator 1 and 2 (ch4)            | This register stores the terminator 1 and 2 (ch4).            | R   |
| SD8656 | Terminator 3 and 4 (ch4)            | This register stores the terminator 3 and 4 (ch4).            | R   |
| SD8740 | Station number setting (ch1)        | This register stores the station number setting (ch1).        | R   |
| SD8741 | Message frame and form (ch1)        | This register stores the message frame and form (ch1).        | R   |
| SD8742 | Timeout time (ch1)                  | This register stores the timeout time (ch1).                  | R   |
| SD8750 | Station number setting (ch2)        | This register stores the station number setting (ch2).        | R/W |
| SD8751 | Message frame and form (ch2)        | This register stores the message frame and form (ch2).        | R   |
| SD8752 | Timeout time (ch2)                  | This register stores the timeout time (ch2).                  | R   |
| SD8760 | Station number setting (ch3)        | This register stores the station number setting (ch3).        | R/W |
| SD8761 | Message frame and form (ch3)        | This register stores the message frame and form (ch3).        | R   |
| SD8762 | Timeout time (ch3)                  | This register stores the timeout time (ch3).                  | R   |
| SD8770 | Station number setting (ch4)        | This register stores the station number setting (ch4).        | R/W |
| SD8771 | Message frame and form (ch4)        | This register stores the message frame and form (ch4).        | R   |
| SD8772 | Timeout time (ch4)                  | This register stores the timeout time (ch4).                  | R   |
| SD8800 | Current retry value (ch1)           | This register stores the current retry value (ch1).           | R   |
| SD8810 | Current retry value (ch2)           | This register stores the current retry value (ch2).           | R   |
| SD8820 | Current retry value (ch3)           | This register stores the current retry value (ch3).           | R   |
| SD8830 | Current retry value (ch4)           | This register stores the current retry value (ch4).           | R   |
| SD8861 | Slave node address (ch1)            | This register stores the host station number (ch1).           | R   |
| SD8862 | Slave response timeout (ch1)        | This register stores the slave response timeout (ch1).        | R   |
| SD8863 | Turn around delay (ch1)             | This register stores the broadcast delay (ch1).               | R   |
| SD8864 | Message to message delay (ch1)      | This register stores the request to request delay (ch1).      | R   |

| No.    | Name  | Description   | R/W |
|--------|---|---|-----|
| SD8865 | Number of retries (ch1)                             | This register stores the number of retries during timeout (ch1).              | R   |
| SD8871 | Slave node address (ch2)                            | This register stores the host station number (ch2).                           | R   |
| SD8872 | Slave response timeout (ch2)                        | This register stores the slave response timeout (ch2).                        | R   |
| SD8873 | Turn around delay (ch2)                             | This register stores the broadcast delay (ch12).                              | R   |
| SD8874 | Message to message delay (ch2)                      | This register stores the request to request delay (ch2).                      | R   |
| SD8875 | Number of retries (ch2)                             | This register stores the number of retries during timeout (ch2).              | R   |
| SD8881 | Slave node address (ch3)                            | This register stores the host station number (ch3).                           | R   |
| SD8882 | Slave response timeout (ch3)                        | This register stores the slave response timeout (ch3).                        | R   |
| SD8883 | Turn around delay (ch3)                             | This register stores the broadcast delay (ch3).                               | R   |
| SD8884 | Message to message delay (ch3)                      | This register stores the request to request delay (ch3).                      | R   |
| SD8885 | Number of retries (ch3)                             | This register stores the number of retries during timeout (ch3).              | R   |
| SD8891 | Slave node address (ch4)                            | This register stores the host station number (ch4).                           | R   |
| SD8892 | Slave response timeout (ch4)                        | This register stores the slave response timeout (ch4).                        | R   |
| SD8893 | Turn around delay (ch4)                             | This register stores the broadcast delay (ch4).                               | R   |
| SD8894 | Message to message delay (ch4)                      | This register stores the request to request delay (ch4).                      | R   |
| SD8895 | Number of retries (ch4)                             | This register stores the number of retries during timeout (ch4).              | R   |
| SD8921 | IVBWR instruction error parameter number (ch1)      | This register stores the IVBWR instruction error parameter number (ch1).      | R   |
| SD8931 | IVBWR instruction error parameter number (ch2)      | This register stores the IVBWR instruction error parameter number (ch2).      | R   |
| SD8941 | IVBWR instruction error parameter number (ch3)      | This register stores the IVBWR instruction error parameter number (ch3).      | R   |
| SD8951 | IVBWR instruction error parameter number (ch4)      | This register stores the IVBWR instruction error parameter number (ch4).      | R   |
| SD8981 | Response wait time (ch1)                            | This register stores the response wait time (ch1).                            | R   |
| SD8991 | Response wait time (ch2)                            | This register stores the response wait time (ch2).                            | R   |
| SD9001 | Response wait time (ch3)                            | This register stores the response wait time (ch3).                            | R   |
| SD9011 | Response wait time (ch4)                            | This register stores the response wait time (ch4).                            | R   |
| SD9040 | Station number                                      | This register stores the station number.                                      | R   |
| SD9041 | Total number of slave stations                      | This register stores the total number of slave stations.                      | R   |
| SD9043 | Current link scan time                              | This register stores the current link scan time.                              | R   |
| SD9044 | Maximum link scan time                              | This register stores the maximum link scan time.                              | R   |
| SD9045 | Number of communication error at master station     | This register stores the number of communication error at master station.     | R   |
| SD9046 | Number of communication error at slave station No.1 | This register stores the number of communication error at slave station No.1. | R   |
| SD9047 | Number of communication error at slave station No.2 | This register stores the number of communication error at slave station No.2. | R   |
| SD9048 | Number of communication error at slave station No.3 | This register stores the number of communication error at slave station No.3. | R   |
| SD9049 | Number of communication error at slave station No.4 | This register stores the number of communication error at slave station No.4. | R   |
| SD9050 | Number of communication error at slave station No.5 | This register stores the number of communication error at slave station No.5. | R   |
| SD9051 | Number of communication error at slave station No.6 | This register stores the number of communication error at slave station No.6. | R   |
| SD9052 | Number of communication error at slave station No.7 | This register stores the number of communication error at slave station No.7. | R   |
| SD9061 | Code of communication error at master station       | This register stores the code of communication error at master station.       | R   |
| SD9062 | Code of communication error at slave station No.1   | This register stores the code of communication error at slave station No.1.   | R   |
| SD9063 | Code of communication error at slave station No.2   | This register stores the code of communication error at slave station No.2.   | R   |
| SD9064 | Code of communication error at slave station No.3   | This register stores the code of communication error at slave station No.3.   | R   |

| No.    | Name  | Description   | R/W |
|--------|---|---|-----|
| SD9065 | Code of communication error at slave station No.4 | This register stores the code of communication error at slave station No.4. | R   |
| SD9066 | Code of communication error at slave station No.5 | This register stores the code of communication error at slave station No.5. | R   |
| SD9067 | Code of communication error at slave station No.6 | This register stores the code of communication error at slave station No.6. | R   |
| SD9068 | Code of communication error at slave station No.7 | This register stores the code of communication error at slave station No.7. | R   |
| SD9080 | Station number setting                            | This register stores the station number setting.                            | R/W |
| SD9081 | Total slave station number setting                | This register stores the total slave station number setting.                | R/W |
| SD9082 | Refresh range setting                             | This register stores the refresh range setting.                             | R   |
| SD9083 | Retry count setting                               | This register stores the retry count setting.                               | R   |
| SD9084 | Communication time-out setting                    | This register stores the communication time-out setting.                    | R   |

## Built-in Ethernet

The special registers for built-in Ethernet are shown below.

R: Read only, R/W: Read/Write

| No.     | Name   | Description   | R/W |
|---------|--|---|-----|
| SD10050 | Local node IP address [Low-order]                      | This register stores the local node IP address.   | R   |
| SD10051 | Local node IP address [High-order]                     |   |     |
| SD10060 | Subnet mask [Low-order]                                | This register stores the subnet mask.   | R   |
| SD10061 | Subnet mask [High-order]                               |   |     |
| SD10064 | Default gateway IP address [Low-order]                 | This register stores the default gateway IP address.  | R   |
| SD10065 | Default gateway IP address [High-order]                |   |     |
| SD10074 | Local node MAC address                                 | This register stores the local node MAC address (5 and 6 bytes).  | R   |
| SD10075 | Local node MAC address                                 | This register stores the local node MAC address (3 and 4 bytes).  | R   |
| SD10076 | Local node MAC address                                 | This register stores the local node MAC address (1 and 2 bytes).  | R   |
| SD10082 | Communication speed setting                            | This register stores the communication speed setting.   | R   |
| SD10084 | MELSOFT connection TCP port No.                        | This register stores the MELSOFT connection TCP port No.  | R   |
| SD10086 | MELSOFT direct connection port No.                     | This register stores the MELSOFT direct connection port No.   | R   |
| SD10130 | Connection No.1 latest error code                      | This register stores the connection No.1 latest error code.   | R   |
| SD10131 | Connection No.2 latest error code                      | This register stores the connection No.2 latest error code.   | R   |
| SD10132 | Connection No.3 latest error code                      | This register stores the connection No.3 latest error code.   | R   |
| SD10133 | Connection No.4 latest error code                      | This register stores the connection No.4 latest error code.   | R   |
| SD10134 | Connection No.5 latest error code                      | This register stores the connection No.5 latest error code.   | R   |
| SD10135 | Connection No.6 latest error code                      | This register stores the connection No.6 latest error code.   | R   |
| SD10136 | Connection No.7 latest error code                      | This register stores the connection No.7 latest error code.   | R   |
| SD10137 | Connection No.8 latest error code                      | This register stores the connection No.8 latest error code.   | R   |
| SD10270 | Remote password lock status connection No. 1 to 8      | b0: Connection No.1<br>b1: Connection No.2<br>b2: Connection No.3<br>b3: Connection No.4<br>b4: Connection No.5<br>b5: Connection No.6<br>b6: Connection No.7<br>b7: Connection No.8<br>0: Unlock status/remote password setting none<br>1: Lock status | R   |
| SD10271 | Remote password lock status system port                | b2: MELSOFT application communication port (TCP)<br>b3: MELSOFT direct connection<br>0: Unlock status/remote password setting none<br>1: Lock status  | R   |
| SD10320 | Connection 1 continuous unlock failure number of times | This register stores the connection 1 continuous unlock failure number of times.  | R   |
| SD10321 | Connection 2 continuous unlock failure number of times | This register stores the connection 2 continuous unlock failure number of times.  | R   |

| No.     | Name  | Description  | R/W |
|---------|---|--|-----|
| SD10322 | Connection 3 continuous unlock failure number of times                        | This register stores the connection 3 continuous unlock failure number of times.   | R   |
| SD10323 | Connection 4 continuous unlock failure number of times                        | This register stores the connection 4 continuous unlock failure number of times.   | R   |
| SD10324 | Connection 5 continuous unlock failure number of times                        | This register stores the connection 5 continuous unlock failure number of times.   | R   |
| SD10325 | Connection 6 continuous unlock failure number of times                        | This register stores the connection 6 continuous unlock failure number of times.   | R   |
| SD10326 | Connection 7 continuous unlock failure number of times                        | This register stores the connection 7 continuous unlock failure number of times.   | R   |
| SD10327 | Connection 8 continuous unlock failure number of times                        | This register stores the connection 8 continuous unlock failure number of times.   | R   |
| SD10338 | MELSOFT communication port (TCP/IP) continuous unlock failure number of times | This register stores the MELSOFT communication port (TCP/IP) continuous unlock failure number of times.  | R   |
| SD10340 | MELSOFT direct connection continuous unlock failure number of times           | This register stores the MELSOFT direct connection continuous unlock failure number of times.  | R   |
| SD10680 | Open completion signal  | b0: Connection No.1<br>b1: Connection No.2<br>b2: Connection No.3<br>b3: Connection No.4<br>b4: Connection No.5<br>b5: Connection No.6<br>b6: Connection No.7<br>b7: Connection No.8<br>0: Close/Open not completed<br>1: Open completed   | R   |
| SD10681 | Open request signal   | b0: Connection No.1<br>b1: Connection No.2<br>b2: Connection No.3<br>b3: Connection No.4<br>b4: Connection No.5<br>b5: Connection No.6<br>b6: Connection No.7<br>b7: Connection No.8<br>0: No open request<br>1: Open request exists       | R   |
| SD10682 | Socket communications receive status signal                                   | b0: Connection No.1<br>b1: Connection No.2<br>b2: Connection No.3<br>b3: Connection No.4<br>b4: Connection No.5<br>b5: Connection No.6<br>b6: Connection No.7<br>b7: Connection No.8<br>0: No data received<br>1: Data receiving completed | R   |
| SD10692 | Predefined protocol ready   | 0: —<br>1: Ready   | R   |
| SD10710 | Predefined protocol setting data error information protocol number            | When a protocol setting data error is detected, stores the protocol number where the error was detected.   | R   |
| SD10711 | Predefined protocol setting data error information setting type               | 0 is stored if an error is detected in the packet setting or element setting.<br>1 is stored if an error is detected in the protocol detailed setting.   | R   |
| SD10712 | Predefined protocol setting data error information packet number              | When an error is detected in the protocol setting data, stores the packet number that detected the error.  | R   |
| SD10713 | Predefined protocol setting data error information Element number             | When an error is detected in the protocol setting data, stores the element number where the error was detected.  | R   |
| SD10714 | Number of registered predefined protocols                                     | Stores the protocol number of the registered protocol setting data.  | R   |
| SD10722 | Predefined protocol registration (1 to 16)                                    | Whether protocol setting data is registered or not is stored.  | R   |
| SD10723 | Predefined protocol registration (17 to 32)                                   |  |     |
| SD10724 | Predefined protocol registration (33 to 48)                                   |  |     |
| SD10725 | Predefined protocol registration (49 to 64)                                   |  |     |



