NAiS

PROGRAMMABLE CONTROLLER

FP SERIES FP Σ

User’s Manual

[Applicable PLC]

- FPΣ–C32 Control unit (Part No. FPG–C32T)

Table of Contents

Chapter 4 Installation and Wiring

Chapter 5 High–speed Counter and Pulse Output Functions

Chapter 6 Communication Cassette

Chapter 7 Communication Function 1 Computer Link

Chapter 8 Communication Function 2 General–purpose Serial Communication

Chapter 9 Communication Function 3 PLC Link Function

Chapter 10 Other Functions

Chapter 11 Self–Diagnostic and Troubleshooting

Chapter 12 Specifications

Before You Start

Installation environment

Do not use the FPΣ unit where it will be exposed to the following:

- **Direct sunlight and ambient temperatures outside the range of 0°C to 55°C/32°F to 131°F.**
- **Ambient humidity outside the range of 30% to 85% RH and sudden temperature changes causing condensation.**
- **Inflammable or corresive gas.**
- **Excessive vibration or shock.**
- **Excessive airborne dust, metal particles or salts.**
- **Water or oil in any from including spray or mist.**
- **Benzine, paint thinner, alcohol or other organic solvents or strong alkaline solutions such as ammonia or caustic soda.**
- **Influence from power transmission lines, high voltage equipment, power cables, power equipment, radio transmitters, or any other equipment that would generate high switching surges.**

Static electricity

- **Before touching the unit, always touch a grounded piece of metal in order to discharge static electricity.**
- **In dry locations, excessive static electricity can cause problems.**

Cleaning

- **Do not use thinner based cleaners because they deform the unit case and fade the colors.**

Power supplies

- **An insulated power supply with an internal protective circuit should be used. The power supply for the control unit operation is a non-insulated circuit, so if an incorrect voltage is directly applied, the internal circuit may be damaged or destroyed.**
- **If using a power supply without a protective circuit, power should be supplied through a protective element such as a fuse.**

Power supply sequence

- **Have the power supply sequence such that the power supply of the control unit turns off before the power supply for input and output.**
- **If the power supply for input and output is turned off before the power supply of the control unit, the control unit will detect the input fluctuations and may begin an unscheduled operation.**

Before turning on the power

When turning on the power for the first time, be sure to take the precautions given below.

- **When performing installation, check to make sure that there are no scraps of wiring, particularly conductive fragments, adhering to the unit.**
- **Verify that the power supply wiring, I/O wiring, and power supply voltage are all correct.**
- **Sufficiently tighten the installation screws and terminal screws.**
- **Set the mode selector to PROG. mode.**

Before entering a program

Be sure to perform a program clear operation before entering a program.

Operation procedure when using FPWIN GR Ver.2

Procedure:

1. **Select “Online Edit Mode” on the FPWIN GR “On line” menu.**
2. **Select “Clear Program” on the “Edit” menu.**
3. **When the confirmation dialog box is displayed, click on “Yes” to clear the program.**

Request concerning program storage

To prevent the accidental loss of programs, the user should consider the following measures.

- **Drafting of documents**
  To avoid accidentally losing programs, destroying files, or overwriting the contents of a file, documents should be printed out and then saved.

- **Specifying the password carefully**
  The password setting is designed to avoid programs being accidentally overwritten. If the password is forgotten, however, it will be impossible to overwrite the program even if you want to. Also, if a password is forcibly bypassed, the program is deleted. When specifying the password, note it in the specifications manual or in another safe location in case it is forgotten at some point.

Programming Tool Restrictions

Type of programming tool		Instruction used/function restrictions
Software for Windows	FPWIN GR Ver.2	All instructions and functions can be used.
	FPWIN GR Ver.1	Not used
Software for MS–DOS	NPST–GR Ver.4	Not used
	NPST–GR Ver.3	
Handy programming unit (FP programmer)	AFP1114V2	Not used
	AFP1114	
	AFP1112A AFP1112	

Note

Precautions concerning programming tools

Programming tools used with the FPΣ require Ver. 2 or a subsequent version of the FPWIN GR. Please be aware that other tools cannot be used.

Chapter 1

Functions and Restrictions of the Unit

1.1 Features and Functions of the Unit

Powerful control capabilities

All of the functions of a mid–scale PLC are packed into the compact body size of the 32–point type FP0. A program capacity of 12 k steps is provided as a standard feature, so you never have to worry about how much memory is left as you're programming. In addition, 32 k words are reserved for data registers, so large volumes of data can be compiled and multiple operations can be processed without running out of memory.

A full range of communication functions

Using the Tool port (RS232C) provided as a standard feature on the main unit, communication can be carried out with a display panel or computer. Additionally, communication cassettes with RS232C and RS485 interfaces are available as an option. Installing a 2–channel RS232C type communication cassette in the FPΣ makes it possible to connect two devices with RS232C port. A full lineup of communication functions means you can also work with C–NET (up to 32 units) and PLC link function (up to 16 units).

Controlling two devices with RS232C port with one FPΣ

When using the 2–channel RS232C type communication cassette

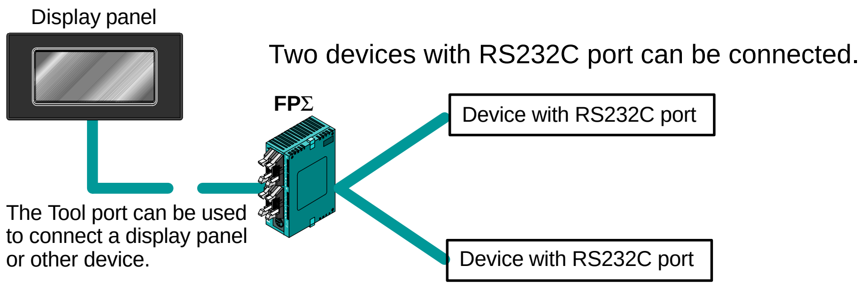


Figure 1: Features–communication (RS232C)

A C–NET up of to 32 units is supported.

When using the 1–channel RS485 type communication cassette

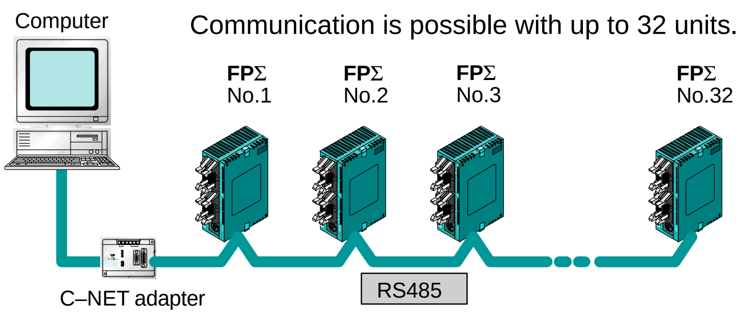


Figure 2: Features–communication (C–NET)

☛ next page

Data can be shared among the various PLCs using the PLC link function.

When using the 1–channel RS485 type communication cassette

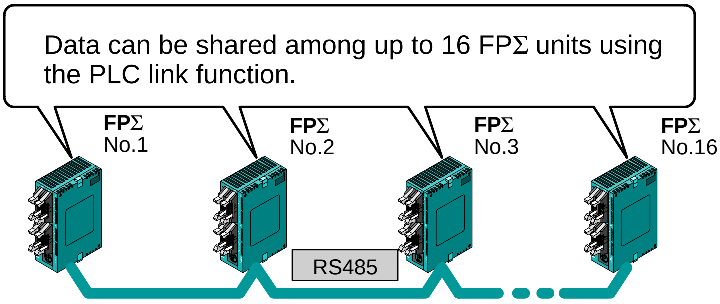


Figure 3: Features–communication (PLC link)

Positioning control supported through high–speed counter and pulse output

A high–speed counter and pulse output functions are provided as standard features. The pulse output function supports frequencies of up to 100 kHz, enabling positioning control using a stepping motor or servo motor.

Measurement using high–speed counter supported

Increment input mode, decrement input mode, 2–phase input mode, individual input mode, and direction discrimination mode are supported.

Single phase: Max. 50 kHz, Two–phase: Max. 20 kHz

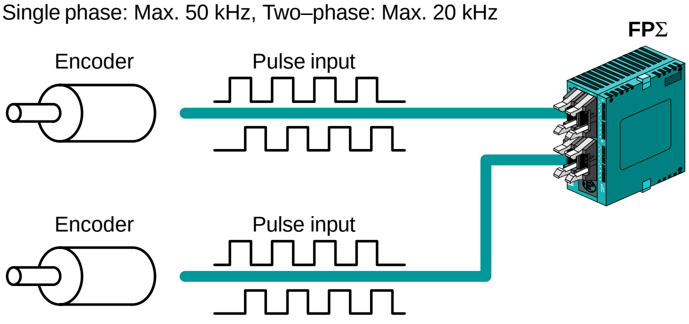


Figure 4: Features–High–speed counter

Positioning control based on pulse output supported

Pulse/sign and CW/CCW output are supported.

1–channel: Max. 100 kHz, 2–channel: Max. 60 kHz

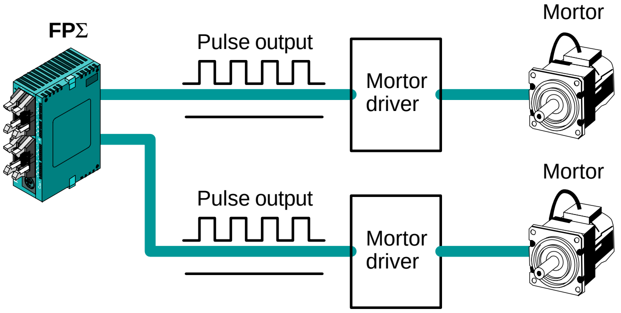


Figure 5: Features–Pulse output

Analog control supported

An analog potentiometer (volume dial) is provided as a standard feature. This can be used in applications such as analog timers, without using the programming tools. An analog unit is also available as the intelligent unit.

1.2 Unit Types

This section explains the type of unit used with the FPΣ and about the optional communication cassette.

1.2.1 FPΣ Control Unit

Name	Part No.
FPΣ Control unit	FPG–C32T

1.2.2 Expansion Unit, Power Supply Unit and Intelligent Unit

The expansion unit, power supply unit and intelligent unit used with the FPΣ can also be used with the earlier FP0 series.

1.2.3 Communication Cassette

A detachable communication cassette (optional) should be used when using the various functions such as the computer link, serial data communication, and PLC link functions.

Name	Description	Part No.
FPΣ Communication cassette 1–channel RS232C type	This communication cassette is a 1–channel unit with a five–wire RS232C port. It supports 1 : 1 computer links and general–purpose serial communication. RS/CS control is possible.	FPG–COM1
FPΣ Communication cassette 2–channel RS232C type	This communication cassette is a 2–channel unit with a three–wire RS232C port. It supports 1 : 1 computer links and general–purpose serial communication. Communication with two external devices is possible.	FPG–COM2
FPΣ Communication cassette 1–channel RS485 type	This communication cassette is a 1–channel unit with a two–wire RS485 port. It supports 1 : N computer links (C–NET), general–purpose serial communication, and a PLC link.	FPG–COM3

1.3 Restrictions on Unit Combinations

This section contains restrictions on unit combinations.

1.3.1 Restrictions on the Number of Expansion Units

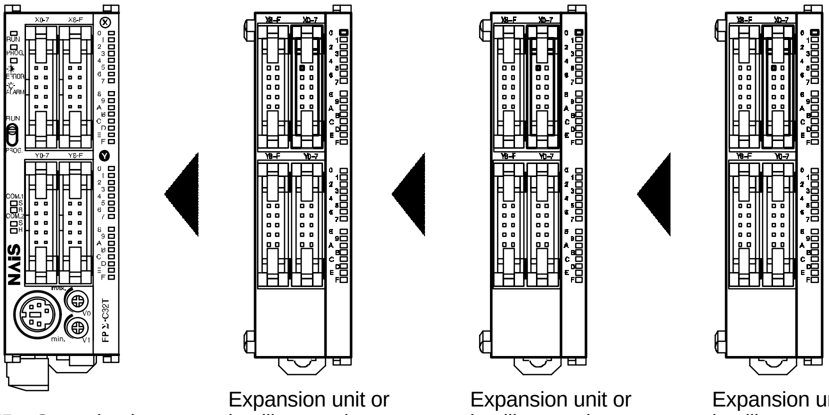


Figure 6: Restriction on unit combinations

A maximum of three FP0 expansion units or FP0 intelligent units can be connected to the FPΣ control unit.

There are no restrictions on the type and the order in which expansion units are installed.

A combination of relay output types and transistor output types is also possible.

1.3.2 Controllable I/O Points

No. of I/O points in control unit	No. of expansion I/O points
32 points	Max. 128 points

1.4 Programming Tools

This section explains about the programming tools for FPΣ.

1.4.1 Tools Needed for Programming

① **Programming tool software**
The tool software can also be used with the FP series.
The “FPWIN GR Ver. 2” Windows software is used with the FPΣ.
The earlier FPWIN GR Ver. 1x, NPST–GR, and FP Programmer cannot be used.

② **PC connection cable**
This cable needed for connection between the FPΣ and the computer.
When connecting to a computer (IBM PC/AT or 100% compatible), use a commercially available adapter.