| No.     | Name   | Description   | R/W |
|---------|--|---|-----|
| SD10740 | Connection No.1 protocol execution status                                | Stores the status of the protocol being executed at connection No.1.<br>0: Unexecuted<br>1: Waiting for transmission<br>2: Sending<br>3: Waiting for data reception<br>4: Receiving<br>5: Execution completed | R   |
| SD10742 | Connection No.1 received data verification result (receive packet No.1)  | Stores the verification results of receive packet No.1.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                 | R   |
| SD10743 | Connection No.1 received data verification result (receive packet No.2)  | Stores the verification results of receive packet No.2.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                 | R   |
| SD10744 | Connection No.1 received data verification result (receive packet No.3)  | Stores the verification results of receive packet No.3.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                 | R   |
| SD10745 | Connection No.1 received data verification result (receive packet No.4)  | Stores the verification results of receive packet No.4.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                 | R   |
| SD10746 | Connection No.1 received data verification result (receive packet No.5)  | Stores the verification results of receive packet No.5.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                 | R   |
| SD10747 | Connection No.1 received data verification result (receive packet No.6)  | Stores the verification results of receive packet No.6.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                 | R   |
| SD10748 | Connection No.1 received data verification result (receive packet No.7)  | Stores the verification results of receive packet No.7.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                 | R   |
| SD10749 | Connection No.1 received data verification result (receive packet No.8)  | Stores the verification results of receive packet No.8.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                 | R   |
| SD10750 | Connection No.1 received data verification result (receive packet No.9)  | Stores the verification results of receive packet No.9.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                 | R   |
| SD10751 | Connection No.1 received data verification result (receive packet No.10) | Stores the verification results of receive packet No.10.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                | R   |
| SD10752 | Connection No.1 received data verification result (receive packet No.11) | Stores the verification results of receive packet No.11.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                | R   |
| SD10753 | Connection No.1 received data verification result (receive packet No.12) | Stores the verification results of receive packet No.12.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                | R   |
| SD10754 | Connection No.1 received data verification result (receive packet No.13) | Stores the verification results of receive packet No.13.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                | R   |
| SD10755 | Connection No.1 received data verification result (receive packet No.14) | Stores the verification results of receive packet No.14.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                | R   |
| SD10756 | Connection No.1 received data verification result (receive packet No.15) | Stores the verification results of receive packet No.15.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                | R   |
| SD10757 | Connection No.1 received data verification result (receive packet No.16) | Stores the verification results of receive packet No.16.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                | R   |
| SD10758 | Connection No.1 protocol execution count                                 | Stores the number of protocol executions in Connection No.1.<br>0: Protocol not executed<br>1 to 65535: Number of executions  | R   |
| SD10759 | Connection No.1 protocol cancellation specification                      | Cancels the protocol executed in connection No.1.<br>0: No cancellation instruction<br>1: Cancellation request (set by user)<br>2: Cancellation completed (set by system)                                     | R/W |

| No.     | Name   | Description   | R/W |
|---------|--|---|-----|
| SD10760 | Connection No.2 protocol execution status                                | Stores the status of the protocol being executed at connection No.2.<br>0: Unexecuted<br>1: Waiting for transmission<br>2: Sending<br>3: Waiting for data reception<br>4: Receiving<br>5: Execution completed | R   |
| SD10762 | Connection No.2 received data verification result (receive packet No.1)  | Stores the verification results of receive packet No.1.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                 | R   |
| SD10763 | Connection No.2 received data verification result (receive packet No.2)  | Stores the verification results of receive packet No.2.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                 | R   |
| SD10764 | Connection No.2 received data verification result (receive packet No.3)  | Stores the verification results of receive packet No.3.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                 | R   |
| SD10765 | Connection No.2 received data verification result (receive packet No.4)  | Stores the verification results of receive packet No.4.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                 | R   |
| SD10766 | Connection No.2 received data verification result (receive packet No.5)  | Stores the verification results of receive packet No.5.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                 | R   |
| SD10767 | Connection No.2 received data verification result (receive packet No.6)  | Stores the verification results of receive packet No.6.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                 | R   |
| SD10768 | Connection No.2 received data verification result (receive packet No.7)  | Stores the verification results of receive packet No.7.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                 | R   |
| SD10769 | Connection No.2 received data verification result (receive packet No.8)  | Stores the verification results of receive packet No.8.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                 | R   |
| SD10770 | Connection No.2 received data verification result (receive packet No.9)  | Stores the verification results of receive packet No.9.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                 | R   |
| SD10771 | Connection No.2 received data verification result (receive packet No.10) | Stores the verification results of receive packet No.10.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                | R   |
| SD10772 | Connection No.2 received data verification result (receive packet No.11) | Stores the verification results of receive packet No.11.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                | R   |
| SD10773 | Connection No.2 received data verification result (receive packet No.12) | Stores the verification results of receive packet No.12.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                | R   |
| SD10774 | Connection No.2 received data verification result (receive packet No.13) | Stores the verification results of receive packet No.13.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                | R   |
| SD10775 | Connection No.2 received data verification result (receive packet No.14) | Stores the verification results of receive packet No.14.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                | R   |
| SD10776 | Connection No.2 received data verification result (receive packet No.15) | Stores the verification results of receive packet No.15.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                | R   |
| SD10777 | Connection No.2 received data verification result (receive packet No.16) | Stores the verification results of receive packet No.16.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                | R   |
| SD10778 | Connection No.2 protocol execution count                                 | Stores the number of protocol executions in connection No.2.<br>0: Protocol not executed<br>1 to 65535: Number of executions  | R   |
| SD10779 | Connection No.2 protocol cancellation specification                      | Cancels the protocol executed in connection No.2.<br>0: No cancellation instruction<br>1: Cancellation request (set by user)<br>2: Cancellation completed (set by system)                                     | R/W |



| No.     | Name   | Description   | R/W |
|---------|--|---|-----|
| SD10780 | Connection No.3 protocol execution status                                | Stores the status of the protocol being executed at connection No.3.<br>0: Unexecuted<br>1: Waiting for transmission<br>2: Sending<br>3: Waiting for data reception<br>4: Receiving<br>5: Execution completed | R   |
| SD10782 | Connection No.3 received data verification result (receive packet No.1)  | Stores the verification results of receive packet No.1.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                 | R   |
| SD10783 | Connection No.3 received data verification result (receive packet No.2)  | Stores the verification results of receive packet No.2.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                 | R   |
| SD10784 | Connection No.3 received data verification result (receive packet No.3)  | Stores the verification results of receive packet No.3.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                 | R   |
| SD10785 | Connection No.3 received data verification result (receive packet No.4)  | Stores the verification results of receive packet No.4.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                 | R   |
| SD10786 | Connection No.3 received data verification result (receive packet No.5)  | Stores the verification results of receive packet No.5.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                 | R   |
| SD10787 | Connection No.3 received data verification result (receive packet No.6)  | Stores the verification results of receive packet No.6.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                 | R   |
| SD10788 | Connection No.3 received data verification result (receive packet No.7)  | Stores the verification results of receive packet No.7.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                 | R   |
| SD10789 | Connection No.3 received data verification result (receive packet No.8)  | Stores the verification results of receive packet No.8.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                 | R   |
| SD10790 | Connection No.3 received data verification result (receive packet No.9)  | Stores the verification results of receive packet No.9.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                 | R   |
| SD10791 | Connection No.3 received data verification result (receive packet No.10) | Stores the verification results of receive packet No.10.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                | R   |
| SD10792 | Connection No.3 received data verification result (receive packet No.11) | Stores the verification results of receive packet No.11.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                | R   |
| SD10793 | Connection No.3 received data verification result (receive packet No.12) | Stores the verification results of receive packet No.12.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                | R   |
| SD10794 | Connection No.3 received data verification result (receive packet No.13) | Stores the verification results of receive packet No.13.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                | R   |
| SD10795 | Connection No.3 received data verification result (receive packet No.14) | Stores the verification results of receive packet No.14.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                | R   |
| SD10796 | Connection No.3 received data verification result (receive packet No.15) | Stores the verification results of receive packet No.15.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                | R   |
| SD10797 | Connection No.3 received data verification result (receive packet No.16) | Stores the verification results of receive packet No.16.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                | R   |
| SD10798 | Connection No.3 protocol execution count                                 | Stores the number of protocol executions in connection No.3.<br>0: Protocol not executed<br>1 to 65535: Number of executions  | R   |
| SD10799 | Connection No.3 protocol cancellation specification                      | Cancels the protocol executed in connection No.3.<br>0: No cancellation instruction<br>1: Cancellation request (set by user)<br>2: Cancellation completed (set by system)                                     | R/W |

| No.     | Name   | Description   | R/W |
|---------|--|---|-----|
| SD10800 | Connection No.4 protocol execution status                                | Stores the status of the protocol being executed at connection No.4.<br>0: Unexecuted<br>1: Waiting for transmission<br>2: Sending<br>3: Waiting for data reception<br>4: Receiving<br>5: Execution completed | R   |
| SD10802 | Connection No.4 received data verification result (receive packet No.1)  | Stores the verification results of receive packet No.1.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                 | R   |
| SD10803 | Connection No.4 received data verification result (receive packet No.2)  | Stores the verification results of receive packet No.2.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                 | R   |
| SD10804 | Connection No.4 received data verification result (receive packet No.3)  | Stores the verification results of receive packet No.3.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                 | R   |
| SD10805 | Connection No.4 received data verification result (receive packet No.4)  | Stores the verification results of receive packet No.4.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                 | R   |
| SD10806 | Connection No.4 received data verification result (receive packet No.5)  | Stores the verification results of receive packet No.5.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                 | R   |
| SD10807 | Connection No.4 received data verification result (receive packet No.6)  | Stores the verification results of receive packet No.6.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                 | R   |
| SD10808 | Connection No.4 received data verification result (receive packet No.7)  | Stores the verification results of receive packet No.7.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                 | R   |
| SD10809 | Connection No.4 received data verification result (receive packet No.8)  | Stores the verification results of receive packet No.8.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                 | R   |
| SD10810 | Connection No.4 received data verification result (receive packet No.9)  | Stores the verification results of receive packet No.9.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                 | R   |
| SD10811 | Connection No.4 received data verification result (receive packet No.10) | Stores the verification results of receive packet No.10.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                | R   |
| SD10812 | Connection No.4 received data verification result (receive packet No.11) | Stores the verification results of receive packet No.11.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                | R   |
| SD10813 | Connection No.4 received data verification result (receive packet No.12) | Stores the verification results of receive packet No.12.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                | R   |
| SD10814 | Connection No.4 received data verification result (receive packet No.13) | Stores the verification results of receive packet No.13.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                | R   |
| SD10815 | Connection No.4 received data verification result (receive packet No.14) | Stores the verification results of receive packet No.14.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                | R   |
| SD10816 | Connection No.4 received data verification result (receive packet No.15) | Stores the verification results of receive packet No.15.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                | R   |
| SD10817 | Connection No.4 received data verification result (receive packet No.16) | Stores the verification results of receive packet No.16.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                | R   |
| SD10818 | Connection No.4 protocol execution count                                 | Stores the number of protocol executions in connection No.4.<br>0: Protocol not executed<br>1 to 65535: Number of executions  | R   |
| SD10819 | Connection No.4 protocol cancellation specification                      | Cancels the protocol executed in connection No.4.<br>0: No cancellation instruction<br>1: Cancellation request (set by user)<br>2: Cancellation completed (set by system)                                     | R/W |

| No.     | Name   | Description   | R/W |
|---------|--|---|-----|
| SD10820 | Connection No.5 protocol execution status                                | Stores the status of the protocol being executed at connection No.5.<br>0: Unexecuted<br>1: Waiting for transmission<br>2: Sending<br>3: Waiting for data reception<br>4: Receiving<br>5: Execution completed | R   |
| SD10822 | Connection No.5 received data verification result (receive packet No.1)  | Stores the verification results of receive packet No.1.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                 | R   |
| SD10823 | Connection No.5 received data verification result (receive packet No.2)  | Stores the verification results of receive packet No.2.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                 | R   |
| SD10824 | Connection No.5 received data verification result (receive packet No.3)  | Stores the verification results of receive packet No.3.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                 | R   |
| SD10825 | Connection No.5 received data verification result (receive packet No.4)  | Stores the verification results of receive packet No.4.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                 | R   |
| SD10826 | Connection No.5 received data verification result (receive packet No.5)  | Stores the verification results of receive packet No.5.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                 | R   |
| SD10827 | Connection No.5 received data verification result (receive packet No.6)  | Stores the verification results of receive packet No.6.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                 | R   |
| SD10828 | Connection No.5 received data verification result (receive packet No.7)  | Stores the verification results of receive packet No.7.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                 | R   |
| SD10829 | Connection No.5 received data verification result (receive packet No.8)  | Stores the verification results of receive packet No.8.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                 | R   |
| SD10830 | Connection No.5 received data verification result (receive packet No.9)  | Stores the verification results of receive packet No.9.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                 | R   |
| SD10831 | Connection No.5 received data verification result (receive packet No.10) | Stores the verification results of receive packet No.10.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                | R   |
| SD10832 | Connection No.5 received data verification result (receive packet No.11) | Stores the verification results of receive packet No.11.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                | R   |
| SD10833 | Connection No.5 received data verification result (receive packet No.12) | Stores the verification results of receive packet No.12.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                | R   |
| SD10834 | Connection No.5 received data verification result (receive packet No.13) | Stores the verification results of receive packet No.13.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                | R   |
| SD10835 | Connection No.5 received data verification result (receive packet No.14) | Stores the verification results of receive packet No.14.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                | R   |
| SD10836 | Connection No.5 received data verification result (receive packet No.15) | Stores the verification results of receive packet No.15.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                | R   |
| SD10837 | Connection No.5 received data verification result (receive packet No.16) | Stores the verification results of receive packet No.16.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                | R   |
| SD10838 | Connection No.5 protocol execution count                                 | Stores the number of protocol executions in connection No.5.<br>0: Protocol not executed<br>1 to 65535: Number of executions  | R   |
| SD10839 | Connection No.5 protocol cancellation specification                      | Cancels the protocol executed in connection No.5.<br>0: No cancellation instruction<br>1: Cancellation request (set by user)<br>2: Cancellation completed (set by system)                                     | R/W |