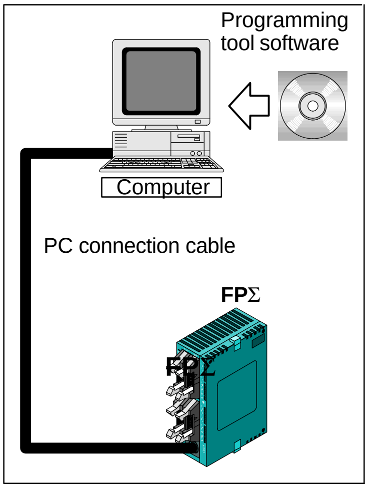


Figure 7: Programming tools

1.4.2 Software Environment and Suitable Cable

Type and environment for software

Type of software	OS (Operating system)	Hard disk capacity
FPWIN GR Ver.2	Windows95/98/Me/2000/NT(Ver.4.0 or later)	30MB or more

Type of computer and suitable cable

Type of computer	Cable	Adapter
IBM PC/AT or its compatible machine	Part No.: AFC8513	Commercially available 9–pin–25–pin conversion adapter (e.g. AT–925S by Data Spec.)
IBM PS/2 machine	Part No.: AFC8513	Commercially available 25–pin male–female conversion adapter (e.g. MF335 by Data Spec.)

Chapter 2

Specifications and Functions of the Unit

2.1 Parts and Functions

This section explains about the parts and functions of FPΣ control unit.

2.1.1 Parts and Functions

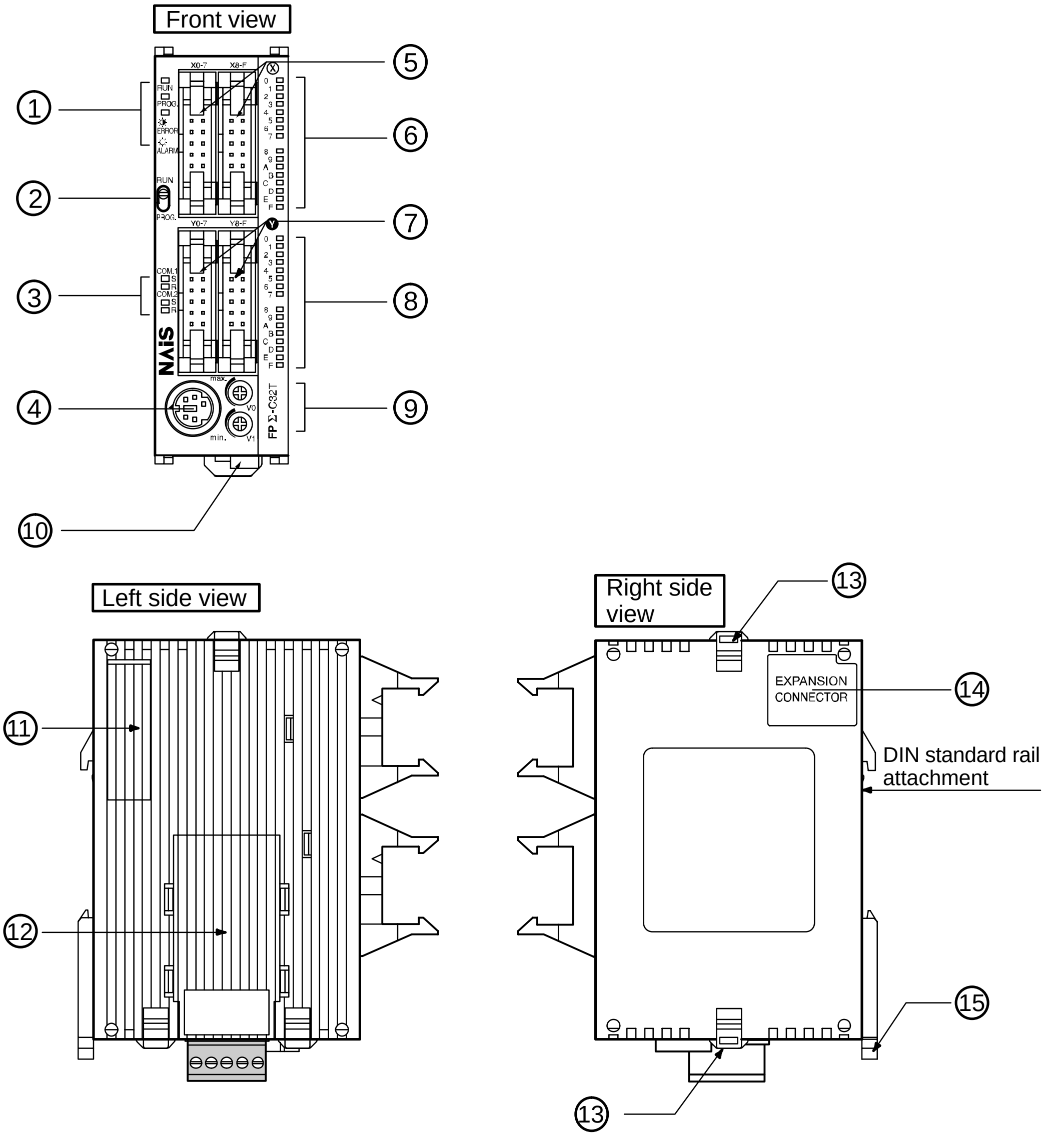


Figure 8: FPΣ Parts and Functions

① Status indicator LEDs

These LEDs display the current mode of operation or the occurrence of an error.

LED	LED and operation status
RUN (green)	Lights when in the RUN mode and indicates that the program is being executed.
	It flashes during forced input/output. (The RUN and PROG LEDs flash alternately.)
PROG. (green)	Lights when in the PROG. mode and indicates that operation has stopped.
	It flashes during forced input/output. (The RUN and PROG LEDs flash alternately.)
ERROR/ALARM (red)	Flashes when an error is detected during the self-diagnostic function.
	Lights if a hardware error occurs, or if operation slows because of the program, and the watchdog timer is activated.

② RUN/PROG. mode switch

This switch is used to change the operation mode of the PLC.

Switch position	Operation mode
RUN (upward)	This sets the RUN mode. The program is executed and operation begins.
PROG. (downward)	This sets the PROG. mode. The operation stops. In this mode, programming can be done using tools.

When performing remote switching from the programming tool, the position of the mode switch and the actual mode of operation may differ. Verify the mode with the status indicator LED. Otherwise, restart the FPΣ and change the mode of operation with the RUN/PROG. mode switch.

③ Communication status LEDs

These display the communication status of the COM.1 and COM.2 ports.

LED			LED and communication status
COM.1	**S**	**Transmitted data monitor**	Flashes while data is being transmitted
			Goes out when no data is being transmitted
	R	**Received data monitor**	Flashes while data is being received
			Goes out when no data is being received
COM.2	**S**	**Transmitted data monitor**	Flashes while data is being transmitted
			Goes out when no data is being transmitted
	R	**Received data monitor**	Flashes while data is being received
			Goes out when no data is being received

④ Tool port (RS232C)

This port is used to connect a programming tool.

⑤ Input connector (10 pins × 2)

⑥ Input indicator LEDs

⑦ Output connector (10 pins × 2)

⑧ Output indicator LEDs

⑨ Analog potentiometer (analog dial)

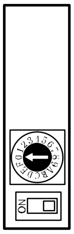
Turning this dial changes the values of special data registers DT90040 and DT90041 within the range of K0 to K1000. It can be used for analog timers and other applications.

⑩ Power supply connector (24 V DC)

Supply 24 V DC. It is connected using the power supply cable (AFP0581) that comes with the unit.

⑪ Unit (Station) number setting switch

This unit (station) number is specified when using the communication functions provided on the optional communication cassettes.



The unit (station) number setting switch is located under the cover on the back of the unit. Specify the unit (station) number using the selector switch and the dial.

Figure 9: FPΣ Parts and Functions (Unit No. setting switch)

⑫ Communication cassette (option)

This is the optional cassette type adapter used when communication is carried out.
Any one of the following the cassette types may be installed.

- – 1–channel RS232C type
- – 2–channel RS232C type
- – 1–channel RS485 type

⑬ Expansion hook

This hook is used to secure expansion units. The hook is also used for installation on flat type mounting plate (AFP0804).

⑭ Expansion connector

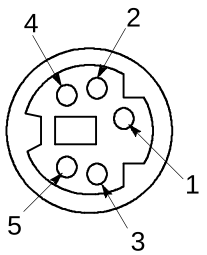
Connects an expansion unit to the internal circuit of the control unit.

⑮ DIN rail attachment lever

The FPΣ unit enables attachment at a touch to a DIN rail. The lever is also used for installation on slim 30 type mounting plate (AFP0811).

2.1.2 Tool Port Specification

A commercial mini–DIN 5–pin connector is used for the Tool port on the control unit.



Pin no.	Signal name	Abbreviation	Signal direction
1	Signal Ground	SG	—
2	Transmitted Data	SD	Unit → External device
3	Received Data	RD	Unit ← External device
4	(Not used)	—	—
5	+ 5 V	+ 5 V	Unit → External device

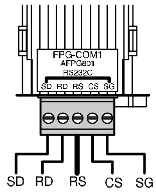
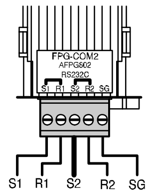
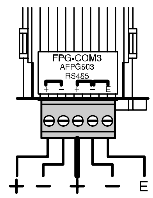
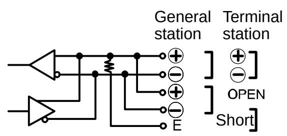
Figure 10: FPΣ Parts and Functions (Tool port)

The following are the default settings set when the unit is shipped from the factory. The system registers should be used to change these.

– Baud rate . . . . . . 9600 bps
– Character bit . . . 8 bit
– Parity check . . . . Odd parity
– Stop bit length . . 1 bit

2.1.3 Communication Cassette

The detachable communication cassette (optional) can be selected from among the three types shown below.

Type	Applicable communication function	Terminal layout diagram
1–channel RS232C type	Computer link General–purpose serial communication	 SD: Transmitted Data (Output) RD: Received Data (Input) RS: Request to Send (Output) CS: Clear to Send (Input) SG: Signal Ground
2–channel RS232C type	Computer link General–purpose serial communication	 S1: Transmitted Data (Output) (COM.1) R1: Received Data (Input) (COM.1) S2: Transmitted Data (Output) (COM.2) R2: Received Data (Input) (COM.2) SG: Signal Ground (COM.1 and 2)
1–channel RS485 type	Computer link General–purpose serial communication PLC link	 

2.2 Input and Output Specifications

This section contains input and output specifications of FPΣ control unit.

2.2.1 Input Specifications

Input specifications

Item		Description
Insulation method		Optical coupler
Rated input voltage		24 V DC
Operating voltage range		21.6 to 26.4 V DC
Rated input current		For X0, X1, X3, X4: approx. 8 mA For X2, X5 to X7: approx. 4.3 mA For X8 to XF: approx. 3.5 mA
Input points per common		16 points/common (Either the positive or negative of the input power supply can be connected to common terminal.)
Min. on voltage/Min. on current		For X0, X1, X3, X4: 19.2 V DC/6 mA For X2, X5 to XF: 19.2 V DC/3 mA
Max. off voltage/Max. off current		2.4 V DC/1.3 mA
Input impedance		For X0, X1, X3, X4: 3 kΩ For X2, X5 to X7: 5.6 kΩ For X8 to XF: 6.8 kΩ
Response time	**off → on**	For X0, X1, X3, X4: 5 µs or less For X2, X5 to X7: 100 µs or less For X8 to XF: 2 ms or less
	on → off	Same as above
Operating mode indicator		LED display

Note

X0 through X7 are inputs for the high-speed counter and have a fast response time. If used as normal inputs, we recommend inserting a timer in the ladder program as chattering and noise may be interpreted as an input signal.
Also, the above specifications apply when the rated input voltage is 24 VDC and the temperature is 25°C/70°F.

Limitations on number of simultaneous input on points

Keep the number of input points per common which are simultaneously on within the following range as determined by the temperature.

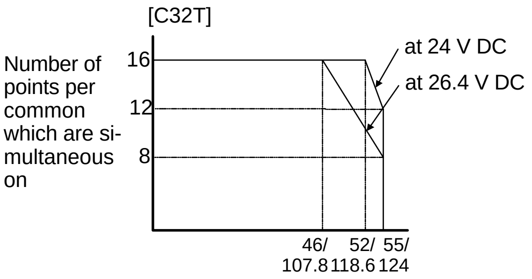


Figure 11: FPΣ Limitations on number of simultaneous input on points

Internal circuit diagram

[X0, X1, X3, X4]

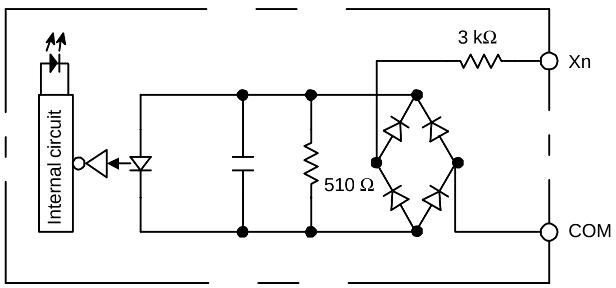
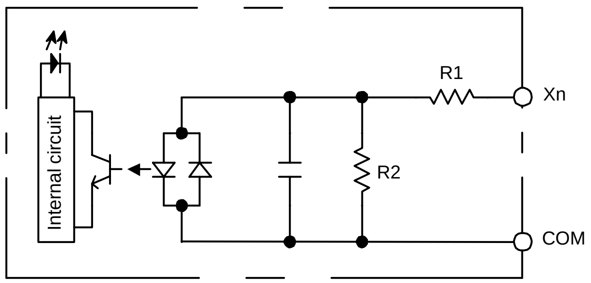


Figure 12: FPΣ Internal circuit diagram (Input–1)

[X2, X5 to XF]



For X2 and X5 to X7, R1: 5.6 kΩ, R2: 1 kΩ
For X8 to XF, R1: 6.8 kΩ, R2: 820 Ω

Figure 13: FPΣ Internal circuit diagram (Input–2)

2.2.2 Output Specifications

Transistor output specifications

Item		Description
Insulation method		Optical coupler
Output type		Open collector
Rated load voltage		5 to 24 V DC
Operating load voltage range		4.75 to 26.4 V DC
Max. load current		For Y0, Y1, Y3, Y4: 0.3 A For Y2, Y5 to YF: 0.1 A
Max. surge current		For Y0, Y1, Y3, Y4: 0.9 A For Y2, Y5 to YF: 0.5 A
Output points per common		16 points/common
Off state leakage current		100 µA or less
On state voltage drop		1.5 V or less
Response time	**off → on**	For Y0, Y1, Y3, Y4 (at 15 mA or more): 2 µs or less For Y2, Y5 to YF: 1 ms or less
	on → off	For Y0, Y1, Y3, Y4 (at 15 mA or more): 8 µs or less For Y2, Y5 to YF: 1 ms or less
External power supply for driving internal circuit	**Voltage**	21.6 to 26.4 V DC
	Current	70 mA or less
Surge absorber		Zener diode
Operating mode indicator		LED display
Phase fault protection		Thermal protection for Y2, Y5 to YF

Limitations on number of simultaneous output on points

Keep the number of output points per common which are simultaneously on within the following range as determined by the ambient temperature.

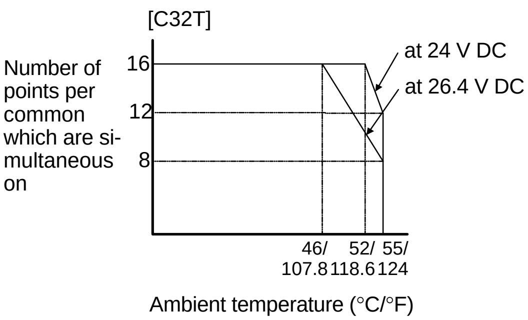


Figure 14: FPΣ Limitations on number of simultaneous output on points

Internal circuit diagram

[Y0, Y1, Y3, Y4]

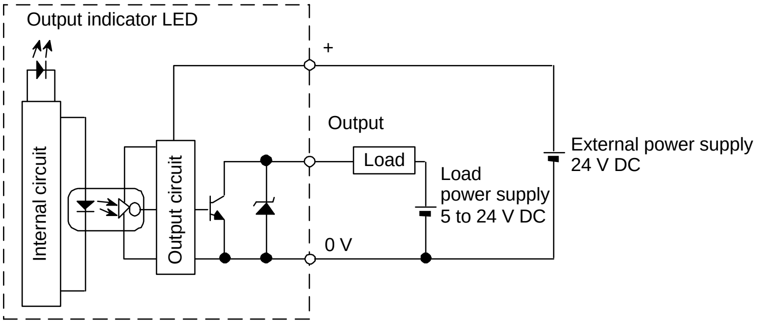


Figure 15: FPΣ Internal circuit diagram (output–1)

[Y2, Y5 to YF]

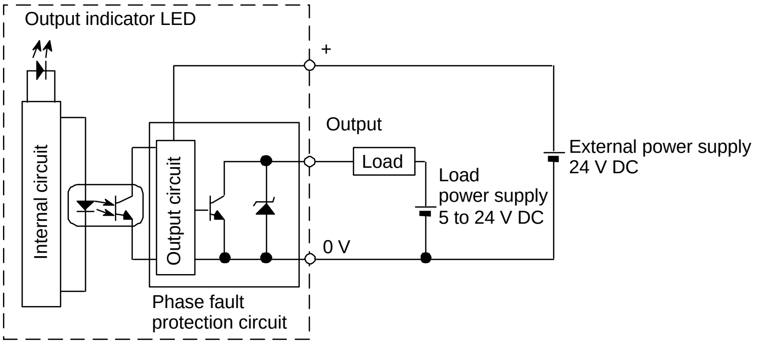
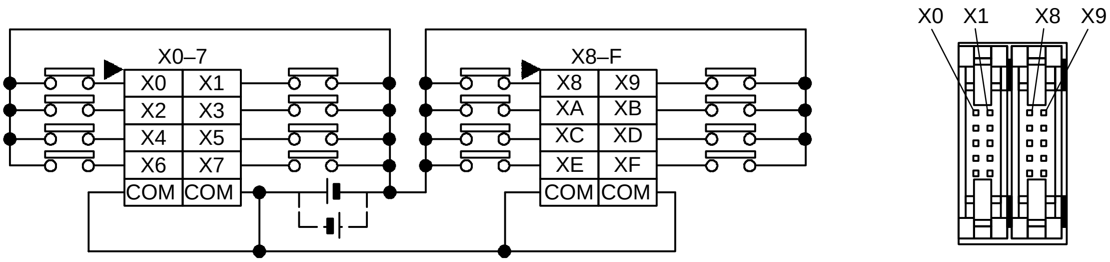


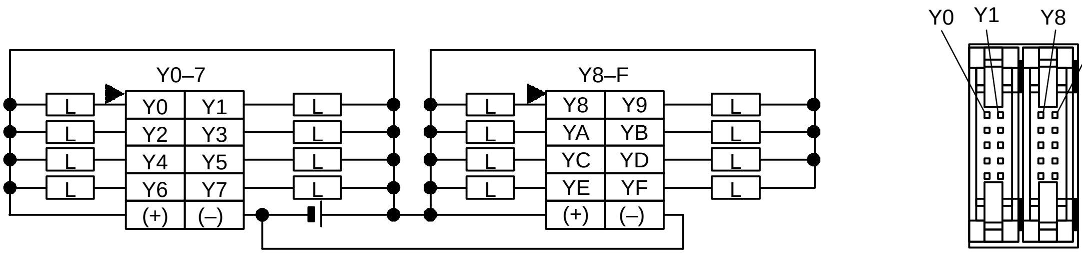
Figure 16: FPΣ Internal circuit diagram (output–2)

2.3 Terminal Layout Diagram

Intput



Output



(Connector front view)

Figure 17: FPΣ Terminal layout diagram (I/O connector)

Notes

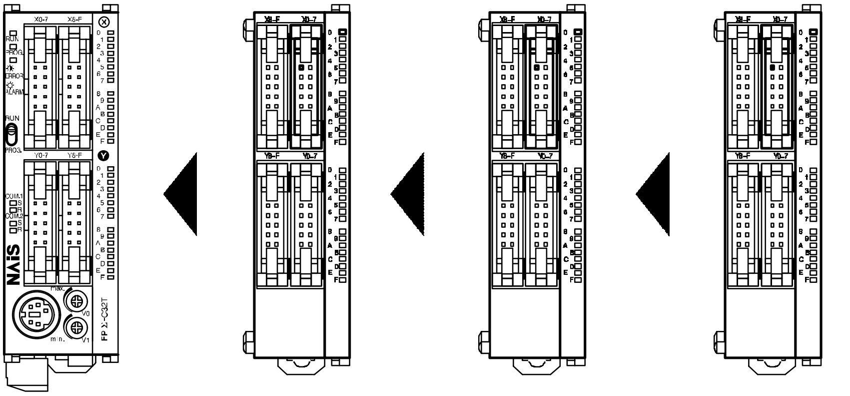
- **The four COM terminals of input circuit are connected internally.**
- **The two (+) terminals of output circuit are connected internally.**
- **The two (–) terminals of output circuit are connected internally.**

Chapter 3

I/O Allocation and Expansion Method

3.1 I/O Allocation

This section explains about the I/O allocation of FPΣ.



(Maximum possible expansion is with a total of 3 units.)

Control unit First expansion Second expansion Third expansion

Figure 18: FPΣ I/O allocation

3.1.1 I/O Number of FPΣ Control Unit

The I/O allocation of FPΣ control unit is fixed.

Unit	Transistor output type
Input (16 points)	X0 to XF
Output (16 points)	Y0 to YF

3.1.2 I/O Number of FP0 Expansion Unit

I/O do not need to be set as I/O allocation is performed automatically when an expansion unit is added. The I/O allocation of expansion unit is determined by the installation location.

Type of expansion unit		First expansion	Second expansion	Third expansion
E8X	**Input (8 points)**	X20 to X27	X40 to X47	X60 to X67
E8R	**Input (4 points)**	X20 to X23	X40 to X43	X60 to X63
	Output (4 points)	Y20 to Y23	Y40 to Y43	Y60 to Y63
E8YR/E8YT/E8YP	**Output (8 points)**	Y20 to Y27	Y40 to Y47	Y60 to Y67
E16X	**Input (16 points)**	X20 to X2F	X40 to X4F	X60 to X6F
E16R/E16T/E16P	**Input (8 points)**	X20 to X27	X40 to X47	X60 to X67
	Output (8 points)	Y20 to Y27	Y40 to Y47	Y60 to Y67
E16YT/E16YP	**Output (16 points)**	Y20 to Y2F	Y40 to Y4F	Y60 to Y6F
E32T/E32P	**Input (16 points)**	X20 to X2F	X40 to X4F	X60 to X6F
	Output (16 points)	Y20 to Y2F	Y40 to Y4F	Y60 to Y6F

3.1.3 I/O Number of FP0 Analog I/O Unit

The I/O allocation of FP0 analog I/O unit “FP0–A21” is determined by the installation location.

Unit		First expansion	Second expansion	Third expansion
Input	CH0 (16 points)	WX2 (X20 to X2F)	WX4 (X40 to X4F)	WX6 (X60 to X6F)
	CH1 (16 points)	WX3 (X30 to X3F)	WX5 (X50 to X5F)	WX7 (X70 to X7F)
Output (16 points)		WY2 (Y20 to Y2F)	WY4 (Y40 to Y4F)	WY6 (Y60 to Y6F)

3.1.4 I/O Number of FP0 A/D Conversion Unit

The I/O allocation of FP0 A/D conversion unit “FP0–A80” is determined by the installation location.

The data for the various channels is converted and loaded with a user program that includes a switching flag to convert the data.

Unit		First expansion	Second expansion	Third expansion
Input	CH0 (16 points)	WX2 (X20 to X2F)	WX4 (X40 to X4F)	WX6 (X60 to X6F)
	CH2 (16 points)			
	CH4 (16 points)			
	CH6 (16 points)			
	CH1 (16 points)	WX3 (X30 to X3F)	WX5 (X50 to X5F)	WX7 (X70 to X7F)
	CH3 (16 points)			
	CH5 (16 points)			
	CH7 (16 points)			

3.1.5 I/O Number of FP0 I/O Link Unit

The I/O allocation of FP0 I/O link unit “FP0–IOL” is determined by the installation location.

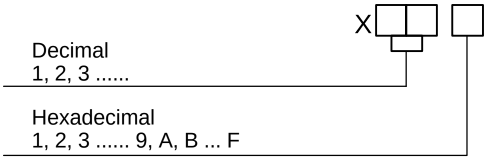
Unit	First expansion	Second expansion	Third expansion
Input (32 points)	X20 to X3F	X40 to X5F	X60 to X7F
Output (32 points)	Y20 to Y3F	Y40 to Y5F	Y60 to Y7F

Tip

I/O number of FPΣ and FP0

Specifying X and Y numbers
On the FPΣ and the FP0, the same numbers are used for input and output.
Example: The same number “X20 and Y20” can be used for input and output

Expression of numbers for input/output relays
Since input relay “X” and output relay “Y” are handled in units of 16 points, they are expressed as a combination of decimal and hexadecimal numbers as shown below.



3.2 Adding Expansion Units

Because unit expansion is done using the expansion connector and hook on the side of the unit, no expansion cable is needed.

3.2.1 Expansion Method

① Peel the seal on the side of the unit so that the internal expansion connector is exposed.

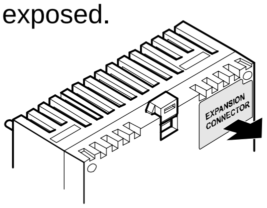


Figure 19: Expansion method procedure–1

② Raise the expansion hooks on the top and bottom sides of the unit with a screw-driver.

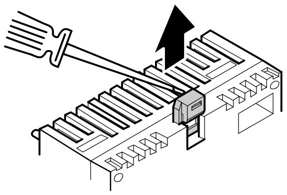


Figure 20: Expansion method procedure–2

③ Align the pins and holes in the four corners of the control unit and expansion unit, and insert the pins into the holes so that there is no gap between the units.

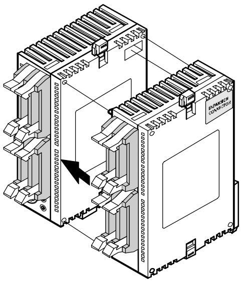


Figure 21: Expansion method procedure–3

④ Press down the expansion hooks raised in step 2 to secure the unit.

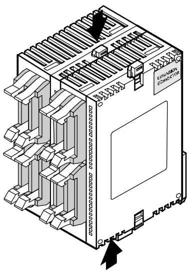


Figure 22: Expansion method procedure–4

Chapter 4

Installation and Wiring

4.1 Installation

This section explains installation environment and installation method of FPΣ.