| No.     | Name   | Description   | R/W |
|---------|--|---|-----|
| SD10840 | Connection No.6 protocol execution status                                | Stores the status of the protocol being executed at connection No.6.<br>0: Unexecuted<br>1: Waiting for transmission<br>2: Sending<br>3: Waiting for data reception<br>4: Receiving<br>5: Execution completed | R   |
| SD10842 | Connection No.6 received data verification result (receive packet No.1)  | Stores the verification results of receive packet No.1.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                 | R   |
| SD10843 | Connection No.6 received data verification result (receive packet No.2)  | Stores the verification results of receive packet No.2.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                 | R   |
| SD10844 | Connection No.6 received data verification result (receive packet No.3)  | Stores the verification results of receive packet No.3.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                 | R   |
| SD10845 | Connection No.6 received data verification result (receive packet No.4)  | Stores the verification results of receive packet No.4.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                 | R   |
| SD10846 | Connection No.6 received data verification result (receive packet No.5)  | Stores the verification results of receive packet No.5.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                 | R   |
| SD10847 | Connection No.6 received data verification result (receive packet No.6)  | Stores the verification results of receive packet No.6.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                 | R   |
| SD10848 | Connection No.6 received data verification result (receive packet No.7)  | Stores the verification results of receive packet No.7.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                 | R   |
| SD10849 | Connection No.6 received data verification result (receive packet No.8)  | Stores the verification results of receive packet No.8.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                 | R   |
| SD10850 | Connection No.6 received data verification result (receive packet No.9)  | Stores the verification results of receive packet No.9.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                 | R   |
| SD10851 | Connection No.6 received data verification result (receive packet No.10) | Stores the verification results of receive packet No.10.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                | R   |
| SD10852 | Connection No.6 received data verification result (receive packet No.11) | Stores the verification results of receive packet No.11.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                | R   |
| SD10853 | Connection No.6 received data verification result (receive packet No.12) | Stores the verification results of receive packet No.12.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                | R   |
| SD10854 | Connection No.6 received data verification result (receive packet No.13) | Stores the verification results of receive packet No.13.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                | R   |
| SD10855 | Connection No.6 received data verification result (receive packet No.14) | Stores the verification results of receive packet No.14.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                | R   |
| SD10856 | Connection No.6 received data verification result (receive packet No.15) | Stores the verification results of receive packet No.15.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                | R   |
| SD10857 | Connection No.6 received data verification result (receive packet No.16) | Stores the verification results of receive packet No.16.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                | R   |
| SD10858 | Connection No.6 protocol execution count                                 | Stores the number of protocol executions in connection No.6.<br>0: Protocol not executed<br>1 to 65535: Number of executions  | R   |
| SD10859 | Connection No.6 protocol cancellation specification                      | Cancels the protocol executed in connection No.6.<br>0: No cancellation instruction<br>1: Cancellation request (set by user)<br>2: Cancellation completed (set by system)                                     | R/W |

| No.     | Name   | Description   | R/W |
|---------|--|---|-----|
| SD10860 | Connection No.7 protocol execution status                                | Stores the status of the protocol being executed at connection No.7.<br>0: Unexecuted<br>1: Waiting for transmission<br>2: Sending<br>3: Waiting for data reception<br>4: Receiving<br>5: Execution completed | R   |
| SD10862 | Connection No.7 received data verification result (receive packet No.1)  | Stores the verification results of receive packet No.1.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                 | R   |
| SD10863 | Connection No.7 received data verification result (receive packet No.2)  | Stores the verification results of receive packet No.2.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                 | R   |
| SD10864 | Connection No.7 received data verification result (receive packet No.3)  | Stores the verification results of receive packet No.3.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                 | R   |
| SD10865 | Connection No.7 received data verification result (receive packet No.4)  | Stores the verification results of receive packet No.4.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                 | R   |
| SD10866 | Connection No.7 received data verification result (receive packet No.5)  | Stores the verification results of receive packet No.5.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                 | R   |
| SD10867 | Connection No.7 received data verification result (receive packet No.6)  | Stores the verification results of receive packet No.6.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                 | R   |
| SD10868 | Connection No.7 received data verification result (receive packet No.7)  | Stores the verification results of receive packet No.7.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                 | R   |
| SD10869 | Connection No.7 received data verification result (receive packet No.8)  | Stores the verification results of receive packet No.8.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                 | R   |
| SD10870 | Connection No.7 received data verification result (receive packet No.9)  | Stores the verification results of receive packet No.9.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                 | R   |
| SD10871 | Connection No.7 received data verification result (receive packet No.10) | Stores the verification results of receive packet No.10.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                | R   |
| SD10872 | Connection No.7 received data verification result (receive packet No.11) | Stores the verification results of receive packet No.11.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                | R   |
| SD10873 | Connection No.7 received data verification result (receive packet No.12) | Stores the verification results of receive packet No.12.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                | R   |
| SD10874 | Connection No.7 received data verification result (receive packet No.13) | Stores the verification results of receive packet No.13.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                | R   |
| SD10875 | Connection No.7 received data verification result (receive packet No.14) | Stores the verification results of receive packet No.14.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                | R   |
| SD10876 | Connection No.7 received data verification result (receive packet No.15) | Stores the verification results of receive packet No.15.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                | R   |
| SD10877 | Connection No.7 received data verification result (receive packet No.16) | Stores the verification results of receive packet No.16.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                | R   |
| SD10878 | Connection No.7 protocol execution count                                 | Stores the number of protocol executions in connection No.7.<br>0: Protocol not executed<br>1 to 65535: Number of executions  | R   |
| SD10879 | Connection No.7 protocol cancellation specification                      | Cancels the protocol executed in connection No.7.<br>0: No cancellation instruction<br>1: Cancellation request (set by user)<br>2: Cancellation completed (set by system)                                     | R/W |

| No.     | Name   | Description   | R/W |
|---------|--|---|-----|
| SD10880 | Connection No.8 protocol execution status                                | Stores the status of the protocol being executed at connection No.8.<br>0: Unexecuted<br>1: Waiting for transmission<br>2: Sending<br>3: Waiting for data reception<br>4: Receiving<br>5: Execution completed | R   |
| SD10882 | Connection No.8 received data verification result (receive packet No.1)  | Stores the verification results of receive packet No.1.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                 | R   |
| SD10883 | Connection No.8 received data verification result (receive packet No.2)  | Stores the verification results of receive packet No.2.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                 | R   |
| SD10884 | Connection No.8 received data verification result (receive packet No.3)  | Stores the verification results of receive packet No.3.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                 | R   |
| SD10885 | Connection No.8 received data verification result (receive packet No.4)  | Stores the verification results of receive packet No.4.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                 | R   |
| SD10886 | Connection No.8 received data verification result (receive packet No.5)  | Stores the verification results of receive packet No.5.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                 | R   |
| SD10887 | Connection No.8 received data verification result (receive packet No.6)  | Stores the verification results of receive packet No.6.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                 | R   |
| SD10888 | Connection No.8 received data verification result (receive packet No.7)  | Stores the verification results of receive packet No.7.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                 | R   |
| SD10889 | Connection No.8 received data verification result (receive packet No.8)  | Stores the verification results of receive packet No.8.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                 | R   |
| SD10890 | Connection No.8 received data verification result (receive packet No.9)  | Stores the verification results of receive packet No.9.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                 | R   |
| SD10891 | Connection No.8 received data verification result (receive packet No.10) | Stores the verification results of receive packet No.10.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                | R   |
| SD10892 | Connection No.8 received data verification result (receive packet No.11) | Stores the verification results of receive packet No.11.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                | R   |
| SD10893 | Connection No.8 received data verification result (receive packet No.12) | Stores the verification results of receive packet No.12.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                | R   |
| SD10894 | Connection No.8 received data verification result (receive packet No.13) | Stores the verification results of receive packet No.13.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                | R   |
| SD10895 | Connection No.8 received data verification result (receive packet No.14) | Stores the verification results of receive packet No.14.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                | R   |
| SD10896 | Connection No.8 received data verification result (receive packet No.15) | Stores the verification results of receive packet No.15.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                | R   |
| SD10897 | Connection No.8 received data verification result (receive packet No.16) | Stores the verification results of receive packet No.16.<br>Element No. where the verification result did not match (b0 to b7)<br>The cause of mismatch (verification result code) (b8 to b15)                | R   |
| SD10898 | Connection No.8 protocol execution count                                 | Stores the number of protocol executions in connection No.8.<br>0: Protocol not executed<br>1 to 65535: Number of executions  | R   |
| SD10899 | Connection No.8 protocol cancellation specification                      | Cancels the protocol executed in connection No.8.<br>0: No cancellation instruction<br>1: Cancellation request (set by user)<br>2: Cancellation completed (set by system)                                     | R/W |

# MEMO



# Appendix 1.4 Error Code

The CPU module stores error code in special register (SD) upon detection of an error using the self-diagnostics function. The error details and cause can be identified by checking the error code. The error code can be checked in either of the following ways.

- Module diagnostics of engineering tool (MELSEC iQ-F FX5 User's Manual (Startup))
- Special register (SD0 (latest self-diagnostics error code), SD10 to SD25 (self-diagnostics error code)) (Page 319 Special Register List)

This section describes errors that may occur in the CPU module and actions to be taken for the errors.

## Error code system

All error codes are given in hexadecimal format (4 digits) (16-bit unsigned integer). The following table lists the error detection type and the error code ranges

| Error detection type                                      | Range           | Description  |
|---|-----------------|--|
| Detection by the self-diagnostics function of each module | 0001H to 3FFFFH | Error code specific to each module, such as self-diagnostics errors  |
| Detected during communication between CPU modules         | 4000H to 4FFFFH | CPU module error   |
|   | 7000H to 7FFFFH | MELSEC iQ-F FX5 User's Manual (Serial Communication)<br>MELSEC iQ-F FX5 User's Manual (MODBUS Communication) |
|   | C000H to CFBFH  | MELSEC iQ-F FX5 User's Manual (Ethernet Communication)   |

## Detailed information

Upon detection of error through self-diagnostics function, the detailed information of the error cause is stored all together. The following detailed information is added to each error code (up to two types of information are stored for each error code. The types differ depending on error code.) Detailed information 1 to 2 of the latest error code(s) can be checked with special register (SD).

| Detailed information   | Item                                     | Description   |
|------------------------|--|---|
| Detailed information 1 | Error location information <sup>*1</sup> | Information on the location in a program  |
|                        | Drive/File information                   | Information on drive names and file names   |
|                        | Parameter information                    | The information for the parameter, such as parameter storage location and parameter type, is indicated. |
|                        | System configuration information         | The information for the system configuration, such as I/O No is indicated.                              |
|                        | Frequency information                    | This section describes the information for frequency such as the write frequency into memory.           |
|                        | Time information                         | The information for the time is indicated.  |
| Detailed information 2 | Drive/File information                   | Information on drive names and file names   |
|                        | Annunciator information                  | Information about annunciators  |
|                        | Parameter information                    | The information for the parameter, such as parameter storage location and parameter type, is indicated. |
|                        | System configuration information         | The information for the system configuration, such as I/O No is indicated.                              |

<sup>\*1</sup> The step No, which is displayed in the program position information, is the step No that is counted from the head of the file. It might be sometimes different from the step No of the program which is displayed in error jump of engineering tool.



## Operation when an error occurs

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There are two types of errors: continuation errors and stop errors.

### Stop error

If a stop error occurs, the CPU module stops its operation and the operating state will be in STOP. Modules can communicate with the CPU module even after a stop error occurs in the CPU module.

### Continuation error

If a continuation error occurs, the CPU module continues its operation. (The operating state will remain the same.)

## How to clear errors

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Continuation errors can be cleared.

## Errors that can be cleared

| Error code   | Error name  |
|--|---|
| 1080H  | ROM write count error                                   |
| 1090H  | Battery error   |
| 1800H  | Annunciator ON  |
| 1810H, 1811H   | Operation error   |
| 1900H  | Constant scan time error                                |
| 1920H  | IP address setting error                                |
| 1921H  | IP address writing/clear request simultaneous detection |
| 1FE0 to 1FE6H, 2008H   | Module configuration error                              |
| 2120H, 2121H   | Memory card error                                       |
| 2400H  | Module verification error                               |
| 2440H, 2441H   | Module major error                                      |
| 2522H  | Invalid interrupt                                       |
| 2801H  | Module specification error                              |
| 2820H, 2821H, 2822H, 2823H   | Device specification error                              |
| 2840H  | File name specification error                           |
| 3360H to 3362H   | Nesting depth error                                     |
| 3380H  | Pointer execution error                                 |
| 3400H to 3406H, 3420H, 3500H, 3502H to 3506H, 350AH, 350C to 350FH, 3510H to 351EH, 3580H, 3581H, 3600H, 3611H to 361CH, 3621H to 362CH, 3631H to 363CH, 3641H to 364CH, 3651H to 365CH, 3661H to 366CH, 3671H to 367CH, 3681H to 368CH, 3691H to 369CH, 36A1H to 36ACH, 36B1H to 36BCH, 36F0H | Operation error   |
| 3780H  | High-speed comparison table maximum excess error        |
| 3781H  | Preset value range outside error                        |

## How to clear errors

Errors can be cleared in two ways:

### ■Using the engineering tool

Clear errors with the module diagnostics function of engineering tool. (Refer to GX Works3 Operating Manual)

### ■Using SM/SD

Clear errors by operating SM/SD.

1. Check SD0 (Latest self-diagnostics error code) to identify what errors are detected.
2. Clear the cause of each of the currently detected continuation errors.
3. Turn off and on SM50 (error reset).

## Precautions

This section describes some precautions to take when using the error clear function:

- Since the function clears all of the currently detected continuation errors at once, errors that should not yet be cleared may be cleared.
- Use the RST instruction to reset each annunciator individually.