4.1.1 Installation Environment and Space

Avoid installing the unit in the following locations:

- Ambient temperatures outside the range of 0°C to 55°C/32°F to 131°F
- Ambient humidity outside the range of 30% to 85% RH
- Sudden temperature changes causing condensation
- Inflammable or corrosive gases
- Excessive airborne dust, metal particles or salts
- Benzine, paint thinner, alcohol or other organic solvents or strong alkaline solutions such as ammonia or caustic soda
- Excessive vibration or shock
- Direct sunlight
- Water or oil in any form including spray or mist

Measures regarding noise:

- Influence from power transmission lines, high voltage equipment, power cables, power equipment, radio transmitters, or any other equipment that would generate high switching surges
- If noise occurs in the power supply line even after the above countermeasures are taken, it is recommended to supply power through an insulation transformer, noise filter, or like.

Measures regarding heat discharge

Always install the unit orientated with the tool port facing outward on the bottom in order to prevent the generation of heat.

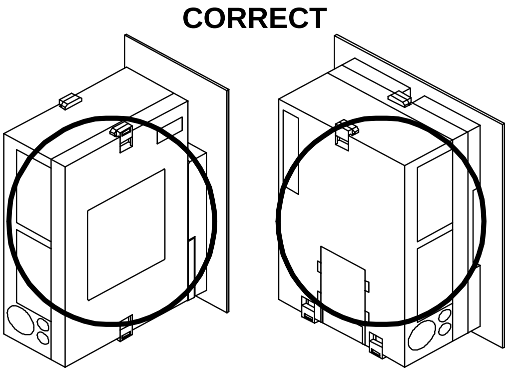


Figure 23: FPΣ Installation–heat discharge

Do not install the FPΣ control unit as shown below.

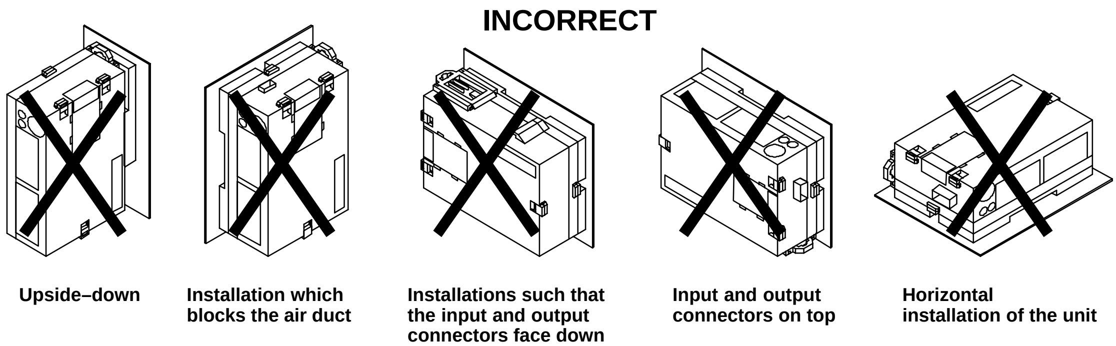


Figure 24: FPΣ Installation direction

Do not install the unit above devices which generate heat such as heaters, transformers or large scale resistors.

Installation space

Leave at least 50 mm/1.97 in. of space between the wiring ducts of the unit and other devices to allow heat radiation and unit replacement.

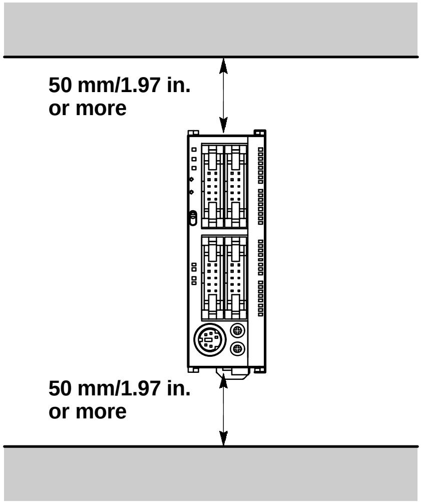


Figure 25: FPΣ Installation space–1

Maintain a minimum of 100 mm/3.937 in. between devices to avoid adverse affects from noise and heat when installing a device or panel door to the front of the PLC unit.

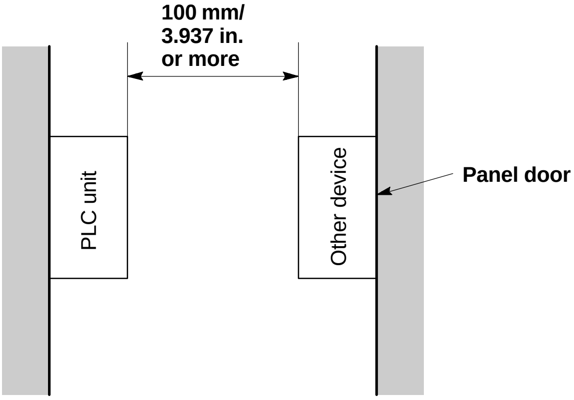


Figure 26: FPΣ Installation space–2

Keep the first 100 mm/3.937 in. from the front surface of the control unit open in order to allow room for programming tool connections and wiring.

4.1.2 Installation and Removal

Attachment to DIN rail and removal from DIN rail

The FPΣ unit enables simple attachment to DIN rails.

Procedure of installation method

① Fit the upper hook of the unit onto the DIN rail.

② Without moving the upper hook, press on the lower hook to fit the unit into position.

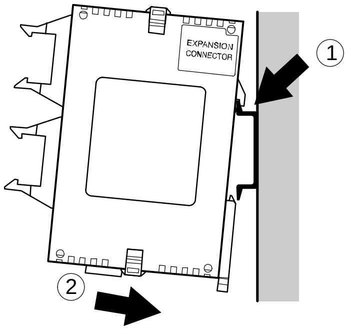


Figure 27: Installation method

Procedure of removal method

① Insert a slotted screwdriver into the DIN rail attachment lever.

② Pull the attachment lever downwards.

③ Lift up the unit and remove it from the rail.

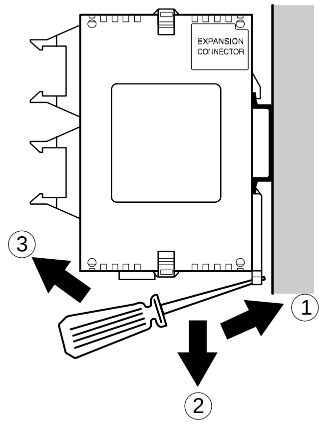


Figure 28: Removal method

Installation using the optional mounting plate

When using the slim 30 type mounting plate (AFP0811)

Use M4 size pan–head screws for attachment of the slim 30 type mounting plate to mounting panel and install according to the dimensions shown below.

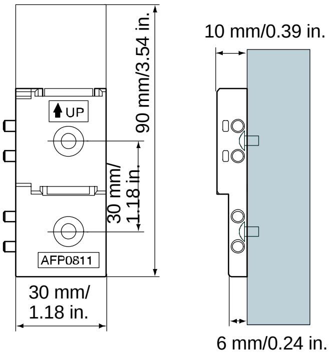


Figure 29: FPΣ Installation–optional slim 30 type mounting plate

The rest of the procedure is the same as that for attaching the unit to the DIN rails.

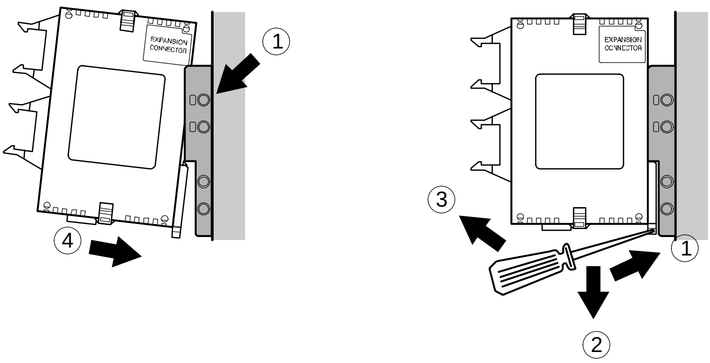


Figure 30: FPΣ Installation using slim 30 type mounting plate

When using an expansion unit, tighten the screws after joining all of the slim 30 type mounting plate to be connected. Tighten the screws at each of the four corners.

Example: Two expansion units

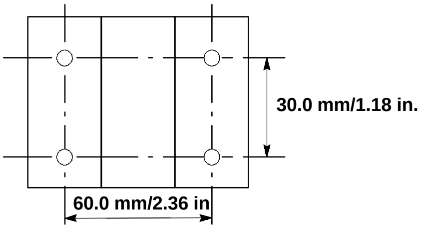


Figure 31: FPΣ Installation using two expansion units

When using the flat type mounting plate (AFP0804)

Use M4 size pan–head screws for attachment of the flat type mounting plate and install according to the dimensions shown below.

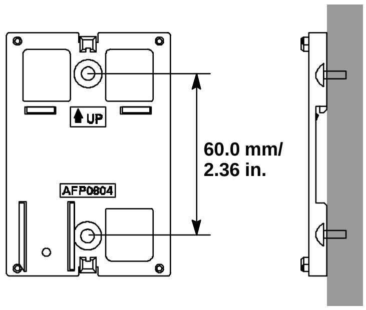


Figure 32: FPΣ Installation–optional flat type mounting plate

Raise the expansion hooks on the top and bottom of the unit.
Align the expansion hooks with the mounting plate and press the hooks on the top and bottom.

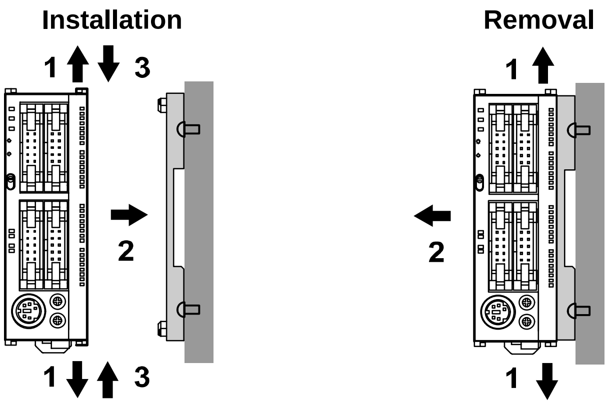


Figure 33: FPΣ Installation using flat type mounting plate

An unit with an attached flat type mounting plate can also be installed sideways on a DIN rail.

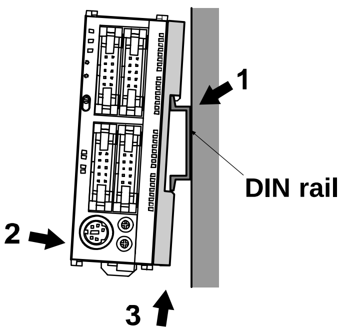


Figure 34: FPΣ Installation on DIN rail using flat type mounting plate

Note

The flat type mounting plate (AFP0804) cannot be used for an expansion unit.

4.2 Wiring of Power Supply

This section explains power supply wiring of FPΣ.

4.2.1 Wiring of Power Supply

Use the power supply cable provided as an accessory to supply power to the unit.

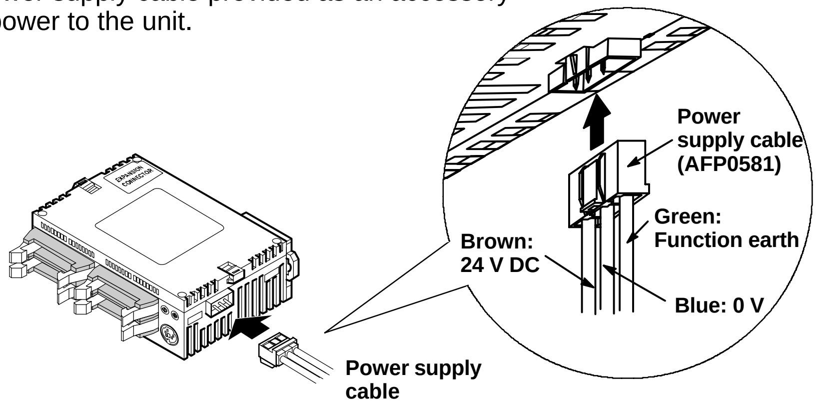


Figure 35: FPΣ Wiring of power supply

Power supply wiring for the unit

Use the power supply cable (Part No.: AFP0581) that comes with the unit to connect the power supply.

–Brown: 24 V DC
–Blue: 0 V
–Green: Function earth

Power supply wire

To minimize adverse effects from noise, twist the brown and blue wires of the power supply cable.

Power supply type

To protect the system against erroneous voltage from the power supply line, use an insulated power supply with an internal protective circuit.

The regulator on the unit is a non-insulated type.

If using a power supply device without an internal protective circuit, always make sure power is supplied to the unit through a protective element such as a fuse.

Power supply voltage

Rated voltage	24 V DC
Operating voltage range	21.6 to 26.4 V DC

Wiring system

Isolate the wiring systems to the control unit, input/output devices, and mechanical power apparatus.

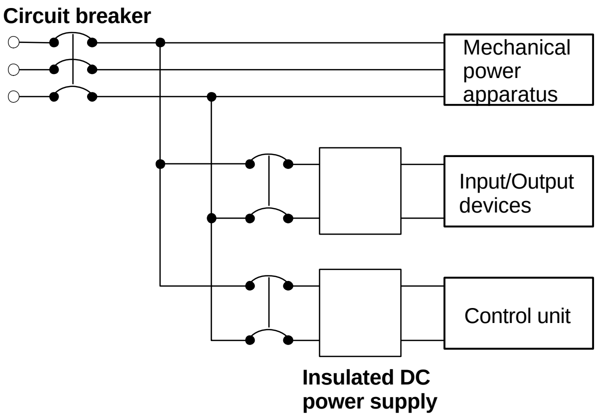


Figure 36: FPΣ Power supply wiring system

Measures regarding power supply sequence (start up sequence)

The power supply sequence should be set up so that power to the control unit is turned off before the input/output power supplies.

If the input/output power supplies are turned off before the power to the control unit, the control unit will detect the input fluctuations and may begin an unscheduled operation.

Be sure to supply power to a control unit and an expansion unit from the same power supply, and turn the power on and off simultaneously for both.

4.2.2 Grounding

Under normal conditions, the inherent noise resistance is sufficient. However, in situations of excess noise, ground the instrument to increase noise suppression.

For grounding purposes, use wiring with a **minimum of 2 mm^2**. The grounding connection should have a resistance of **less than 100 Ω**.

The point of grounding should be as close to the PLC unit as possible. The ground wire should be as short as possible.

If two devices share a single ground point, it may produce an adverse effect. Always use an exclusive ground for each device.

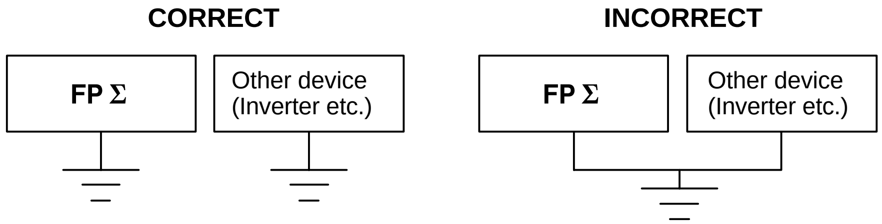


Figure 37: FPΣ Grounding

Note

Depending on the surroundings in which the equipment is used, grounding may cause problems.
Example:
Since the power supply line of the FPΣ power supply connector is connected to the function earth through a varistor, if there is an irregular potential between the power supply line and earth, the varistor may be shorted.

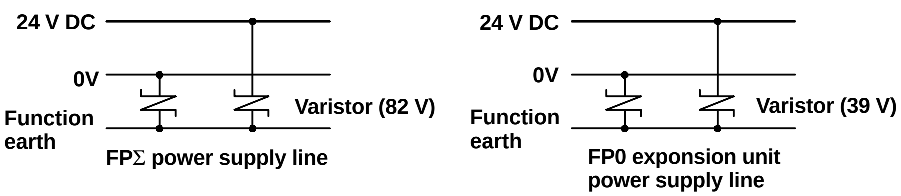


Figure 38: Power supply line of FPΣ and FP0 expansion unit

4.3 Wiring of Input and Output

This section explains input wiring and output wiring of FPΣ.

4.3.1 Input Wiring

Connection of photoelectric sensor and proximity sensor

Relay output type

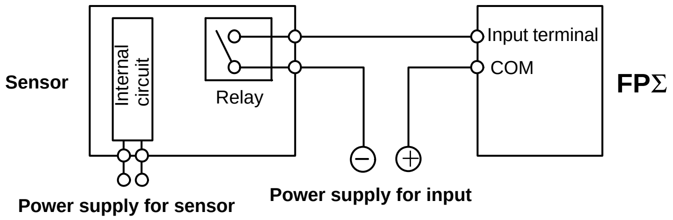


Figure 39: FPΣ Relay output type sensor

NPN open collector output type

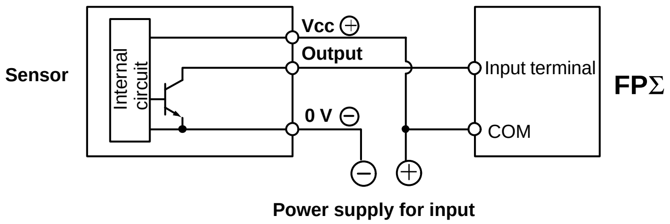


Figure 40: FPΣ NPN open collector output type sensor

Voltage output (Universal output) type

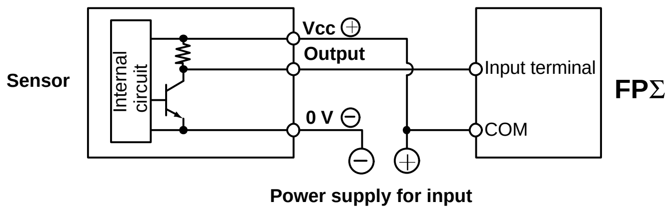


Figure 41: FPΣ Voltage output (universal output) type sensor

Two-wire output type

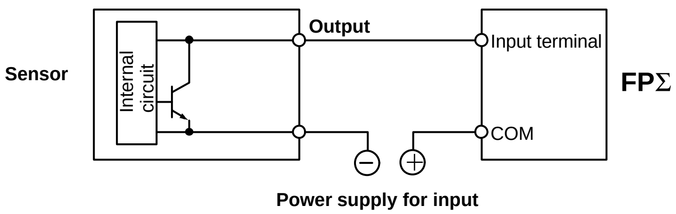


Figure 42: FPΣ Two–wire output type sensor

Precaution when using LED–equipped lead switch

When a LED is connected in series to an input contact such as LED-equipped lead switch, make sure that the on voltage applied to the PLC input terminal is greater than 19.2 V DC. In particular, take care when connecting a number of switches in series.

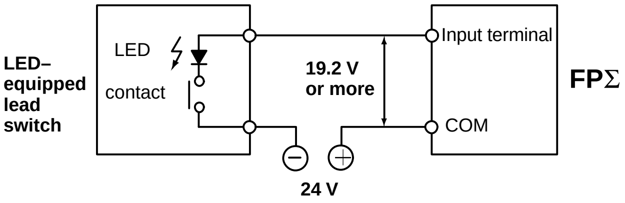


Figure 43: FPΣ Precaution when using LED–equipped lead switch

Precaution when using two–wire type sensor

If the input of PLC does not turn off because of leakage current from the two-wire type sensor “photoelectric sensor or proximity sensor”, the use of a bleeder resistor is recommended, as shown below.

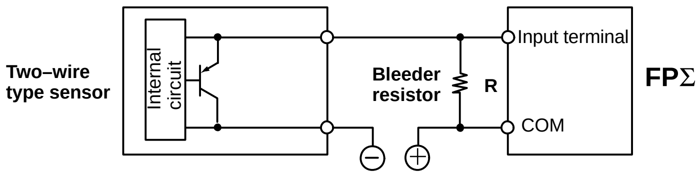


Figure 44: FPΣ Precaution when using two–wire type sensor

The off voltage of the input is 2.4 V, therefore, select the value of bleeder resistor “R” so that the voltage between the COM terminal and the input terminal will be less than 2.4 V.

The input impedance is 5.6 kΩ. (I: Sensor’s leakage current (mA))

The resistance R of the bleeder resistor is: $R \leqq \dfrac{13.44}{5.6 \times I - 2.4}$ (kΩ)

The formula is based on an input impedance of 5.6 kΩ. The input impedance varies depending on the input terminal number.

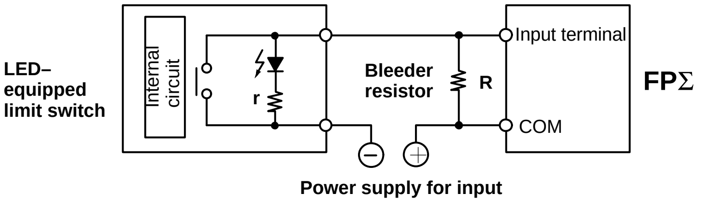
The wattage W of the resistor is:

$$W = \frac{(\text{Power supply voltage})^2}{R}$$

In the actual selection, use a value that is 3 to 5 times the value of W.

Precaution when using LED–equipped limit switch

If the input of PLC does not turn off because of the leakage current from the LED-equipped limit switch, the use of a bleeder resistor is recommended, as shown below.



r: Internal resistor of limit switch (kW)

Figure 45: FPΣ Precaution when using LED–equipped limit switch

The off voltage of input is 2.4 V, therefore when the power supply voltage is 24 V, select the bleeder resistor "R" so that

the current will be greater than $I = \frac{24 - 2.4}{r}$

The resistance R of the bleeder resistor is: $R \leqq \frac{13.44}{5.6 \times I - 2.4}$ (kΩ)

The wattage W of the resistor is: $W = \frac{(\text{Power supply voltage})^2}{R}$

In the actual selection, use a value that is 3 to 5 times the value of W.

4.3.2 Output Wiring

Protective circuit for inductive loads

With an inductive load, a protective circuit should be installed in parallel with the load.

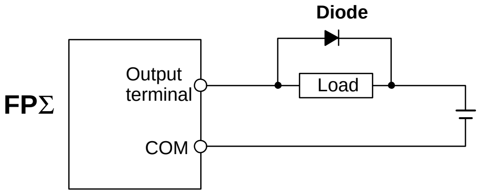


Figure 46: FPΣ Protective circuit for inductive load

Precautions when using capacitive loads

When connecting loads with large in-rush currents, to minimize their effect, connect a protection circuit as shown below.

Figure 47: FPΣ Precautions when using capacitive loads

About the short–circuit protective circuit

To prevent the output circuit from being damaged by a short–circuit or other electrical problems on the output side, a transistor with short–circuit protection is provided.

4.3.3 Precautions Regarding Input and Output Wirings

Be sure to select the thickness (dia.) of the input and output wires while taking into consideration the required current capacity.

Arrange the wiring so that the input and output wiring are separated, and these wirings are separated from the power wiring, as much as possible. Do not route them through the same duct or wrap them up together.

Separate the input/output wires from the power and high voltage wires by at least 100 mm/3.937 in.

4.4 Wiring of MIL Connector Type

Supplied connector and Suitable wires

The connector “housings, semi-cover and welders” listed below come supplied with the FPΣ control unit. Use the wires given below. Also, use the required pressure connection tools for connecting the wires.

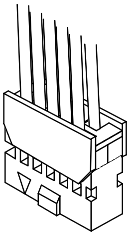


Figure 48: FPΣ Supplied MIL connector

Supplied connector (AFP0807)

Type and Product No.	
Housing	10–pin type only
Semi–cover	AXW61001
Welder (contact)	AXW7221

Suitable wires

Size	Conductor cross–sectional area	Insulation thickness
AWG#22	0.3 mm^2	dia. 1.5 to dia. 1.1
AWG#24	0.2 mm^2	

Pressure connection tool

Product No.	AXY52000

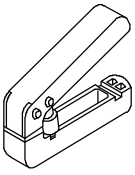


Figure 49: FPΣ Pressure connection tool

Procedure of assembly (Wiring method)

The wire end can be directly crimped without removing the wire’s insulation, saving labor.

① Bend the welder (contact) back from the carrier, and set it in the pressure connection tool.

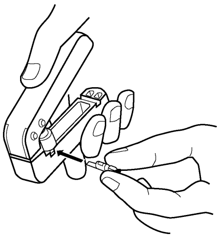


Figure 50: FPΣ MIL connector assembly procedure–1

② Insert the wire without removing its insulation until it stops, and lightly grip the tool.

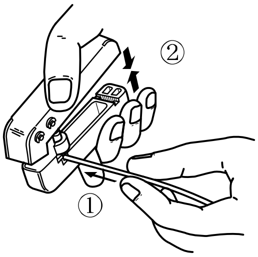


Figure 51: FPΣ MIL connector assembly procedure–2

③ After press-fitting the wire, insert it into the housing.

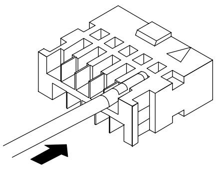


Figure 52: FPΣ MIL connector assembly procedure–3

④ When all wires has been inserted, fit the semi-cover into place.

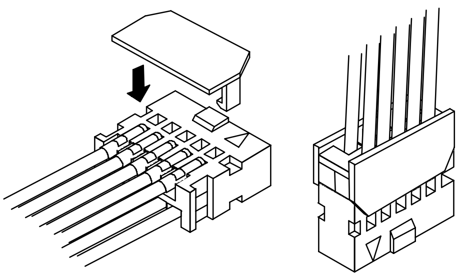


Figure 53: FPΣ MIL connector assembly procedure–4

If there is a wiring mistake or the cable is incorrectly pressure-connected, the contact puller pin provided with the fitting can be used to remove the contact.

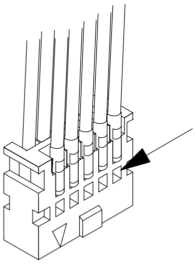


Figure 54: FPΣ MIL connector–rewiring

Tip

If using a MIL connector for flat cables, specify the product no. AXM110915.

4.5 Safety Measures

This section explains the safety measures, momentary power failures and protection of power supply and output.

4.5.1 Safety Measures

Precautions regarding system design

In certain applications, malfunction may occur for the following reasons:

- Power on timing differences between the PLC system and input/output or mechanical power apparatus
- Responce time lag when a momentary power drop occurs
- Abnormality in the PLC unit, external power supply, or other devices

In order to prevent a malfunction resulting in system shutdown choose the adequates safety measures listed in the following:

Interlock circuit

When a motor clockwise/counter-clockwise operation is controlled, provide an interlock circuit externally.

Emergency stop circuit

Add an emergency stop circuit externally to controlled devices in order to prevent a system shutdown or an irreparable accident when malfunction occurs.

Start up sequence

The PLC should be operated after all of the outside devices are energized. To keep this sequence, the following measures are recommended:

- Turn on the PLC with the mode selector set to the PROG. mode, and then switch to the RUN mode.
- Program the PLC so as to disregard the inputs and outputs until the outside devices are energized

Note

When stopping the operation of the PLC also, have the input/output devices turned off after the PLC has stopped operating.

Grounding

When installing the PLC next to devices that generate high voltages from switching, such as inverters, do not ground them together. Use an exclusive ground for each device.