# List of error codes

## Self-diagnostics error codes of the CPU module (1000H to 3FFFH)

The following table lists the error codes detected by the self-diagnostics function of the CPU module.

| Error code | Error name  | Error details and cause  | Action   | Detailed information                                   | Diagnostic timing            |
|------------|---|--|--|--|------------------------------|
| 1080H      | ROM write count error                                   | • The number of writes to the data memory exceeded 20,000 times.   | • Replace the CPU module.  | Frequency information                                  | At write                     |
| 1090H      | Battery error   | • Low battery voltage was detected. An error was also detected in a battery latched (backed) device.                                 | • Check the connection of the battery.<br>• Replace the battery as soon as possible.   | —  | At END instruction execution |
| 1130H      | IP address duplication error                            | • Overlapping IP addresses were detected.  | • Check the IP address.  | —  | —                            |
| 1800H      | Annunciator ON  | • An annunciator that was turned ON by the SET F instruction or OUT F instruction was detected.                                      | • Check the program of that number (annunciator number).   | Error location information and annunciator information | At instruction execution     |
| 1810H      | Operation error   | • The channel specified by instructions using communication functions or built-in I/O is already used by other instructions.         | • Verify that the channel specified by instructions using communication functions or built-in I/O is not used by other instructions. | Error location information                             | At instruction execution     |
| 1811H      | Operation error   | • The number of times that applied instructions are used in the program exceeded the specified limit.                                | • Verify that the number of times that applied instructions are used in the program does not exceed the specified limit.             | Error location information                             | At instruction execution     |
| 1900H      | Constant scan time error                                | • The scan time exceeded the constant scan setting value.  | • Check and correct the constant scan time setting. Recheck the setting time of the constant scan.                                   | Time information                                       | At END instruction execution |
| 1920H      | IP address setting error                                | • Values such as the IP address setting (SD8492 to SD8497) are outside the set range.  | • Recheck the values such as the IP address setting (SD8492 to SD8497).  | —  | At END instruction execution |
| 1921H      | IP address writing/clear request simultaneous detection | • Write request and clear request (M8492 and SM8495) turned from OFF to ON simultaneously.   | • Verify that write request and clear request (SM8492 and MS8495) do not turn from OFF to ON simultaneously.                         | —  | At END instruction execution |
| 1930H      | Online change error                                     | • An error was detected when writing was executed during RUN.  | • Set the CPU module to STOP and write a set of project data.  | —  | At END instruction execution |
| 1931H      | Online change error                                     | • An error was detected when writing was executed during RUN.  | • Set the CPU module to STOP and write a set of project data.  | —  | At END instruction execution |
| 1FE0H      | Module configuration error                              | • The number of I/O points specified in the I/O assignment setting of the parameters is different from that of the module connected. | • Make sure that the parameters are consistent with the connections.   | System configuration information                       | At power-on, at RESET        |
| 1FE1H      | Module configuration error                              | • The module position specified in the I/O assignment setting of the parameters is different from that of the module connected.      | • Make sure that the parameters are consistent with the connections.   | System configuration information                       | At power-on, at RESET        |
| 1FE2H      | Module configuration error                              | • No parameters available for the module connected exist.  | • Make sure that the parameters are consistent with the connections.   | System configuration information                       | At power-on, at RESET        |
| 1FE3H      | Module configuration error                              | • The module specified in the I/O assignment setting of the parameters is not connected.   | • Make sure that the parameters are consistent with the connections.   | System configuration information                       | At power-on, at RESET        |
| 1FE4H      | Module configuration error                              | • Parameters for a standard input/output module are set to a high-speed pulse input/output module.                                   | • Make sure that the parameters are consistent with the connections.   | System configuration information                       | At power-on, at RESET        |
| 1FE5H      | Module configuration error                              | • The I/O numbers of the reserved module specified in the I/O assignment setting of the parameters overlap those of other modules.   | • Make sure that the parameters are consistent with the connections.   | System configuration information                       | At power-on, at RESET        |

| Error code | Error name                        | Error details and cause  | Action  | Detailed information                            | Diagnostic timing                          |
|------------|-----------------------------------|--|---|---|--|
| 1FE6H      | Module configuration error        | <ul style="list-style-type: none"> <li>The I/O method of the input/output module is different.</li> </ul>  | <ul style="list-style-type: none"> <li>Make sure that the parameters are consistent with the connections.</li> </ul>  | System configuration information                | At power-on, at RESET                      |
| 1FE7H      | Module configuration error        | <ul style="list-style-type: none"> <li>The type of the CPU module is different.</li> </ul>   | <ul style="list-style-type: none"> <li>Make sure that the parameters are consistent with the connections.</li> </ul>  | System configuration information                | At power-on, at RESET                      |
| 2003H      | Module configuration error        | <ul style="list-style-type: none"> <li>The model of the module connected is different from that of the module set in the parameters.</li> </ul>  | <ul style="list-style-type: none"> <li>Make sure the model of the module to be set is consistent with the parameters of the module connected.</li> </ul>  | System configuration information                | At power-on, at RESET                      |
| 2008H      | Module configuration error        | <ul style="list-style-type: none"> <li>The total number of I/O points (excluding remote I/O) exceeded 256.</li> </ul>  | <ul style="list-style-type: none"> <li>Do not use more than 256 I/O points in programs.</li> </ul>  | System configuration information                | At power-on, at RESET                      |
| 2042H      | CPU module configuration error    | <ul style="list-style-type: none"> <li>The number of input, output, input/output, and intelligent function modules connected is equal to or greater than 17.</li> <li>The number of communication adapters connected is equal to or greater than 3.</li> <li>The number of analog adapters connected is equal to or greater than 5.</li> <li>The number of extension power supply modules connected is equal to or greater than 3.</li> <li>The number of expansion boards connected is equal to or greater than 2.</li> </ul> | <ul style="list-style-type: none"> <li>Use up to 16 input, output, input/output, and intelligent function modules.</li> <li>Use up to 2 communication adapters.</li> <li>Use up to 4 analog adapters.</li> <li>Use up to 2 extension power supply modules.</li> <li>Use up to 1 expansion board.</li> </ul> | System configuration information                | At power-on, at RESET                      |
| 20E0H      | Invalid module detection          | <ul style="list-style-type: none"> <li>An unsupported module was detected.</li> </ul>  | <ul style="list-style-type: none"> <li>Verify that the version of the CPU module is compatible with the module where the error was detected.</li> <li>If the version of the CPU module is correct, there may be a malfunction in the connected module. Replace the connected module.</li> </ul>             | System configuration information                | At power-on, at RESET                      |
| 2120H      | Memory card error                 | <ul style="list-style-type: none"> <li>An SD memory card error was detected.</li> <li>The SD memory card may have been removed without the SD memory card disabled.</li> </ul>   | <ul style="list-style-type: none"> <li>Check the connection of the SD memory card. If the problem persists, there may be a malfunction in the SD memory card or CPU module.</li> </ul>  | Drive/file information                          | Always                                     |
| 2121H      | Memory card error                 | <ul style="list-style-type: none"> <li>An SD memory card error was detected.</li> <li>The SD memory card may not be correctly formatted.</li> </ul>  | <ul style="list-style-type: none"> <li>Format the SD memory card. If the problem persists, there may be a malfunction in the SD memory card or CPU module.</li> </ul>   | Drive/file information                          | Always                                     |
| 2180H      | Invalid file                      | <ul style="list-style-type: none"> <li>An error was found in the data of the file.</li> </ul>  | <ul style="list-style-type: none"> <li>Recreate the file.</li> </ul>  | Drive/file information                          | At power-on, at RESET, at STOP → RUN state |
| 21A0H      | File specification error          | <ul style="list-style-type: none"> <li>The file specified in the parameters does not exist.</li> </ul>   | <ul style="list-style-type: none"> <li>Rewrite the project.</li> </ul>  | Drive/file information<br>Parameter information | At power-on, at RESET, at STOP → RUN state |
| 2220H      | Parameter error                   | <ul style="list-style-type: none"> <li>The contents of the parameters are corrupted.</li> </ul>  | <ul style="list-style-type: none"> <li>Rewrite the project.</li> </ul>  | Parameter information                           | At power-on, at RESET                      |
| 2221H      | Parameter error                   | <ul style="list-style-type: none"> <li>The parameter set value is out of range.</li> </ul>   | <ul style="list-style-type: none"> <li>Modify the parameter set value and rewrite the project.</li> </ul>   | Parameter information                           | At power-on, at RESET                      |
| 2222H      | Parameter error                   | <ul style="list-style-type: none"> <li>The parameter set value is out of range.</li> </ul>   | <ul style="list-style-type: none"> <li>Modify the parameter set value and rewrite the project.</li> </ul>   | Parameter information                           | At power-on, at RESET                      |
| 2241H      | Parameter error (module)          | <ul style="list-style-type: none"> <li>The module parameter settings and the target module are different.</li> </ul>   | <ul style="list-style-type: none"> <li>Modify the module parameter set value and rewrite the project.</li> </ul>  | Parameter information                           | At power-on, at RESET                      |
| 2300H      | Security key authentication error | <ul style="list-style-type: none"> <li>The security key locking the program does not match the security key written in the CPU module.</li> </ul>  | <ul style="list-style-type: none"> <li>Write the correct security key to the CPU module.</li> </ul>   | Drive/file information                          | At power-on, at RESET, at STOP → RUN state |

| Error code | Error name                        | Error details and cause  | Action   | Detailed information  | Diagnostic timing                               |
|------------|-----------------------------------|--|--|---|---|
| 2301H      | Security key authentication error | <ul style="list-style-type: none"> <li>The program is locked by the security key, but the security key is not written in the CPU module.</li> </ul>                      | <ul style="list-style-type: none"> <li>Write the security key to the CPU module.</li> </ul>  | Drive/file information  | At power-on, at RESET, at STOP → RUN state      |
| 2302H      | Security key authentication error | <ul style="list-style-type: none"> <li>The security key written in the CPU module is corrupted.</li> </ul>   | <ul style="list-style-type: none"> <li>Rewrite the security key to the CPU module.</li> </ul>  | —   | At power-on, at RESET, at STOP → RUN state      |
| 2320H      | Remote password setting error     | <ul style="list-style-type: none"> <li>A module supporting remote passwords is not connected to the module number specified in the remote password parameter.</li> </ul> | <ul style="list-style-type: none"> <li>Recheck the remote password parameter setting or module configuration.</li> </ul>   | System configuration information                                | At power-on, at RESET                           |
| 2400H      | Module verification error         | <ul style="list-style-type: none"> <li>The power of a module connected is OFF or a connection error has been detected.</li> </ul>  | <ul style="list-style-type: none"> <li>Verify that the connected module is powered on.</li> <li>Verify that extension cables are correctly connected.</li> <li>Implement anti-noise measures.</li> <li>If there is no problem, there may be a malfunction in the connected module. Replace the connected module.</li> </ul>                                    | System configuration information                                | Always  |
| 2401H      | Module verification error         | <ul style="list-style-type: none"> <li>A module was connected during operation.</li> </ul>   | <ul style="list-style-type: none"> <li>Avoid connecting a module during operation.</li> </ul>  | System configuration information                                | Always  |
| 2440H      | Module major error                | <ul style="list-style-type: none"> <li>The communication procedure with a module failed during initial processing.</li> </ul>  | <ul style="list-style-type: none"> <li>Verify that extension cables are correctly connected.</li> <li>Verify that the version of the CPU module is compatible with the module where the error was detected.</li> <li>If the version of the CPU module is correct, there may be a malfunction in the connected module. Replace the connected module.</li> </ul> | System configuration information                                | At power-on, at RESET                           |
| 2441H      | Module major error                | <ul style="list-style-type: none"> <li>The communication procedure with a module failed when an instruction was executed.</li> </ul>                                     | <ul style="list-style-type: none"> <li>Review the program and check the contents of the operands used in the applied instructions.</li> <li>Verify that the specified buffer memory exists in the counterpart equipment.</li> <li>Verify that extension cables are correctly connected.</li> </ul>   | Error location information and system configuration information | At instruction execution                        |
| 2500H      | WDT error                         | <ul style="list-style-type: none"> <li>The initial scan time exceeded the set value of execution monitor time.</li> </ul>  | <ul style="list-style-type: none"> <li>Recheck the set value of execution monitor time or program.</li> </ul>  | Time information  | Always  |
| 2501H      | WDT error                         | <ul style="list-style-type: none"> <li>The scan time of the second and subsequent scans exceeded the set value of execution monitor time.</li> </ul>                     | <ul style="list-style-type: none"> <li>Recheck the set value of execution monitor time or program.</li> </ul>  | Time information  | Always  |
| 2522H      | Invalid interrupt                 | <ul style="list-style-type: none"> <li>An interrupt request was detected from a module that does not have an interrupt pointer specified in the parameters.</li> </ul>   | <ul style="list-style-type: none"> <li>Correctly set the interrupt pointer for module interrupt.</li> </ul>  | System configuration information                                | At interrupt occurrence                         |
| 2801H      | Module specification error        | <ul style="list-style-type: none"> <li>Verify that the module with the specified module number exists.</li> </ul>  | <ul style="list-style-type: none"> <li>Specify the correct module number.</li> </ul>   | Error location information and system configuration information | At instruction execution                        |
| 2820H      | Device specification error        | <ul style="list-style-type: none"> <li>A device used as an instruction operand is outside the allowable device range.</li> </ul>   | <ul style="list-style-type: none"> <li>Check the device range and modify the program.</li> </ul>   | Error location information                                      | At power-on, at RESET, at instruction execution |
| 2821H      | Device specification error        | <ul style="list-style-type: none"> <li>There are duplicate devices used as an instruction operand.</li> </ul>  | <ul style="list-style-type: none"> <li>Check the range of devices used by each operand and modify the program.</li> </ul>  | Error location information                                      | At instruction execution                        |
| 2822H      | Device specification error        | <ul style="list-style-type: none"> <li>A device or modification that cannot be used as an instruction operand is used.</li> </ul>  | <ul style="list-style-type: none"> <li>Check the usage of the instruction and modify the program.</li> </ul>   | Error location information                                      | At power-on, at RESET                           |