4.5.2 Momentary Power Failures

Operation of momentary power failures

If the duration of the power failure is less than 4 ms, the FPΣ continues to operate. If the power is off for 4 ms or longer, operation changes depending on the combination of units, the power supply voltage, and other factors. (In some cases, operation may be the same as that for a power supply reset.)

4.5.3 Protection of Power Supply and Output Sections

Power supply

An insulated power supply with an internal protective circuit should be used. The power supply for the control unit operation is a non-insulated circuit, so if an incorrect voltage is directly applied, the internal circuit may be damaged or destroyed. If using a power supply without a protective circuit, power should be supplied through a protective element such as a fuse.

Protection of output

If current exceeding the rated control capacity is being supplied in the form of a motor lock current or a coil shorting in an electromagnetic device, a protective element such as a fuse should be attached externally.

4.6 Backup Battery

This section explains installation, lifetime of backup battery and battery alarm error function setting.

4.6.1 Installation of Backup Battery

Installing a backup battery in the FPΣ makes it possible to access clock/calendar functions for use, in addition to backing up data registers and other data.

① Using a screwdriver or similar tool, open the battery cover.

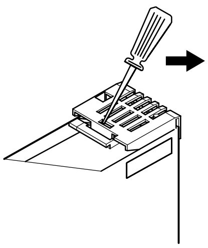


Figure 55: FPΣ Backup battery installation procedure–1

② Connect the connector, and place the battery so that the battery terminal fits between the two tabs.

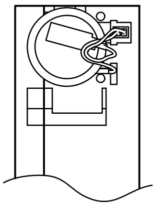


Figure 56: FPΣ Backup battery installation procedure–2

③ Insert the battery cover from above.

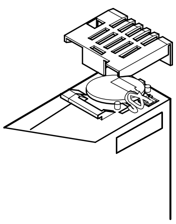


Figure 57: FPΣ Backup battery installation procedure–3

4.6.2 System Register Setting

Setting the battery error alarm

In the system register default settings, “No. 4 Alarm Battery Error” is set to “Off”. When using the battery, set system register No. 4 of the control unit so that the battery error alarm is turned on.

Setting procedure using FPWIN GR

1. **Select “PLC Configuration” on the “Option” menu, and click on “Action on Error” tab.**
2. **Turn on “No. 4 Alarm Battery Error” check box.**

PLC Configuration setting dialog box

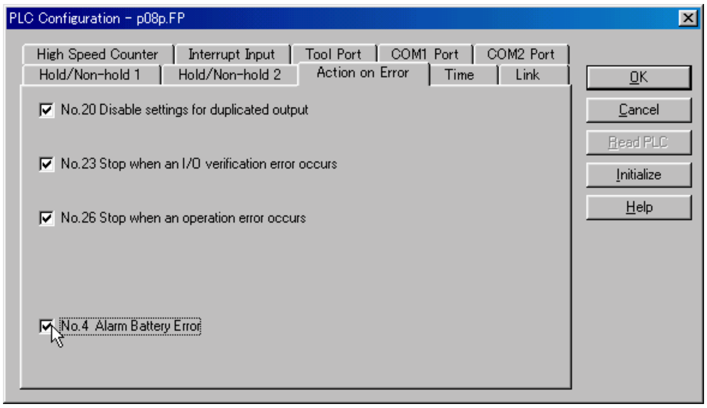


Figure 58: FPWIN GR – PLC Configuration setting dialog box

Specifying the hold area

In order to use backup functions such as data registers, settings must be entered for system registers Nos. 6 to 12.

For hold area setting using FPWIN GR, select “PLC Configuration” on the “Option” menu, and click on “Hold/Non–hold 1” and “Hold/Non–hold 2”.

4.6.3 Lifetime of Backup Battery

The life of the backup battery will eventually expire and therefore it is important to replace it with a new battery periodically. Refer to the table below for a guide as to when to replace the battery.

Item	Description
Battery lifetime	220 days or more (typical lifetime in actual use: approx. 840 days at 25 °C/70 °F) (Suggested replacement interval: 1 year) (Value when no power at all is supplied)

Maintenance battery

Name	Part No.
Battery for FPΣ	AFPG804

Notes

- **If system register "No. 4 Alarm Battery Error" is set to "ON", special internal relays R9005 and R9006 will go on if the battery voltage drops, and the ERROR/ALARM LED will flash. The battery remains effective for about a week after the alarm is issued, but in some cases the problem is not detected immediately. The battery should be replaced as soon as possible, without turning off the power supply.**
- **When replacing the battery, connect the new battery within 20 seconds of removing the old one.**

Chapter 5

High–speed Counter and Pulse Output Functions

☛ next page

5.1 Overview of Each Functions

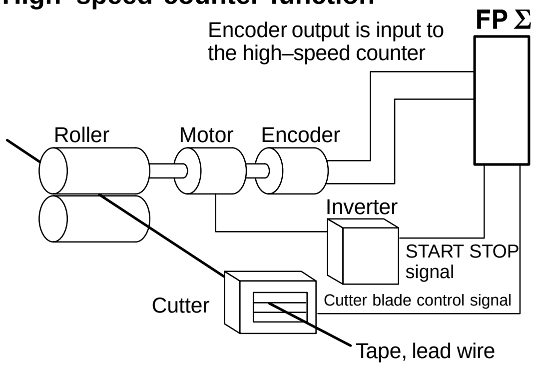
This section explains about the functions that use built–in high–speed counter of FPΣ.

5.1.1 Three Functions that Use Built–in High–speed Counter

Functions that use built–in high–speed counter

There are three functions available when using the high–speed counter built into the FPΣ.

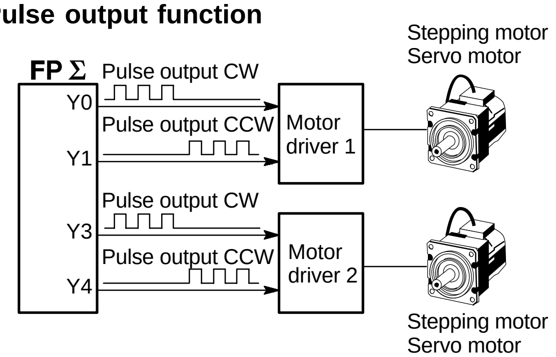
High–speed counter function



The high–speed counter function counts external inputs such as those from sensors or encoders. When the count reaches the target value, this function turns on/off the desired output.

Figure 59: FPΣ High–speed counter function

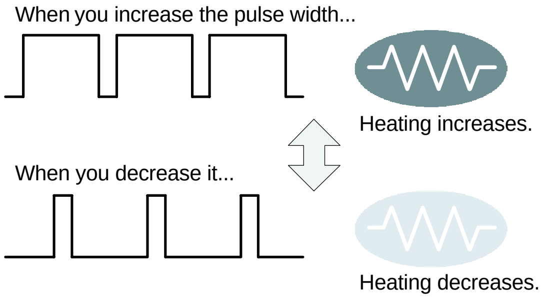
Pulse output function



Combined with a commercially available motor driver, the function enables positioning control. With the exclusive instruction, you can perform trapezoidal control, home return, and JOG operation.

Figure 60: FPΣ Pulse output function

PWM output function



By using the exclusive instruction, the PWM output function enables a pulse output of the desired duty ratio.

Figure 61: FPΣ PWM output function

5.1.2 Performance of Built–in High–speed Counter

Number of channel

There are four channels for the built–in high–speed counter.

The channel number allocated for the high–speed counter will change depending on the function being used.

Counting range

K–2,147,483,648 to K2,147,483,647 (Coded 32–bit binary)

The built–in high–speed counter is a ring counter. Consequently, if the counted value exceeds the maximum value, it returns to the minimum value. Similarly, if the counted value drops below the minimum value, it goes back to the maximum value and continues counting from there.

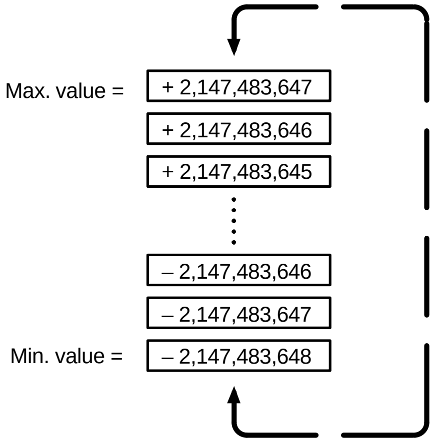


Figure 62: Counting range of high–speed counter

5.2 Function Specifications and Restricted Items

This section contains specifications and restriction of functions.

5.2.1 Table of Specifications

High–speed counter function specifications

Input/output contact number being used			Built–in high–speed counter chan-nel no.	Memory area being used			Performance specifications		Related instruc-tions
On/off output	**Count input mode**	**Input contact number (value in pa-renthe-sis is reset input) *Note**		**Control flag**	**Elapsed value area**	**Target value area**	**Mini-mum input pulse width**	**Maximum counting speed**	
Specify the desired output from Y0 to Y7 using instruc-tion	**Incre-mental input, Decre-mental input**	**X0 (X2)**	CH0	R903A	DT90044 to DT90045	DT90046 to DT90047	10 μs	· Using one channel: Max. 50 kHz (×1–channel)	**F0 (MV), F1 (DMV), F166 (HC1S), F167 (HC1R)**
		X1 (X2)	CH1	R903B	DT90048 to DT90049	DT90050 to DT90051		· Using two channels: Max. 30 kHz (×2–channel)	
		X3 (X5)	CH2	R903C	DT90200 to DT90201	DT90202 to DT90203		· Using three channels: Max. 20 kHz (×3–channel)	
		X4 (X5)	CH3	R903D	DT90204 to DT90205	DT90206 to DT90207		· Using four channels: Max. 20 kHz (×4–channel)	
Specify the desired output from Y0 to Y7 using instruc-tion	**2–phase input, Incre-mental/ decre-mental input, Direc-tional distinc-tion**	**X0 X1 (X2)**	CH0	R903A	DT90044 to DT90045	DT90046 to DT90047	25 μs	· Using one channel: Max. 20 kHz (×1–channel)	
		X3 X4 (X5)	CH2	R903C	DT90200 to DT90201	DT90202 to DT90203		· Using two channels: Max. 15 kHz (×2–channel)	

Note

Reset input X2 can be set to either CH0 or CH1. Reset input X5 can be set to either CH2 or CH3.

Pulse output function specifications

Built–in high–speed counter channel no.	Input/output contact number being used					Memory area being used			Maximum output frequency	Related instruc-tions
	CW or Pulse output	CCW or sign output	Deviation counter clear output	Home input	Near home input	Control flag	Elapsed value area	Target value area		
CH0	Y0	Y1	Y2	X2	DT90052 <bit4>	R903A	DT90044 to DT90045	DT90046 to DT90047	· Using one channel: Max. 100 kHz (×1–channel)	**F0 (MV), F1 (DMV), F171 (SPDH), F172 (PLSH)**
CH2	Y3	Y4	Y5	X5	DT90052 <bit4>	R903C	DT90200 to DT90201	DT90202 to DT90203	· Using two channels: Max. 60 kHz (×2–channel)	

PWM output function specifications

Built–in high–speed counter channel no.	Output contact number being used	Memory area being used	Output frequency (duty)	Related instructions
		Control flag		
CH0	**Y0**	R903A	· When the resolution is 1000, 1.5 to 12.5 kHz (0.0 to 99.9 %)	**F0 (MV), F1 (DMV), F173 (PWMH)**
CH2	**Y3**	R903C	· When the resolution is 100, 15.6 to 41.7 kHz (0 to 99 %)	

5.2.2 Function being Used and Restrictions

Channel

The same channel cannot be used by more than one function.

Function being used	Channel	High–speed counter function (When using single phase input mode)				High–speed counter function (When using two–phase input mode)	
		CH0	CH1	CH2	CH3	CH0	CH2
Pulse output function	CH0	N/A	A	A	A	N/A	A
	CH2	A	A	N/A	A	A	N/A

A: Available N/A: Not Available

Restrictions on I/O allocations

The inputs and outputs allocated to the various functions listed in the table in the previous section “5.2.1” cannot be allocated to more than one function.

Except for the examples noted below, inputs and outputs that have been allocated to the various functions cannot be allocated as normal inputs and outputs.

Cases in which inputs and outputs can be used as exceptions

Example 1:

If no reset input is used in the high–speed counter function, X2 and X5 are allocated as normal inputs.

Example 2:

If no output is used to clear the differential counter in the pulse output function, Y2 and Y5 are allocated as normal outputs.

Restrictions on the execution of related instructions (F166 to F173)

When any of the instructions related to the high–speed counter “**F166** to **F173”** are executed, the control flag (special internal relay: R903A to R903D) corresponding to the used channel turns on.

Please be aware that the control flag is in progress may change while a scan is being carried out. To prevent this, an internal relay should be substituted at the beginning of the program.

When the flag for a channel turns on, another instruction cannot be executed using that same channel.

Restrictions for maximum counting speed and pulse output frequency

The counting speed when using the high–speed counter function will differ depending on the counting mode as shown in the table on page 5 - 5.

Example 1:

While in the decremental input mode and using the two channels CH0 and CH1, CH0 and CH1 can be used up to 30 kHz.

Example 2:

While in the two–phase input mode and using the two channels CH0 and CH2, CH0 and CH2 can be used up to 15 kHz.

The maximum output frequency when using the pulse output function will differ depending on the number of channel being used as shown in the table on page 5 - 6.

Example 1:

When using only one channel, CH0, up to 100 kHz can be used.

Example 2:

When using two channels, CH0 and CH2, up to 60 kHz may be used for each channel.

If using both the pulse output function and the high–speed counter function, the following combinations result.

Example 1:

When using one pulse output channel with a maximum output of 100 kHz, the maximum counting speed of the high–speed counter is 20 kHz in the single–phase and three channels mode.

Example 2:

When using one pulse output channel with a maximum output of 100 kHz, the maximum counting speed of the high–speed counter is 20 kHz in the two–phase and one channel mode.

5.3 High–speed Counter Function

This section explains about the high–speed counter function of FPΣ.

5.3.1 Overview of High–speed Counter Function

High–speed counter function

The high–speed counter function counts the input signals, and when the count reaches the target value, turns on and off the desired output.

To turn on an output when the target value is matched, use the target value match on instruction **F166 (HC1S)**. To turn off an output, use the target value match off instruction **F167 (HC1R)**.

Preset the output to be turned on and off with the **SET/RET** instruction.

Setting the system register

In order to use the high–speed counter function, it is necessary to set system register Nos. 400 and 401.

5.3.2 Types of Input Modes

Incremental input mode

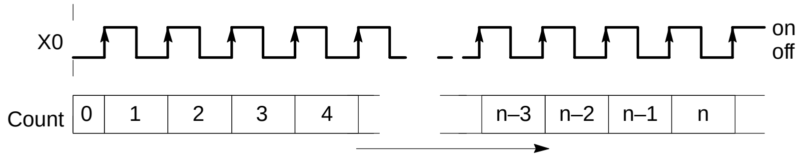


Figure 63: FPΣ High–speed counter function – incremental input mode

Decremental input mode

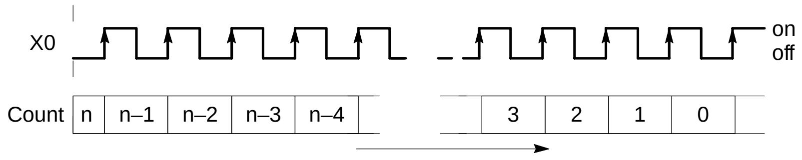


Figure 64: FPΣ High–speed counter function – decremental input mode

Two–phase input mode

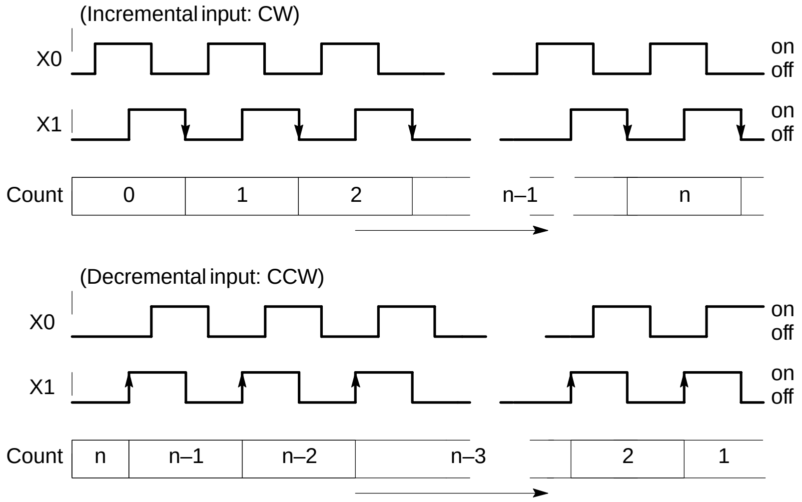


Figure 65: FPΣ High–speed counter function – two–phase input mode

Individual input mode (Incremental and decremental input mode)

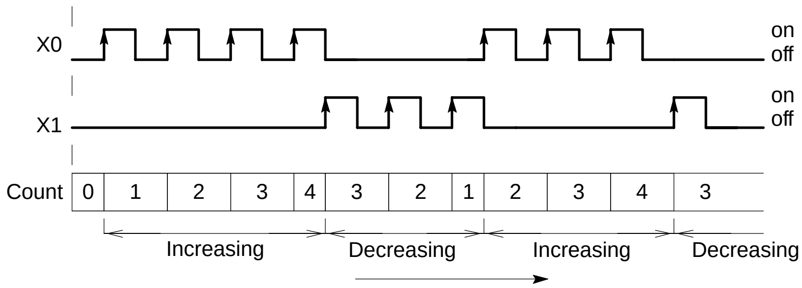


Figure 66: FPΣ High–speed counter function – individual input mode

Direction control mode

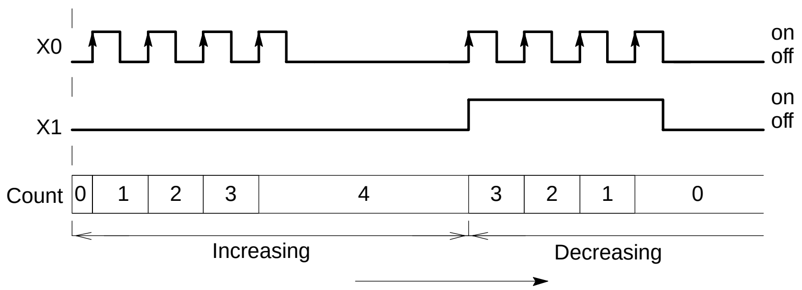


Figure 67: FPΣ High–speed counter function – direction control mode

5.3.3 Min. Input Pulse Width

The minimum input pulse width indicated below is necessary for the period T (1/frequency).

Single phase

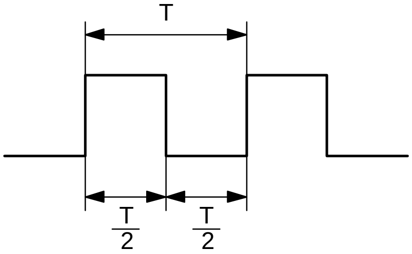


Figure 68: FPΣ High–speed counter function – min. input pulse width (single phase)

Two–phase

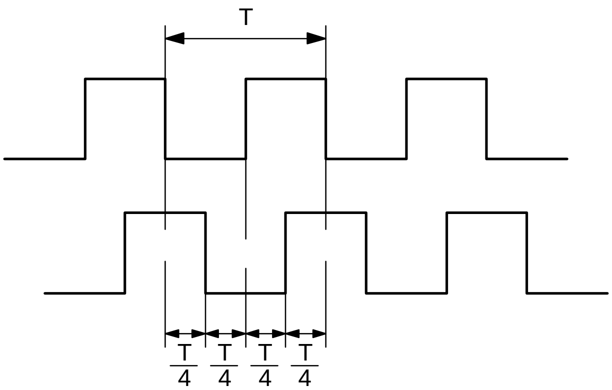


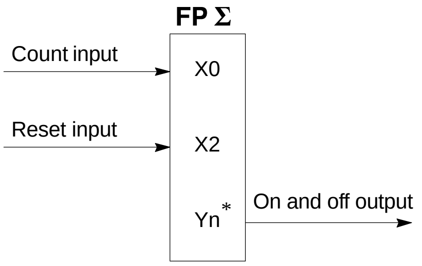
Figure 69: FPΣ High–speed counter function – min. input pulse width (two–phase)

5.3.4 I/O Allocation

The inputting, as shown in the table on page 5 - 5, will differ depending on the channel number being used.

The output turned on and off can be specified from Y0 to Y7 as desired with instructions **F166 (HC1S)** and **F167 (HC1R)**.

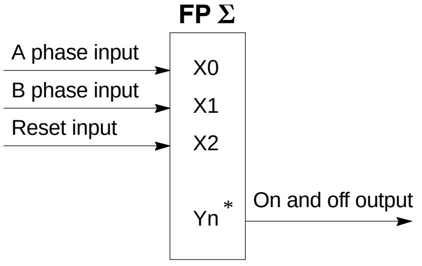
When using CH0 with incremental input and reset input



* The output turned on and off when the target values match can be specified from Y0 to Y7 as desired.

Figure 70: FPΣ High–speed counter function – I/O allocation–1

When using CH0 with two–phase input and reset input



* The output turned on and off when the target values match can be specified from Y0 to Y7 as desired.

Figure 71: FPΣ High–speed counter function – I/O allocation–2

5.3.5 Instructions Used with High–speed Counter Function

High–speed counter control instruction (F0)

This instruction is used for counter operations such as software reset and count disable.

Specify this instruction together with the special data register DT90052.

Once this instruction is executed, the settings will remain until this instruction is executed again.

Operations that can be performed with this instruction

- Counter software reset
- Counting operation enable/disable
- Hardware reset enable/disable
- Clear controls from high–speed counter instructions **F166**, **F167** and **F171** to **F173**
- Clear target value match interrupt

Example:

Performing a software reset

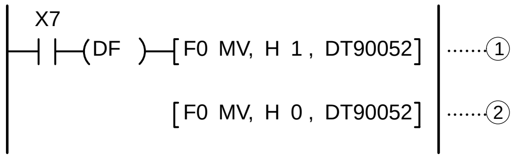


Figure 72: FPΣ Program of high–speed counter control instruction “F0”

In the above program, the reset is performed in step ① and 0 is entered just after that in step ②. The count is now ready for operation. If it is only reset, counting will not be performed.

Elapsed value change and read instruction (F1)

This instruction changes or reads the elapsed value of the high–speed counter.

Specify this instruction together with the special data register DT90044.

The elapsed value is stored as 32–bit data in the combined area of special data registers DT90044 and DT90045.

Use this **F1 (DMV)** instruction to set the elapsed value.

Example 1:

Changing the elapsed value.

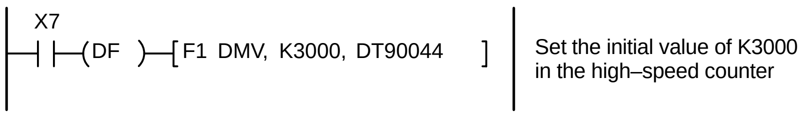


Figure 73: FPΣ Program (1) of elapsed value change and read instruction “F1”

Example 2:

Reading the elapsed value

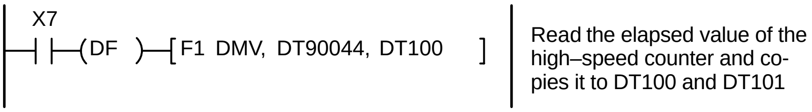


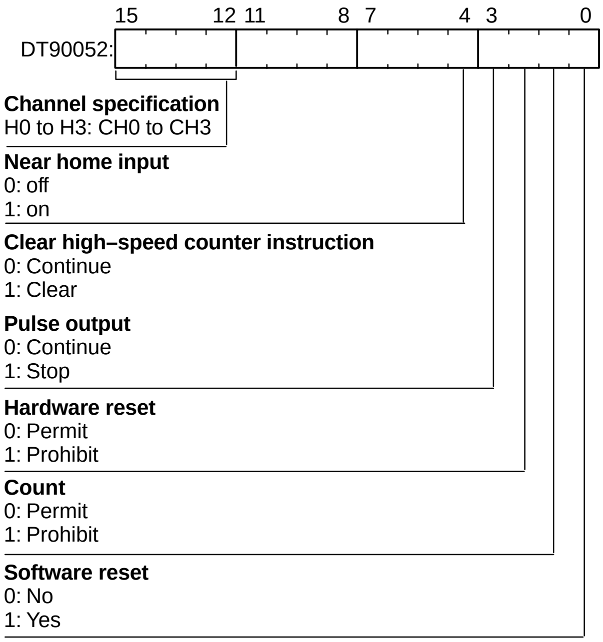
Figure 74: FPΣ Program (2) of elapsed value change and read instruction “F1”

Tip

The area DT90052 for writing channels and control codes is allocated as shown below.

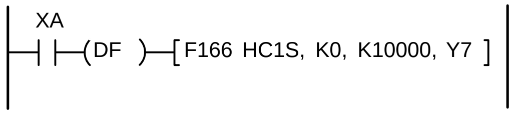
Control codes written with an **F0(MV)** instruction are stored by channel in special data registers DT90190 to DT90193.

High–speed counter control flag area of FPΣ



Target value match on instruction (F166)

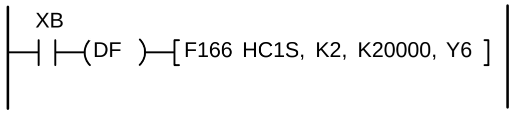
Example 1:



If the elapsed value (DT90044 and DT90045) for channel 0 matches K10000, output Y7 turns on.

Figure 75: FPΣ Program (1) of target value match on instruction “F166”

Example 2:

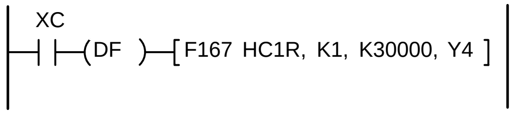


If the elapsed value (DT90200 and DT90201) for channel 2 matches K20000, output Y6 turns on.

Figure 76: FPΣ Program (2) of target value match on instruction “F166”

Target value match off instruction (F167)

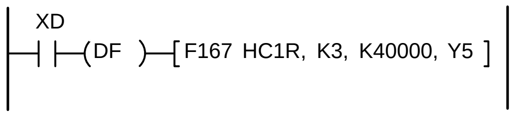
Example 1:



If the elapsed value (DT90048 and DT90049) for channel 1 matches K30000, output Y4 turns off.

Figure 77: FPΣ Program (1) of target value match off instruction “F167”

Example 2:



If the elapsed value (DT90204 and DT90205) for channel 3 matches K40000, output Y5 turns off.