| Error code | Error name                    | Error details and cause  | Action  | Detailed information  | Diagnostic timing            |
|------------|-------------------------------|--|---|---|------------------------------|
| 2823H      | Device specification error    | <ul style="list-style-type: none"> <li>• Verify that the specified module has buffer memory.</li> <li>• Check the buffer memory range of the specified module.</li> <li>• Verify that the size specified from the specified buffer memory number is within the buffer memory range.</li> </ul> | <ul style="list-style-type: none"> <li>• Review the program or check the contents of the operands used in applied instructions.</li> <li>• Verify that the specified buffer memory exists in the counterpart equipment.</li> </ul>  | Error location information                                      | At instruction execution     |
| 2840H      | File name specification error | <ul style="list-style-type: none"> <li>• The program file specified does not exist.</li> </ul>   | <ul style="list-style-type: none"> <li>• Rewrite the project.</li> </ul>  | Error location information                                      | At power-on, at RESET        |
| 3000H      | Boot function execution error | <ul style="list-style-type: none"> <li>• An error was found in the boot file.</li> </ul>   | <ul style="list-style-type: none"> <li>• Replace the boot file in the SD memory card with the correct file and turn the PLC power ON again.</li> </ul>  | Drive/file information  | At power-on, at RESET        |
| 3001H      | Boot function execution error | <ul style="list-style-type: none"> <li>• Formatting failed during booting.</li> </ul>  | <ul style="list-style-type: none"> <li>• Reset the CPU module, and then execute the boot function again. If the same error appears, the hardware of the CPU module may be malfunctioning. Consult your local Mitsubishi Electric representative.</li> </ul>   | Drive/file information  | At power-on, at RESET        |
| 3003H      | Boot function execution error | <ul style="list-style-type: none"> <li>• A mismatch between the file password 32 of the boot source file and that of the boot destination file was detected during booting.</li> </ul>   | <ul style="list-style-type: none"> <li>• Check the file password 32 of the boot source file.</li> </ul>   | Drive/file information  | At power-on, at RESET        |
| 3004H      | Boot function execution error | <ul style="list-style-type: none"> <li>• The capacity of the boot destination data memory becomes insufficient due to booting.</li> </ul>  | <ul style="list-style-type: none"> <li>• Allow sufficient capacity on the boot destination or recheck the file size of the boot source.</li> </ul>  | Drive/file information  | At power-on, at RESET        |
| 3005H      | Boot function execution error | <ul style="list-style-type: none"> <li>• A mismatch between the security information of the boot source file and that of the boot destination file was detected during booting.</li> </ul>   | <ul style="list-style-type: none"> <li>• Check the security information of the boot source file.</li> </ul>   | Drive/file information  | At power-on, at RESET        |
| 3048H      | Online change error           | <ul style="list-style-type: none"> <li>• An error was detected when writing was executed during RUN.</li> </ul>  | <ul style="list-style-type: none"> <li>• Set the CPU module to STOP and write a set of project data.</li> </ul>   | —   | At END instruction execution |
| 3049H      | Online change error           | <ul style="list-style-type: none"> <li>• An error was detected when writing was executed during RUN.</li> </ul>  | <ul style="list-style-type: none"> <li>• Set the CPU module to STOP and write a set of project data.</li> </ul>   | —   | At END instruction execution |
| 304AH      | Online change error           | <ul style="list-style-type: none"> <li>• An error was detected when writing was executed during RUN.</li> </ul>  | <ul style="list-style-type: none"> <li>• Set the CPU module to STOP and write a set of project data.</li> </ul>   | —   | At END instruction execution |
| 304BH      | Online change error           | <ul style="list-style-type: none"> <li>• An error was detected when writing was executed during RUN.</li> </ul>  | <ul style="list-style-type: none"> <li>• Set the CPU module to STOP and write a set of project data.</li> </ul>   | —   | At END instruction execution |
| 3050H      | System bus error              | <ul style="list-style-type: none"> <li>• Communication with the module failed due to power discontinuity or the like.</li> </ul>   | <ul style="list-style-type: none"> <li>• Verify that the connected module is powered on.</li> <li>• Verify that extension cables are correctly connected.</li> <li>• Verify that the version of the CPU module is compatible with the module where the error was detected.</li> <li>• Implement anti-noise measures.</li> <li>• If there is no problem, there may be a malfunction in the connected module or in the extension cables.</li> </ul>   | System configuration information                                | At power-on, at RESET        |
| 3056H      | System bus error              | <ul style="list-style-type: none"> <li>• A timeout occurred during communication with a connected module when an instruction was executed.</li> </ul>  | <ul style="list-style-type: none"> <li>• Verify that extension cables are correctly connected.</li> <li>• Verify that the version of the CPU module is compatible with the module where the error was detected.</li> <li>• Implement anti-noise measures.</li> <li>• If there is no problem, there may be a malfunction in the connected module or in the extension cables.</li> <li>• When an error occurs alongside positioning function, positioning may not stop at the specified position. After removing the cause of the system bus error, perform zero return and clear error.</li> </ul> | Error location information and system configuration information | At instruction execution     |

| Error code | Error name              | Error details and cause   | Action  | Detailed information             | Diagnostic timing   |
|------------|-------------------------|---|---|----------------------------------|---|
| 3057H      | System bus error        | <ul style="list-style-type: none"> <li>A timeout occurred during communication with a connected module during system processing.</li> </ul>   | <ul style="list-style-type: none"> <li>Verify that extension cables are correctly connected.</li> <li>Verify that the version of the CPU module is compatible with the module where the error was detected.</li> <li>Implement anti-noise measures.</li> <li>If there is no problem, there may be a malfunction in the connected module or in the extension cables.</li> <li>When an error occurs alongside positioning function, positioning may not stop at the specified position. After removing the cause of the system bus error, perform zero return and clear error.</li> </ul> | System configuration information | At END instruction execution, at interrupt occurrence, at module access |
| 3060H      | System bus error        | <ul style="list-style-type: none"> <li>A signal error was detected with a connected module when an instruction was executed.</li> </ul>   | <ul style="list-style-type: none"> <li>Verify that extension cables are correctly connected.</li> <li>Verify that the version of the CPU module is compatible with the module where the error was detected.</li> <li>Implement anti-noise measures.</li> <li>If there is no problem, there may be a malfunction in the connected module or in the extension cables.</li> <li>When an error occurs alongside positioning function, positioning may not stop at the specified position. After removing the cause of the system bus error, perform zero return and clear error.</li> </ul> | Error location information       | At instruction execution  |
| 3061H      | System bus error        | <ul style="list-style-type: none"> <li>A signal error was detected during system processing.</li> </ul>   | <ul style="list-style-type: none"> <li>Verify that extension cables are correctly connected.</li> <li>Verify that the version of the CPU module is compatible with the module where the error was detected.</li> <li>Implement anti-noise measures.</li> <li>If there is no problem, there may be a malfunction in the connected module or in the extension cables.</li> <li>When an error occurs alongside positioning function, positioning may not stop at the specified position. After removing the cause of the system bus error, perform zero return and clear error.</li> </ul> | System configuration information | At instruction execution  |
| 3142H      | Program structure error | <ul style="list-style-type: none"> <li>The temporary area was used incorrectly.</li> </ul>  | <ul style="list-style-type: none"> <li>Check the detailed information (error location information) of the error by executing module diagnostics using the engineering tool, display the error program (step) by clicking the [Error Jump] button, and check the program. The step number displayed in the error location information is counted from the top of the file. (It may be different from the step number in the program displayed by the jump function.)</li> </ul>  | Error location information       | At instruction execution  |
| 3200H      | Program execution error | <ul style="list-style-type: none"> <li>The device/label assignment does not match the device/label assignment in the program. (After the device assignment was changed, only the parameters were written to the CPU module.)</li> </ul> | <ul style="list-style-type: none"> <li>If the index modification setting of the PLC parameter is changed, write the parameter and program file to the CPU module at the same time.</li> </ul>   | Drive/file information           | At power-on, at RESET   |
| 3202H      | Program execution error | <ul style="list-style-type: none"> <li>The program file is invalid or the file does not contain a program.</li> </ul>   | <ul style="list-style-type: none"> <li>Write the correct program file.</li> </ul>   | Drive/file information           | At power-on, at RESET   |
| 3203H      | Program execution error | <ul style="list-style-type: none"> <li>No program file exists.</li> </ul>   | <ul style="list-style-type: none"> <li>Write a program file.</li> </ul>   | Drive/file information           | At power-on, at RESET   |
| 3210H      | Program execution error | <ul style="list-style-type: none"> <li>A program with more than 64 k steps was written.</li> </ul>  | <ul style="list-style-type: none"> <li>Reduce the number of steps in the program.</li> </ul>  | —                                | At power-on, at RESET   |

| Error code | Error name                      | Error details and cause  | Action   | Detailed information       | Diagnostic timing            |
|------------|---------------------------------|--|--|----------------------------|------------------------------|
| 3211H      | Program execution error         | • An FB program larger than the internal memory capacity was written.                    | • Reduce the number of steps in the FB program.  | —                          | At power-on, at RESET        |
| 3212H      | Program execution error         | • No program setting is found in the parameters.   | • Specify the program to execute in the parameters.  | —                          | At power-on, at RESET        |
| 3213H      | Program execution error         | • The parameter set value is out of range.   | • To use this parameter, a new version of the CPU module is required. Replace the CPU module or perform version upgrade.   | Parameter information      | At power-on, at RESET        |
| 3302H      | Pointer setting error           | • Duplicate pointers are programmed.   | • Modify the program to not use duplicate pointers in a program.   | Error location information | At power-on, at RESET        |
| 3320H      | Interrupt pointer setting error | • Duplicate interrupt pointers are programmed.   | • Modify the program to not use duplicate interrupt pointers in a program.   | Error location information | At power-on, at RESET        |
| 3340H      | FOR-NEXT instruction error      | • The relationship between FOR and NEXT instructions is invalid.                         | • Make sure that FOR and NEXT instructions are each executed the same number of times. In addition, check the FOR syntax for any invalid jump instructions.  | Error location information | At END instruction execution |
| 3341H      | FOR-NEXT instruction error      | • The relationship between FOR and NEXT instructions is invalid.                         | • Make sure that FOR and NEXT instructions are each executed the same number of times. In addition, check syntax for any invalid jump instructions.  | Error location information | At END instruction execution |
| 3342H      | FOR-NEXT instruction error      | • A BREAK instruction was executed outside the FOR syntax.                               | • The BREAK instruction must be executed inside the FOR syntax.  | Error location information | At instruction execution     |
| 3360H      | Nesting depth error             | • The number of nesting levels of subroutine calls is invalid.                           | • Make sure that the number of nesting levels is 16 or lower. In addition, check subroutine programs for any invalid jump instructions.  | Error location information | At instruction execution     |
| 3361H      | Nesting depth error             | • The number of nesting levels of FOR instructions is invalid.                           | • Make sure that the number of nesting levels is 16 or lower. In addition, check the FOR syntax for any invalid jump instructions.   | Error location information | At instruction execution     |
| 3362H      | Nesting depth error             | • The number of nesting levels of DI instructions is invalid.                            | • Make sure that the number of nesting levels is 16 or lower. In addition, check the relationship between DI and EI instructions.  | Error location information | At instruction execution     |
| 3380H      | Pointer execution error         | • There is no pointer to the jump destination.   | • Specify the correct jump destination in the program.   | Error location information | At instruction execution     |
| 3381H      | Pointer execution error         | • There is an END, FEND, GOEND, or STOP instruction in a subroutine program.             | • The END, FEND, GOEND, and STOP instructions can be executed only in the main routine program.  | Error location information | At END instruction execution |
| 3382H      | Pointer execution error         | • A RET instruction was executed without a CALL or XCALL instruction executed.           | • Check where there is any invalid jump to subroutine programs.  | Error location information | At instruction execution     |
| 33D0H      | Temporary area exceeded         | • The temporary area was used incorrectly.   | • Check the detailed information (error location information) of the error by executing module diagnostics using the engineering tool, display the error program (step) by clicking the [Error Jump] button, and check the program. The step number displayed in the error location information is counted from the top of the file. (It may be different from the step number in the program displayed by the jump function.) | Error location information | At instruction execution     |
| 33E0H      | Program structure error         | • The relationship between LD/LDI/LDP/LDF/LDPI/LDFI and ANB/ORB instructions is invalid. | • Rewrite the program file.  | Error location information | At power-on, at RESET        |
| 33E1H      | Program structure error         | • The relationship among MPS, MRD, and MPP is invalid.                                   | • Rewrite the program file.  | Error location information | At power-on, at RESET        |
| 33E2H      | Program structure error         | • An instruction that should start from the bus line is not connected to the bus line.   | • Rewrite the program file.  | Error location information | At power-on, at RESET        |



| Error code | Error name              | Error details and cause   | Action   | Detailed information       | Diagnostic timing                                     |
|------------|-------------------------|---|--|----------------------------|---|
| 33E3H      | Program structure error | • The relationship between FOR and NEXT instructions is invalid.  | • Modify the program so that the mutual relationship between instructions becomes correct.                   | Error location information | At power-on, at RESET                                 |
| 33E4H      | Program structure error | • The relationship between MC and MCR instructions is invalid.  | • Modify the program so that the mutual relationship between instructions becomes correct.                   | Error location information | At power-on, at RESET                                 |
| 33E5H      | Program structure error | • The relationship between STL and RETSTL instructions is invalid.  | • Modify the program so that the mutual relationship between instructions becomes correct.                   | Error location information | At power-on, at RESET                                 |
| 33E6H      | Program structure error | • An instruction or interrupt pointer that cannot be used in the main routine program is used.            | • Modify the program so that instruction or pointer use becomes correct.                                     | Error location information | At power-on, at RESET                                 |
| 33E7H      | Program structure error | • The relationship among a global pointer, interrupt pointer, and return instruction is invalid.          | • Modify the program so that the mutual relationship between pointer and return instruction becomes correct. | Error location information | At power-on, at RESET                                 |
| 33F1H      | Program structure error | • The program structure of the ST language, FB, and functions is invalid.                                 | • Check the syntax of the ST language, FB, and functions.  | Error location information | At END instruction execution, at interrupt occurrence |
| 33F2H      | Program structure error | • The program structure of the ST language, FB, and functions is invalid.                                 | • Check the syntax of the ST language, FB, and functions.  | Error location information | At instruction execution                              |
| 33E3H      | Program structure error | • The relationship between FOR and NEXT instructions is invalid.  | • Modify the program so that the mutual relationship between instructions becomes correct.                   | Error location information | At power-on, at RESET                                 |
| 3400H      | Operation error         | • A value of 0 was input as a divisor in an applied instruction.  | • Review the data specified as the divisor in the applied instruction.                                       | Error location information | At instruction execution                              |
| 3401H      | Operation error         | • Data that cannot be converted was input in an applied instruction.                                      | • Review the data specified in the applied instruction.  | Error location information | At instruction execution                              |
| 3402H      | Operation error         | • A value of -0, a denormalized number, a non-number, or $\pm\infty$ was input in an applied instruction. | • Review the data specified in the applied instruction.  | Error location information | At instruction execution                              |
| 3403H      | Operation error         | • An overflow occurred in an applied instruction.   | • Review the data specified in the applied instruction.  | Error location information | At instruction execution                              |
| 3405H      | Operation error         | • Data that is outside the allowable range was input in an applied instruction.                           | • Review the data specified in the applied instruction.  | Error location information | At instruction execution                              |
| 3406H      | Operation error         | • The output result is outside the allowable device range in an applied instruction.                      | • Review the data specified in the applied instruction.  | Error location information | At instruction execution                              |
| 3420H      | Operation error         | • A module access device is specified to both (s) and (d) in a BMOV instruction.                          | • Review the device specified in the BMOV instruction.   | Error location information | At instruction execution                              |
| 3500H      | Operation error         | • A value outside the allowable range was set to the sampling time (TS).                                  | • Check the contents of the parameters.  | Error location information | At instruction execution                              |
| 3502H      | Operation error         | • A value outside the allowable range was set to the input filter constant ( $\alpha$ ).                  | • Check the contents of the parameters.  | Error location information | At instruction execution                              |
| 3503H      | Operation error         | • A value outside the allowable range was set to the proportional gain (KP).                              | • Check the contents of the parameters.  | Error location information | At instruction execution                              |
| 3504H      | Operation error         | • A value outside the allowable range was set to the integral time (TI).                                  | • Check the contents of the parameters.  | Error location information | At instruction execution                              |
| 3505H      | Operation error         | • A value outside the allowable range was set to the derivative gain (KD).                                | • Check the contents of the parameters.  | Error location information | At instruction execution                              |

| Error code | Error name      | Error details and cause   | Action   | Detailed information       | Diagnostic timing        |
|------------|-----------------|---|--|----------------------------|--------------------------|
| 3506H      | Operation error | <ul style="list-style-type: none"> <li>A value outside the allowable range was set to the derivative time (TD).</li> </ul>  | <ul style="list-style-type: none"> <li>Check the contents of the parameters.</li> </ul>  | Error location information | At instruction execution |
| 350AH      | Operation error | <ul style="list-style-type: none"> <li>The sampling time is lower than the scan time.</li> </ul>  | <ul style="list-style-type: none"> <li>The operation is continued in the condition "sampling time (TS) = cyclic time (scan time)".</li> </ul>  | Error location information | At instruction execution |
| 350CH      | Operation error | <ul style="list-style-type: none"> <li>The variation of measured value is greater than the maximum value or lower than the minimum value.</li> </ul>  | <ul style="list-style-type: none"> <li>The operation is continued with the maximum or minimum value.</li> </ul>  | Error location information | At instruction execution |
| 350DH      | Operation error | <ul style="list-style-type: none"> <li>The deviation is greater than the maximum value or lower than the minimum value.</li> </ul>  | <ul style="list-style-type: none"> <li>The operation is continued with the maximum or minimum value.</li> </ul>  | Error location information | At instruction execution |
| 350EH      | Operation error | <ul style="list-style-type: none"> <li>The integral result is greater than the maximum value or lower than the minimum value.</li> </ul>  | <ul style="list-style-type: none"> <li>The operation is continued with the maximum or minimum value.</li> </ul>  | Error location information | At instruction execution |
| 350FH      | Operation error | <ul style="list-style-type: none"> <li>The derivative value is greater than the maximum value or lower than the minimum value due to the derivative gain (KP).</li> </ul>   | <ul style="list-style-type: none"> <li>The operation is continued with the maximum or minimum value.</li> </ul>  | Error location information | At instruction execution |
| 3510H      | Operation error | <ul style="list-style-type: none"> <li>The derivative result is greater than the maximum value or lower than the minimum value.</li> </ul>  | <ul style="list-style-type: none"> <li>The operation is continued with the maximum or minimum value.</li> </ul>  | Error location information | At instruction execution |
| 3511H      | Operation error | <ul style="list-style-type: none"> <li>The PID operation result is greater than the maximum value or lower than the minimum value.</li> </ul>   | <ul style="list-style-type: none"> <li>The operation is continued with the maximum or minimum value.</li> </ul>  | Error location information | At instruction execution |
| 3512H      | Operation error | <ul style="list-style-type: none"> <li>The output upper limit value is lower than the output lower limit value.</li> </ul>  | <ul style="list-style-type: none"> <li>Calculation is continued with the output upper limit value and output lower limit value transposed.</li> </ul>  | Error location information | At instruction execution |
| 3513H      | Operation error | <ul style="list-style-type: none"> <li>The input variation alarm set value or output variation alarm set value is outside the allowable range.</li> </ul>   | <ul style="list-style-type: none"> <li>The operation is continued without alarm output.</li> </ul>   | Error location information | At instruction execution |
| 3514H      | Operation error | <ul style="list-style-type: none"> <li>The auto tuning result in the step response method is abnormal.</li> <li>The deviation at start of auto tuning is 75 or less.</li> <li>The deviation at end of auto tuning is 1/3 or less of the deviation at start of auto tuning.</li> </ul> | <ul style="list-style-type: none"> <li>Check the measured value and target value, and then execute auto tuning again.</li> </ul>   | Error location information | At instruction execution |
| 3515H      | Operation error | <ul style="list-style-type: none"> <li>The operation direction estimated from the measured value at the start of auto tuning in the step response method was different from the actual operation direction of the output during auto tuning.</li> </ul>                               | <ul style="list-style-type: none"> <li>Correct the relationship among the target value, output value for auto tuning, and the measured value, and then execute auto tuning again.</li> </ul>   | Error location information | At instruction execution |
| 3516H      | Operation error | <ul style="list-style-type: none"> <li>Because the set value fluctuated during auto tuning in the step response method, auto tuning was not executed correctly.</li> </ul>  | <ul style="list-style-type: none"> <li>Set the sampling time to a value larger than the output change cycle, or set a larger value for the input filter constant. After changing the setting, execute auto tuning again.</li> </ul>  | Error location information | At instruction execution |
| 3517H      | Operation error | <ul style="list-style-type: none"> <li>The output set value upper limit for auto tuning is lower than the lower limit.</li> </ul>   | <ul style="list-style-type: none"> <li>Verify that the target setting contents are correct.</li> </ul>   | Error location information | At instruction execution |
| 3518H      | Operation error | <ul style="list-style-type: none"> <li>A value outside the allowable range was set to the PV threshold for auto tuning.</li> </ul>  | <ul style="list-style-type: none"> <li>Verify that the target setting contents are correct.</li> </ul>   | Error location information | At instruction execution |
| 3519H      | Operation error | <ul style="list-style-type: none"> <li>Operation is not performed normally because devices occupied by the PID instruction were overwritten.</li> </ul>   | <ul style="list-style-type: none"> <li>Ensure that devices occupied by PID instruction are not overwritten in the program.</li> </ul>  | Error location information | At instruction execution |
| 351AH      | Operation error | <ul style="list-style-type: none"> <li>The auto tuning time is longer than necessary.</li> </ul>  | <ul style="list-style-type: none"> <li>Increase the difference (ULV - LLV) between the upper limit and lower limit of the output value for auto tuning, set a smaller value to the input filter constant (<math>\alpha</math>), or set a smaller value to the PV threshold (SHPV) for auto tuning, and then check the result for improvement.</li> </ul> | Error location information | At instruction execution |

| Error code | Error name                            | Error details and cause   | Action   | Detailed information  | Diagnostic timing                                      |
|------------|---------------------------------------|---|--|---|--|
| 351BH      | Operation error                       | <ul style="list-style-type: none"> <li>The variation of the measured value is too small compared with the output value.</li> </ul>  | <ul style="list-style-type: none"> <li>Multiply the measured value (PV) by "10" so that the variation of the measured value will increase during auto tuning. The operation is continued with KP = 32767.</li> </ul>   | Error location information                                      | At instruction execution                               |
| 351CH      | Operation error                       | <ul style="list-style-type: none"> <li>The auto tuning time is longer than necessary.</li> </ul>  | <ul style="list-style-type: none"> <li>Increase the difference (ULV - LLV) between the upper limit and lower limit of the output value for auto tuning, set a smaller value to the input filter constant (<math>\alpha</math>), or set a smaller value to the PV threshold (SHPV) for auto tuning, and then check the result for improvement. The operation is continued with KP = 32767.</li> </ul> | Error location information                                      | At instruction execution                               |
| 351DH      | Operation error                       | <ul style="list-style-type: none"> <li>The auto tuning time is longer than necessary.</li> </ul>  | <ul style="list-style-type: none"> <li>Increase the difference (ULV - LLV) between the upper limit and lower limit of the output value for auto tuning, set a smaller value to the input filter constant (<math>\alpha</math>), or set a smaller value to the PV threshold (SHPV) for auto tuning, and then check the result for improvement. The operation is continued with KP = 32767.</li> </ul> | Error location information                                      | At instruction execution                               |
| 3580H      | Operation error                       | <ul style="list-style-type: none"> <li>An instruction that cannot be used in an interrupt routine program is used.</li> </ul>   | <ul style="list-style-type: none"> <li>Modify the program so that no instruction whose use is disabled by the interrupt routine program is used.</li> </ul>  | Error location information                                      | At instruction execution                               |
| 3581H      | Operation error                       | <ul style="list-style-type: none"> <li>Modules subsequent to the bus conversion module are using an operand that cannot be used.</li> </ul>   | <ul style="list-style-type: none"> <li>Modify the program so that no operand whose use is disabled for modules subsequent to the bus conversion module is used.</li> </ul>   | Error location information                                      | At instruction execution                               |
| 3582H      | Operation error                       | <ul style="list-style-type: none"> <li>An instruction that cannot be used in an interrupt routine program is used.</li> </ul>   | <ul style="list-style-type: none"> <li>Modify the program so that no instruction whose use is disabled by the interrupt routine program is used.</li> </ul>  | Error location information                                      | At instruction execution                               |
| 3600H      | Operation error                       | <ul style="list-style-type: none"> <li>The channel specified by instructions using communication functions or built-in I/O does not have the appropriate parameter.</li> </ul>  | <ul style="list-style-type: none"> <li>Verify that the parameter setting of the channel specified by instructions using communication functions or built-in I/O is correct.</li> </ul>   | Error location information                                      | At instruction execution                               |
| 3611H      | CH1 pulse width, period setting error | <ul style="list-style-type: none"> <li>The value of the special register to set the pulse width and cycle of the PWM/DPWM instruction is abnormal.</li> </ul>   | <ul style="list-style-type: none"> <li>Modify the value of the special register and restart PWM.</li> </ul>  | Error location information and system configuration information | At END instruction execution                           |
| 3612H      | CH2 pulse width, period setting error | <ul style="list-style-type: none"> <li>The value of the special register to set the pulse width and cycle of the PWM/DPWM instruction is abnormal.</li> </ul>   | <ul style="list-style-type: none"> <li>Modify the value of the special register and restart PWM.</li> </ul>  | Error location information and system configuration information | At END instruction execution                           |
| 3613H      | CH3 pulse width, period setting error | <ul style="list-style-type: none"> <li>The value of the special register to set the pulse width and cycle of the PWM/DPWM instruction is abnormal.</li> </ul>   | <ul style="list-style-type: none"> <li>Modify the value of the special register and restart PWM.</li> </ul>  | Error location information and system configuration information | At END instruction execution                           |
| 3614H      | CH4 pulse width, period setting error | <ul style="list-style-type: none"> <li>The value of the special register to set the pulse width and cycle of the PWM/DPWM instruction is abnormal.</li> </ul>   | <ul style="list-style-type: none"> <li>Modify the value of the special register and restart PWM.</li> </ul>  | Error location information and system configuration information | At END instruction execution                           |
| 3621H      | Axis 1 limit detection error          | <ul style="list-style-type: none"> <li>Both the forward and reverse limits were detected at the time of zero return or the limit of the moving direction was detected after the near-point dog was detected.</li> </ul> | <ul style="list-style-type: none"> <li>Recheck the relationship between the near-point dog and limits.</li> </ul>  | Error location information and system configuration information | At END instruction execution, at instruction execution |
| 3622H      | Axis 2 limit detection error          | <ul style="list-style-type: none"> <li>Both the forward and reverse limits were detected at the time of zero return or the limit of the moving direction was detected after the near-point dog was detected.</li> </ul> | <ul style="list-style-type: none"> <li>Recheck the relationship between the near-point dog and limits.</li> </ul>  | Error location information and system configuration information | At END instruction execution, at instruction execution |

| Error code | Error name                       | Error details and cause   | Action  | Detailed information  | Diagnostic timing                                      |
|------------|----------------------------------|---|---|---|--|
| 3623H      | Axis 3 limit detection error     | <ul style="list-style-type: none"> <li>Both the forward and reverse limits were detected at the time of zero return or the limit of the moving direction was detected after the near-point dog was detected.</li> </ul>   | <ul style="list-style-type: none"> <li>Recheck the relationship between the near-point dog and limits.</li> </ul> | Error location information and system configuration information | At END instruction execution, at instruction execution |
| 3624H      | Axis 4 limit detection error     | <ul style="list-style-type: none"> <li>Both the forward and reverse limits were detected at the time of zero return or the limit of the moving direction was detected after the near-point dog was detected.</li> </ul>   | <ul style="list-style-type: none"> <li>Recheck the relationship between the near-point dog and limits.</li> </ul> | Error location information and system configuration information | At END instruction execution, at instruction execution |
| 3631H      | Axis 1 positioning address error | <ul style="list-style-type: none"> <li>The 32-bit range was exceeded when the unit of the positioning address was converted.</li> <li>The total transfer distance before and after the interrupt of the DVIT/DDVIT instruction or 1-speed positioning with interruption exceeded 7FFFFFFFH. Or, when the operation was started, the positioning address was set to 0.</li> <li>Pulses of 7FFFFFFFH or greater are needed to specify an absolute address.</li> </ul> | <ul style="list-style-type: none"> <li>Start the positioning within specifications.</li> </ul>                    | Error location information and system configuration information | At END instruction execution, at interrupt occurrence  |
| 3632H      | Axis 2 positioning address error | <ul style="list-style-type: none"> <li>The 32-bit range was exceeded when the unit of the positioning address was converted.</li> <li>The total transfer distance before and after the interrupt of the DVIT/DDVIT instruction or 1-speed positioning with interruption exceeded 7FFFFFFFH. Or, when the operation was started, the positioning address was set to 0.</li> <li>Pulses of 7FFFFFFFH or greater are needed to specify an absolute address.</li> </ul> | <ul style="list-style-type: none"> <li>Start the positioning within specifications.</li> </ul>                    | Error location information and system configuration information | At END instruction execution, at interrupt occurrence  |
| 3633H      | Axis 3 positioning address error | <ul style="list-style-type: none"> <li>The 32-bit range was exceeded when the unit of the positioning address was converted.</li> <li>The total transfer distance before and after the interrupt of the DVIT/DDVIT instruction or 1-speed positioning with interruption exceeded 7FFFFFFFH. Or, when the operation was started, the positioning address was set to 0.</li> <li>Pulses of 7FFFFFFFH or greater are needed to specify an absolute address.</li> </ul> | <ul style="list-style-type: none"> <li>Start the positioning within specifications.</li> </ul>                    | Error location information and system configuration information | At END instruction execution, at interrupt occurrence  |
| 3634H      | Axis 4 positioning address error | <ul style="list-style-type: none"> <li>The 32-bit range was exceeded when the unit of the positioning address was converted.</li> <li>The total transfer distance before and after the interrupt of the DVIT/DDVIT instruction or 1-speed positioning with interruption exceeded 7FFFFFFFH. Or, when the operation was started, the positioning address was set to 0.</li> <li>Pulses of 7FFFFFFFH or greater are needed to specify an absolute address.</li> </ul> | <ul style="list-style-type: none"> <li>Start the positioning within specifications.</li> </ul>                    | Error location information and system configuration information | At END instruction execution, at interrupt occurrence  |
| 3641H      | Axis 1 command speed error       | <ul style="list-style-type: none"> <li>The 32-bit range was exceeded when the unit of the command speed was converted.</li> </ul>   | <ul style="list-style-type: none"> <li>Start the positioning within specifications.</li> </ul>                    | Error location information and system configuration information | At instruction execution                               |
| 3642H      | Axis 2 command speed error       | <ul style="list-style-type: none"> <li>The 32-bit range was exceeded when the unit of the command speed was converted.</li> </ul>   | <ul style="list-style-type: none"> <li>Start the positioning within specifications.</li> </ul>                    | Error location information and system configuration information | At instruction execution                               |

| Error code | Error name                             | Error details and cause   | Action  | Detailed information  | Diagnostic timing                                      |
|------------|--|---|---|---|--|
| 3643H      | Axis 3 command speed error             | <ul style="list-style-type: none"> <li>The 32-bit range was exceeded when the unit of the command speed was converted.</li> </ul>   | <ul style="list-style-type: none"> <li>Start the positioning within specifications.</li> </ul>                              | Error location information and system configuration information | At instruction execution                               |
| 3644H      | Axis 4 command speed error             | <ul style="list-style-type: none"> <li>The 32-bit range was exceeded when the unit of the command speed was converted.</li> </ul>   | <ul style="list-style-type: none"> <li>Start the positioning within specifications.</li> </ul>                              | Error location information and system configuration information | At instruction execution                               |
| 3651H      | Axis 1 error stop (deceleration stop)  | <ul style="list-style-type: none"> <li>When pulses were being output or positioning was starting, the PLC decelerated and stopped the pulse output due to the limit of the moving direction or writing during RUN. (The PLSY/DPLSY instruction stops pulse output immediately at both limits.)</li> </ul> | <ul style="list-style-type: none"> <li>Eliminate the error that has caused the stop and restart the positioning.</li> </ul> | Error location information and system configuration information | At END instruction execution, at instruction execution |
| 3652H      | Axis 2 error stop (deceleration stop)  | <ul style="list-style-type: none"> <li>When pulses were being output or positioning was starting, the PLC decelerated and stopped the pulse output due to the limit of the moving direction or writing during RUN. (The PLSY/DPLSY instruction stops pulse output immediately at both limits.)</li> </ul> | <ul style="list-style-type: none"> <li>Eliminate the error that has caused the stop and restart the positioning.</li> </ul> | Error location information and system configuration information | At END instruction execution, at instruction execution |
| 3653H      | Axis 3 error stop (deceleration stop)  | <ul style="list-style-type: none"> <li>When pulses were being output or positioning was starting, the PLC decelerated and stopped the pulse output due to the limit of the moving direction or writing during RUN. (The PLSY/DPLSY instruction stops pulse output immediately at both limits.)</li> </ul> | <ul style="list-style-type: none"> <li>Eliminate the error that has caused the stop and restart the positioning.</li> </ul> | Error location information and system configuration information | At END instruction execution, at instruction execution |
| 3654H      | Axis 4 error stop (deceleration stop)  | <ul style="list-style-type: none"> <li>When pulses were being output or positioning was starting, the PLC decelerated and stopped the pulse output due to the limit of the moving direction or writing during RUN. (The PLSY/DPLSY instruction stops pulse output immediately at both limits.)</li> </ul> | <ul style="list-style-type: none"> <li>Eliminate the error that has caused the stop and restart the positioning.</li> </ul> | Error location information and system configuration information | At END instruction execution, at instruction execution |
| 3661H      | Axis 1 error stop (immediately stop)   | <ul style="list-style-type: none"> <li>When pulses were being output or positioning was rising, the PLC stopped the pulse output immediately by the pulse stop command or detection of the all outputs disable flag.</li> </ul>   | <ul style="list-style-type: none"> <li>Eliminate the error that has caused the stop and restart the positioning.</li> </ul> | Error location information and system configuration information | At END instruction execution, at instruction execution |
| 3662H      | Axis 2 error stop (immediately stop)   | <ul style="list-style-type: none"> <li>When pulses were being output or positioning was rising, the PLC stopped the pulse output immediately by the pulse stop command or detection of the all outputs disable flag.</li> </ul>   | <ul style="list-style-type: none"> <li>Eliminate the error that has caused the stop and restart the positioning.</li> </ul> | Error location information and system configuration information | At END instruction execution, at instruction execution |
| 3663H      | Axis 3 error stop (immediately stop)   | <ul style="list-style-type: none"> <li>When pulses were being output or positioning was rising, the PLC stopped the pulse output immediately by the pulse stop command or detection of the all outputs disable flag.</li> </ul>   | <ul style="list-style-type: none"> <li>Eliminate the error that has caused the stop and restart the positioning.</li> </ul> | Error location information and system configuration information | At END instruction execution, at instruction execution |
| 3664H      | Axis 4 error stop (immediately stop)   | <ul style="list-style-type: none"> <li>When pulses were being output or positioning was rising, the PLC stopped the pulse output immediately by the pulse stop command or detection of the all outputs disable flag.</li> </ul>   | <ul style="list-style-type: none"> <li>Eliminate the error that has caused the stop and restart the positioning.</li> </ul> | Error location information and system configuration information | At END instruction execution, at instruction execution |
| 3671H      | Axis 1 positioning table operand error | <ul style="list-style-type: none"> <li>The value of an operand in the table is abnormal. (Other than the positioning address and command speed)</li> </ul>  | <ul style="list-style-type: none"> <li>Set the correct value to the table.</li> </ul>                                       | Error location information and system configuration information | At END instruction execution, at interrupt occurrence  |

| Error code | Error name   | Error details and cause  | Action  | Detailed information  | Diagnostic timing                                     |
|------------|--|--|---|---|---|
| 3672H      | Axis 2 positioning table operand error                     | <ul style="list-style-type: none"> <li>The value of an operand in the table is abnormal. (Other than the positioning address and command speed)</li> </ul>   | <ul style="list-style-type: none"> <li>Set the correct value to the table.</li> </ul>                   | Error location information and system configuration information | At END instruction execution, at interrupt occurrence |
| 3673H      | Axis 3 positioning table operand error                     | <ul style="list-style-type: none"> <li>The value of an operand in the table is abnormal. (Other than the positioning address and command speed)</li> </ul>   | <ul style="list-style-type: none"> <li>Set the correct value to the table.</li> </ul>                   | Error location information and system configuration information | At END instruction execution, at interrupt occurrence |
| 3674H      | Axis 4 positioning table operand error                     | <ul style="list-style-type: none"> <li>The value of an operand in the table is abnormal. (Other than the positioning address and command speed)</li> </ul>   | <ul style="list-style-type: none"> <li>Set the correct value to the table.</li> </ul>                   | Error location information and system configuration information | At END instruction execution, at interrupt occurrence |
| 3681H      | Axis 1 positioning table shift error (table specification) | <ul style="list-style-type: none"> <li>Tables which cannot be used together were specified for continuous operation.</li> <li>The counterpart axis for the interpolation operation table was specified.</li> </ul> | <ul style="list-style-type: none"> <li>Observe the restrictions on table operation.</li> </ul>          | Error location information and system configuration information | At END instruction execution, at interrupt occurrence |
| 3682H      | Axis 2 positioning table shift error (table specification) | <ul style="list-style-type: none"> <li>Tables which cannot be used together were specified for continuous operation.</li> <li>The counterpart axis for the interpolation operation table was specified.</li> </ul> | <ul style="list-style-type: none"> <li>Observe the restrictions on table operation.</li> </ul>          | Error location information and system configuration information | At END instruction execution, at interrupt occurrence |
| 3683H      | Axis 3 positioning table shift error (table specification) | <ul style="list-style-type: none"> <li>Tables which cannot be used together were specified for continuous operation.</li> <li>The counterpart axis for the interpolation operation table was specified.</li> </ul> | <ul style="list-style-type: none"> <li>Observe the restrictions on table operation.</li> </ul>          | Error location information and system configuration information | At END instruction execution, at interrupt occurrence |
| 3684H      | Axis 4 positioning table shift error (table specification) | <ul style="list-style-type: none"> <li>Tables which cannot be used together were specified for continuous operation.</li> <li>The counterpart axis for the interpolation operation table was specified.</li> </ul> | <ul style="list-style-type: none"> <li>Observe the restrictions on table operation.</li> </ul>          | Error location information and system configuration information | At END instruction execution, at interrupt occurrence |
| 3691H      | Axis 1 positioning table shift error (table shift)         | <ul style="list-style-type: none"> <li>Table shift cannot be completed in time because one or more tables shifted per 10 ms.</li> </ul>  | <ul style="list-style-type: none"> <li>Set the interval of table shifts to 10 ms or greater.</li> </ul> | Error location information and system configuration information | At interrupt occurrence                               |
| 3692H      | Axis 2 positioning table shift error (table shift)         | <ul style="list-style-type: none"> <li>Table shift cannot be completed in time because one or more tables shifted per 10 ms.</li> </ul>  | <ul style="list-style-type: none"> <li>Set the interval of table shifts to 10 ms or greater.</li> </ul> | Error location information and system configuration information | At interrupt occurrence                               |
| 3693H      | Axis 3 positioning table shift error (table shift)         | <ul style="list-style-type: none"> <li>Table shift cannot be completed in time because one or more tables shifted per 10 ms.</li> </ul>  | <ul style="list-style-type: none"> <li>Set the interval of table shifts to 10 ms or greater.</li> </ul> | Error location information and system configuration information | At interrupt occurrence                               |
| 3694H      | Axis 4 positioning table shift error (table shift)         | <ul style="list-style-type: none"> <li>Table shift cannot be completed in time because one or more tables shifted per 10 ms.</li> </ul>  | <ul style="list-style-type: none"> <li>Set the interval of table shifts to 10 ms or greater.</li> </ul> | Error location information and system configuration information | At interrupt occurrence                               |
| 36A1H      | Axis 1 interpolation operation error (no counterpart axis) | <ul style="list-style-type: none"> <li>The counterpart axis table for the interpolation operation cannot be found.</li> </ul>  | <ul style="list-style-type: none"> <li>Set the table of the counterpart axis correctly.</li> </ul>      | Error location information and system configuration information | At instruction execution                              |
| 36A2H      | Axis 2 interpolation operation error (no counterpart axis) | <ul style="list-style-type: none"> <li>The counterpart axis table for the interpolation operation cannot be found.</li> </ul>  | <ul style="list-style-type: none"> <li>Set the table of the counterpart axis correctly.</li> </ul>      | Error location information and system configuration information | At instruction execution                              |

| Error code | Error name   | Error details and cause  | Action  | Detailed information  | Diagnostic timing                                      |
|------------|--|--|---|---|--|
| 36A3H      | Axis 3 interpolation operation error (no counterpart axis)               | <ul style="list-style-type: none"> <li>The counterpart axis table for the interpolation operation cannot be found.</li> </ul>  | <ul style="list-style-type: none"> <li>Set the table of the counterpart axis correctly.</li> </ul>  | Error location information and system configuration information | At instruction execution                               |
| 36A4H      | Axis 4 interpolation operation error (no counterpart axis)               | <ul style="list-style-type: none"> <li>The counterpart axis table for the interpolation operation cannot be found.</li> </ul>  | <ul style="list-style-type: none"> <li>Set the table of the counterpart axis correctly.</li> </ul>  | Error location information and system configuration information | At instruction execution                               |
| 36B1H      | Axis 1 interpolation operation error (reference/ counterpart axis error) | <ul style="list-style-type: none"> <li>Conditions such as limits were satisfied to stop pulses in the reference axis or counterpart axis.</li> <li>Pulses are being output.</li> </ul> | <ul style="list-style-type: none"> <li>Verify that the reference axis and counterpart axis are not in use and the stop conditions are not satisfied.</li> </ul>   | Error location information and system configuration information | At instruction execution                               |
| 36B2H      | Axis 2 interpolation operation error (reference/ counterpart axis error) | <ul style="list-style-type: none"> <li>Conditions such as limits were satisfied to stop pulses in the reference axis or counterpart axis.</li> <li>Pulses are being output.</li> </ul> | <ul style="list-style-type: none"> <li>Verify that the reference axis and counterpart axis are not in use and the stop conditions are not satisfied.</li> </ul>   | Error location information and system configuration information | At instruction execution                               |
| 36B3H      | Axis 3 interpolation operation error (reference/ counterpart axis error) | <ul style="list-style-type: none"> <li>Conditions such as limits were satisfied to stop pulses in the reference axis or counterpart axis.</li> <li>Pulses are being output.</li> </ul> | <ul style="list-style-type: none"> <li>Verify that the reference axis and counterpart axis are not in use and the stop conditions are not satisfied.</li> </ul>   | Error location information and system configuration information | At instruction execution                               |
| 36B4H      | Axis 4 interpolation operation error (reference/ counterpart axis error) | <ul style="list-style-type: none"> <li>Conditions such as limits were satisfied to stop pulses in the reference axis or counterpart axis.</li> <li>Pulses are being output.</li> </ul> | <ul style="list-style-type: none"> <li>Verify that the reference axis and counterpart axis are not in use and the stop conditions are not satisfied.</li> </ul>   | Error location information and system configuration information | At instruction execution                               |
| 36F0H      | ABS sum error  | <ul style="list-style-type: none"> <li>There is a sum check error in ABS data read from servo.</li> </ul>  | <ul style="list-style-type: none"> <li>Check servo wiring and setting.</li> </ul>   | Error location information and system configuration information | At instruction execution                               |
| 3780H      | High-speed comparison table maximum excess error                         | <ul style="list-style-type: none"> <li>The number of high-speed comparison tables registered is greater than the upper limit.</li> </ul>   | <ul style="list-style-type: none"> <li>Check the total number of tables in the parameters and tables registered in the comparison match instruction.</li> </ul>   | Error location information                                      | At END instruction execution, at instruction execution |
| 3781H      | Preset value range outside error   | <ul style="list-style-type: none"> <li>The preset value is greater than the ring length set value.</li> </ul>  | <ul style="list-style-type: none"> <li>Disable the ring length.</li> <li>Set the preset value within the ring length range.</li> </ul>  | Error location information and system configuration information | At instruction execution                               |
| 3C00H      | Hardware failure   | <ul style="list-style-type: none"> <li>A hardware failure was detected.</li> </ul>   | <ul style="list-style-type: none"> <li>Reset the CPU module and perform RUN. If the same error appears, the hardware of the CPU module may be malfunctioning. Consult your local Mitsubishi Electric representative.</li> </ul> | System configuration information                                | At power-on, at RESET                                  |
| 3C01H      | Hardware failure   | <ul style="list-style-type: none"> <li>A hardware failure was detected.</li> </ul>   | <ul style="list-style-type: none"> <li>Reset the CPU module and perform RUN. If the same error appears, the hardware of the CPU module may be malfunctioning. Consult your local Mitsubishi Electric representative.</li> </ul> | System configuration information                                | At power-on, at RESET                                  |
| 3C02H      | Hardware failure   | <ul style="list-style-type: none"> <li>A hardware failure was detected.</li> </ul>   | <ul style="list-style-type: none"> <li>Reset the CPU module and perform RUN. If the same error appears, the hardware of the CPU module may be malfunctioning. Consult your local Mitsubishi Electric representative.</li> </ul> | System configuration information                                | At power-on, at RESET                                  |
| 3C03H      | Hardware failure   | <ul style="list-style-type: none"> <li>A hardware failure was detected.</li> </ul>   | <ul style="list-style-type: none"> <li>Reset the CPU module and perform RUN. If the same error appears, the hardware of the CPU module may be malfunctioning. Consult your local Mitsubishi Electric representative.</li> </ul> | —   | At power-on, at RESET                                  |



| Error code | Error name              | Error details and cause   | Action  | Detailed information | Diagnostic timing                       |
|------------|-------------------------|---|---|----------------------|---|
| 3C0FH      | Hardware failure        | • A hardware failure was detected.                                | • Reset the CPU module and perform RUN. If the same error appears, the hardware of the CPU module may be malfunctioning. Consult your local Mitsubishi Electric representative. | —                    | At power-on, at RESET                   |
| 3C20H      | Memory error            | • A memory error was detected.                                    | • Reset the CPU module and perform RUN. If the same error appears, the hardware of the CPU module may be malfunctioning. Consult your local Mitsubishi Electric representative. | —                    | At power-on, at RESET                   |
| 3C22H      | Memory error            | • A memory error was detected.                                    | • Reset the CPU module and perform RUN. If the same error appears, the hardware of the CPU module may be malfunctioning. Consult your local Mitsubishi Electric representative. | —                    | At power-on, at RESET                   |
| 3C2FH      | Memory error            | • A memory error was detected.                                    | • Reset the CPU module and perform RUN. If the same error appears, the hardware of the CPU module may be malfunctioning. Consult your local Mitsubishi Electric representative. | —                    | At power-on, at RESET                   |
| 3E20H      | Program execution error | • A program larger than the internal memory capacity was written. | • Reset the CPU module and perform RUN. If the same error appears, the hardware of the CPU module may be malfunctioning. Consult your local Mitsubishi Electric representative. | —                    | At memory card attachment or detachment |

## Error codes of the CPU module (4000H to 4FFFH)

The following table lists the error codes detected by other causes than the self-diagnostics function of the CPU module.

| Error code | Error name                 | Error details and cause  | Action  |
|------------|----------------------------|--|---|
| 4000H      | Common error               | • Serial communication sum check error.  | • Connect the serial communication cable correctly.<br>• Take measures to reduce noise.   |
| 4001H      | Common error               | • An unsupported request was executed.   | • Check the command data of SLMP/MC protocol.<br>• Check the CPU module model name selected in the engineering tool.<br>• Check the target CPU module model name.   |
| 4002H      | Common error               | • An unsupported request was executed.   | • Check the command data of SLMP/MC protocol.<br>• Check the CPU module model name selected in the engineering tool.<br>• Execute the request again.<br>• If the same error code is displayed again, the possible cause is a hardware failure of the CPU module. Please consult your local Mitsubishi representative. |
| 4005H      | Common error               | • The volume of data handled according to the specified request is too large.            | • Check the command data of SLMP/MC protocol.   |
| 4006H      | Common error               | • Initial communication has failed.  | • When using serial communication, check with the external device manufacturer for support conditions.<br>• When using serial communication, check the CPU module model name selected in the engineering tool.<br>• When using Ethernet communication, shift the communication start timing.                          |
| 4010H      | CPU module operation error | • Since the CPU module is running, the request contents cannot be executed.              | • Execute after setting the CPU module to STOP status.  |
| 4013H      | CPU module operation error | • Since the CPU module is not in a STOP status, the request contents cannot be executed. | • Execute after setting the CPU module to STOP status.  |
| 4021H      | File related error         | • The specified drive (memory) does not exist or there is an error.                      | • Check the specified drive (memory) status.<br>• Back up data in the CPU module, and then initialize the memory.   |
| 4022H      | File related error         | • The file with the specified file name or file No. does not exist.                      | • Check the specified file name and file No.  |
| 4025H      | File related error         | • The specified file is processing the request from another engineering tool.            | • Forcibly execute the request. Or, execute the request again after the processing being performed ends.  |
| 4027H      | File related error         | • The specified range is larger than the file size.                                      | • Check the specified range and access within that range.   |
| 4029H      | File related error         | • The specified file capacity cannot be obtained.  | • Review the specified file capacity, and execute the request again.  |



| Error code | Error name                                      | Error details and cause  | Action   |
|------------|---|--|--|
| 402CH      | File related error                              | <ul style="list-style-type: none"> <li>The requested operation cannot be executed currently.</li> </ul>  | <ul style="list-style-type: none"> <li>Execute again after a while.</li> </ul>   |
| 4030H      | Device specification error                      | <ul style="list-style-type: none"> <li>The specified device name cannot be handled.</li> </ul>   | <ul style="list-style-type: none"> <li>Check the specified device name.</li> </ul>   |
| 4031H      | Device specification error                      | <ul style="list-style-type: none"> <li>The specified device No. is outside the range.</li> <li>The CPU module cannot handle the specified device.</li> </ul> | <ul style="list-style-type: none"> <li>Check the specified device No.</li> <li>Check the device assignment of the CPU module.</li> <li>Check the specified device name.</li> </ul>   |
| 4040H      | Intelligent function module specification error | <ul style="list-style-type: none"> <li>The request contents cannot be executed in the specified intelligent function module.</li> </ul>                      | <ul style="list-style-type: none"> <li>Check whether the specified module is the intelligent function module having the buffer memory.</li> </ul>  |
| 4041H      | Intelligent function module specification error | <ul style="list-style-type: none"> <li>The access range exceeds the buffer memory range of the specified intelligent function module.</li> </ul>             | <ul style="list-style-type: none"> <li>Check the start address and access number of points and access within the range that exists in the intelligent function module.</li> </ul>  |
| 4042H      | Intelligent function module specification error | <ul style="list-style-type: none"> <li>The specified intelligent function module cannot be accessed.</li> </ul>  | <ul style="list-style-type: none"> <li>Check that the specified intelligent function module is operating normally.</li> <li>Check the specified module for a hardware fault.</li> </ul>  |
| 4043H      | Intelligent function module specification error | <ul style="list-style-type: none"> <li>The intelligent function module does not exist in the specified position.</li> </ul>                                  | <ul style="list-style-type: none"> <li>Check the I/O number of the specified intelligent function module.</li> </ul>   |
| 4053H      | Protect error                                   | <ul style="list-style-type: none"> <li>An error occurred when writing data to the specified drive (memory).</li> </ul>                                       | <ul style="list-style-type: none"> <li>Check the specified drive (memory). Or, write data again after changing the corresponding drive (memory).</li> </ul>  |
| 4060H      | Online registration error                       | <ul style="list-style-type: none"> <li>The online debug function and the data logging function are being executed with another engineering tool.</li> </ul>  | <ul style="list-style-type: none"> <li>Finish the operation of the other engineering tool and then execute the function again.</li> <li>If the operation of the other engineering tool is on hold, resume and finish the operation of the other engineering tool, and then execute the function again.</li> </ul>  |
| 4080H      | Other errors                                    | <ul style="list-style-type: none"> <li>Request data error.</li> </ul>  | <ul style="list-style-type: none"> <li>Check the request data that has been specified.</li> </ul>  |
| 4081H      | Other errors                                    | <ul style="list-style-type: none"> <li>The search target data cannot be detected.</li> </ul>   | <ul style="list-style-type: none"> <li>Check the data to be searched.</li> </ul>   |
| 408BH      | Other errors                                    | <ul style="list-style-type: none"> <li>The remote request cannot be executed.</li> </ul>   | <ul style="list-style-type: none"> <li>Reexecute after the CPU module is in a status where the remote request can be executed.</li> <li>For remote operation, set the parameter to "Enable remote reset".</li> </ul>   |
| 4121H      | File related error                              | <ul style="list-style-type: none"> <li>The specified drive (memory) or file does not exist.</li> </ul>   | <ul style="list-style-type: none"> <li>Execute again after checking the specified drive (memory) or file.</li> </ul>   |
| 4122H      | File related error                              | <ul style="list-style-type: none"> <li>The specified drive (memory) or file does not exist.</li> </ul>   | <ul style="list-style-type: none"> <li>Execute again after checking the specified drive (memory) or file.</li> </ul>   |
| 4127H      | File related error                              | <ul style="list-style-type: none"> <li>File password 32 mismatch.</li> </ul>   | <ul style="list-style-type: none"> <li>Execute again after checking the file password 32.</li> </ul>   |
| 4135H      | File related error                              | <ul style="list-style-type: none"> <li>The date/time data of the engineering tool (personal computer) is out of range.</li> </ul>                            | <ul style="list-style-type: none"> <li>Execute again after checking the clock setting of the engineering tool (personal computer).</li> </ul>  |
| 4139H      | File related error                              | <ul style="list-style-type: none"> <li>The size of the specified file has exceeded that of the existing file.</li> </ul>                                     | <ul style="list-style-type: none"> <li>Execute again after checking the size of the specified file.</li> </ul>   |
| 413AH      | File related error                              | <ul style="list-style-type: none"> <li>The specified file has exceeded the already existing file size.</li> </ul>  | <ul style="list-style-type: none"> <li>Execute again after checking the size of the specified file.</li> </ul>   |
| 413BH      | File related error                              | <ul style="list-style-type: none"> <li>The same file was simultaneously accessed from different engineering tools.</li> </ul>                                | <ul style="list-style-type: none"> <li>Execute again after a while.</li> </ul>   |
| 413EH      | File related error                              | <ul style="list-style-type: none"> <li>Operation is disabled for the specified drive (memory).</li> </ul>  | <ul style="list-style-type: none"> <li>Execute again after changing the target drive (memory).</li> </ul>  |
| 4181H      | CPU module built-in Ethernet port error         | <ul style="list-style-type: none"> <li>Transmission to the receiving modules is unsuccessful.</li> </ul>   | <ul style="list-style-type: none"> <li>Check the external device operation.</li> <li>Check the status of the lines, such as cables, hubs and routes, connected to receiving modules.</li> <li>Some line packets may be engaged. Retry to communicate a little while later.</li> <li>The receiving module may have no free space in receive area (TCP window size is small). Check whether the receiving module processes receive data, or whether the CPU module does not send unnecessary data.</li> <li>Check whether the settings of the subnet mask pattern and the default router IP address of the CPU module and the receiving modules are correct, or whether the class of the IP address is correct.</li> </ul> |

# MEMO

## Revised History

| Date   | Revision | Description   |
|--------|----------|---------------|
| 2/2017 | A        | First Edition |
|        |          |               |

# Mitsubishi Programmable Controller Training Manual

## MELSEC iQ-F Series Basic Course (for GX Works3)

|               |  |
|---------------|--|
| MODEL         |  |
| MODEL<br>CODE |  |
| JY997D69701   |  |

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