Figure 78: FPΣ Program (2) of target value match off instruction “F167”

5.3.6 Sample Program

Positioning operations with a single speed inverter

Wiring example

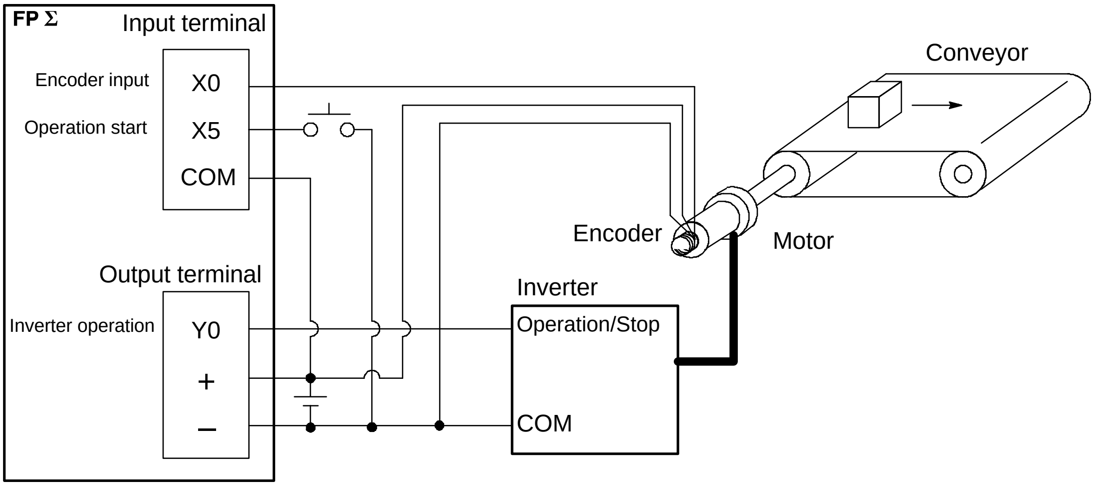
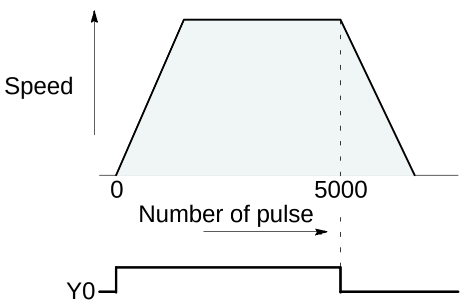


Figure 79: FPΣ High–speed counter function – sample program 1 (wiring)

Operation chart



I/O allocation

I/O No.	Description
X0	Encoder input
X5	Operation start signal
Y0	Inverter operation signal
R100	Positioning operation running
R101	Positioning operation start
R102	Positioning done pulse
R903A	High–speed counter CH0 control flag

Figure 80: FPΣ High–speed counter function – sample program 1 (operation chart)

Program

When X5 is turned on, Y0 turns on and the conveyor begins moving. When the elapsed value (DT90044 and DT90045) reaches K5000, Y0 turns off and the conveyor stops.

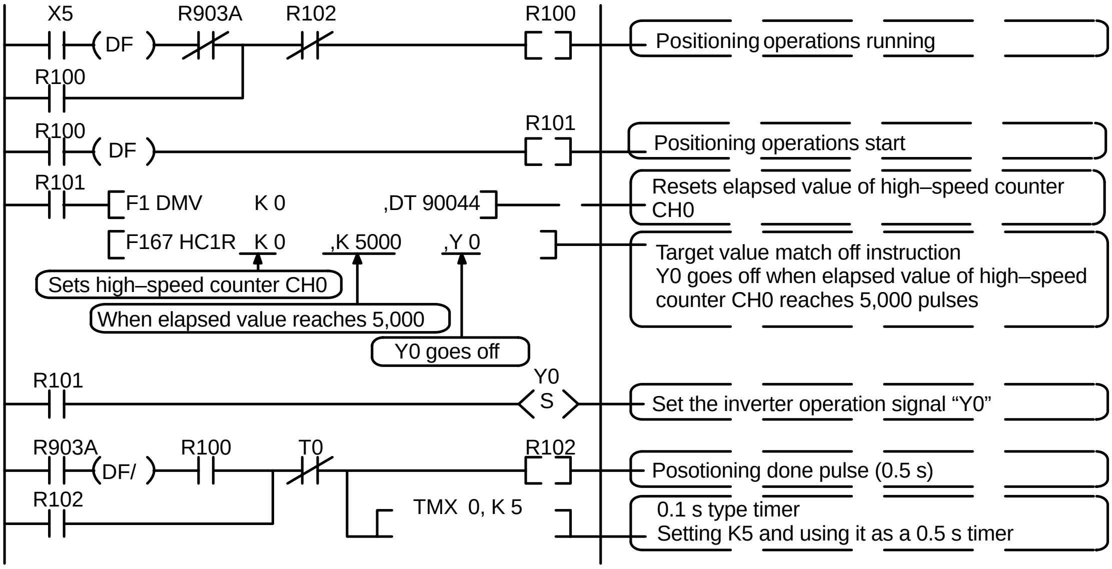


Figure 81: FPΣ High–speed counter function – sample program 1 (program)

Positioning operations with a double speed inverter

Wiring example

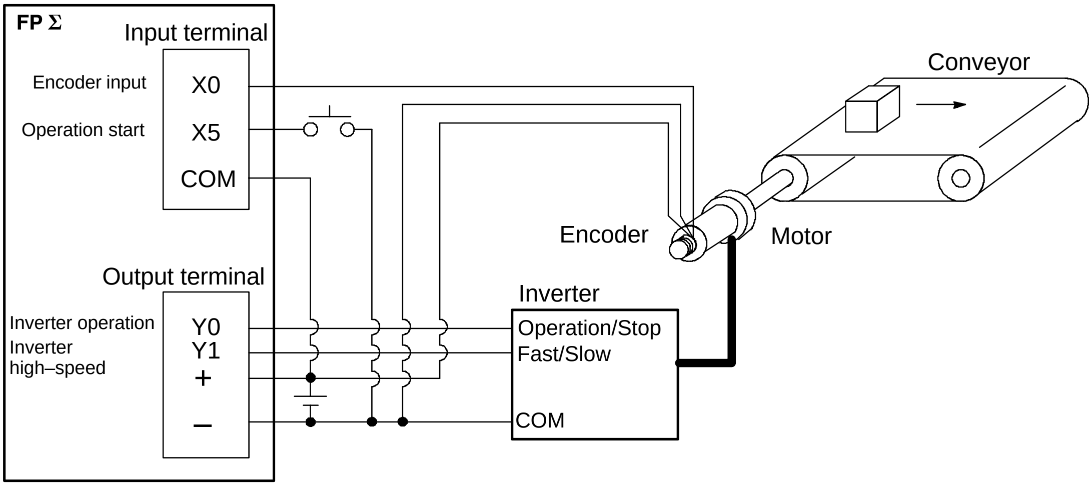
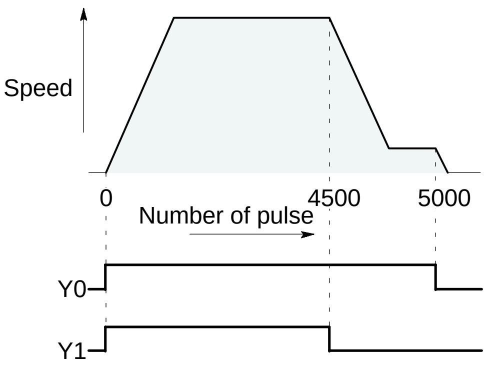


Figure 82: FPΣ High–speed counter function – sample program 2 (wiring)

Operation chart



I/O allocation

I/O No.	Description
X0	Encoder input
X5	Operation start signal
Y0	Inverter operation signal
Y1	Inverter high–speed signal
R100	Positioning operation running
R101	Positioning operation start
R102	Arrival at deceleration point
R103	Positioning done pulse
R900C	Comparison instruction “<” flag
R903A	High–speed counter CH0 control flag

Figure 83: FPΣ High–speed counter function – sample program 2 (operation chart)

Program

When X5 is turned on, Y0 and Y1 turn on and the conveyor begins moving. When the elapsed value (DT90044 and DT90045) reaches K4500, Y1 turns off and the conveyor begins decelerating. When the elapsed value reaches K5000, Y0 turns off and the conveyor stops.

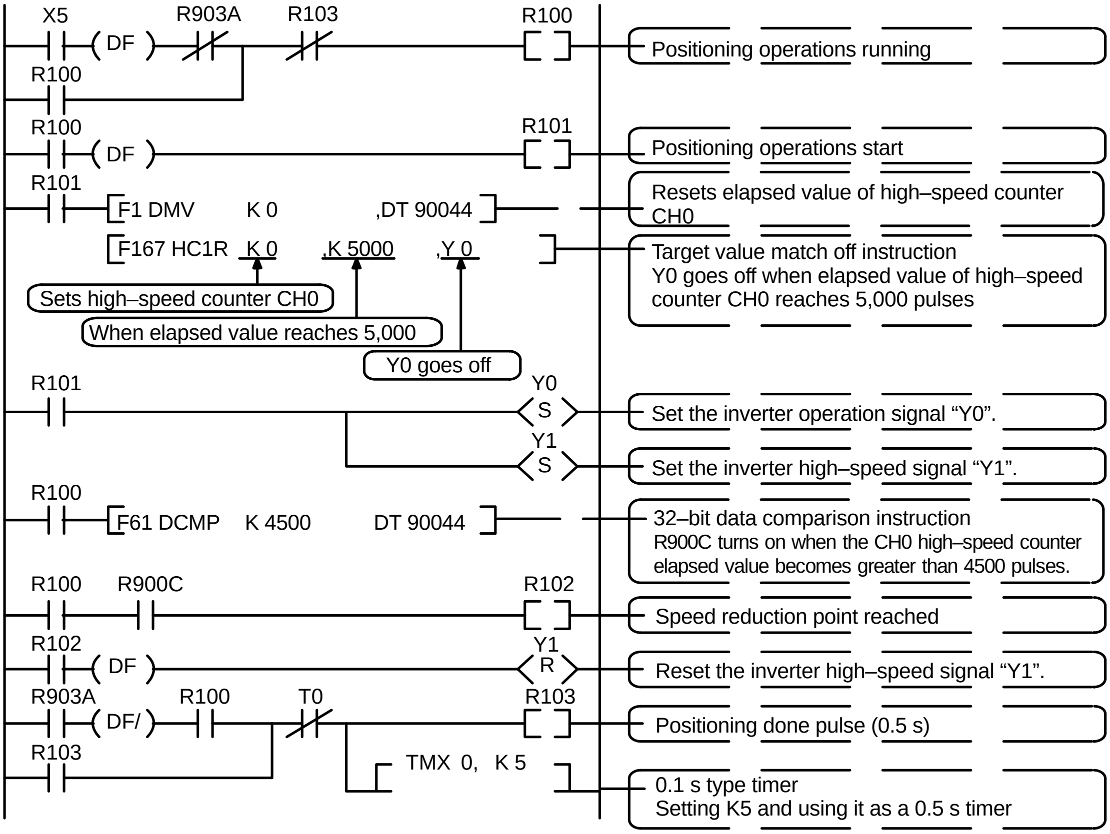


Figure 84: FPΣ High–speed counter function – sample program 2 (program)

5.4 Pulse Output Function

This section explains about the pulse output function of FPΣ.

5.4.1 Overview of Pulse Output Function

Instructions used and controls

The pulse output function enables positioning control by use in combination with a commercially available pulse–string input type motor driver.

Provides trapezoidal (table–shaped) control with the exclusive instruction **F171 (SPDH)** for automatically obtaining pulse outputs by specifying the initial speed, maximum speed, acceleration/deceleration time, and target value.

The exclusive instruction **F171 (SPDH)** also enables automatic home return operation.

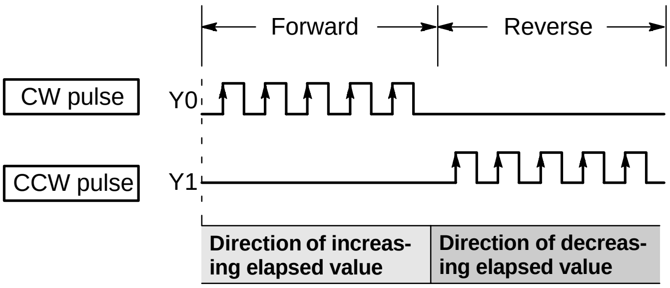
JOG operation with the exclusive instruction **F172 (PLSH)** for pulse output while the execution condition (trigger) is in the on state.

Setting the system register

When using the pulse output function, set the channels corresponding to system registers 400 and 401 to “Do not use high–speed counter.”

5.4.2 Types of Pulse Output Method

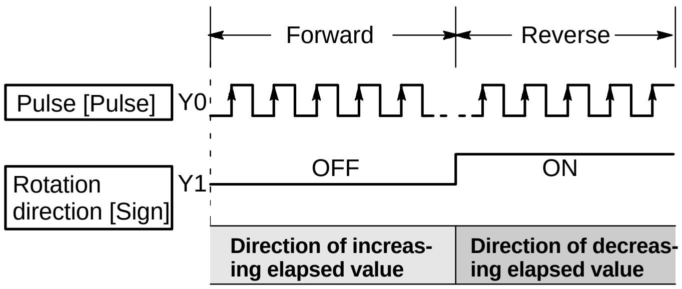
CW/CCW output method



This is a method in which control is carried out using two pulses, a forward rotation pulse and a reverse rotation pulse.

Figure 85: FPΣ Pulse output function – CW/CCW output method

Pulse/Sign output method (Forward: off/Reverse: on)

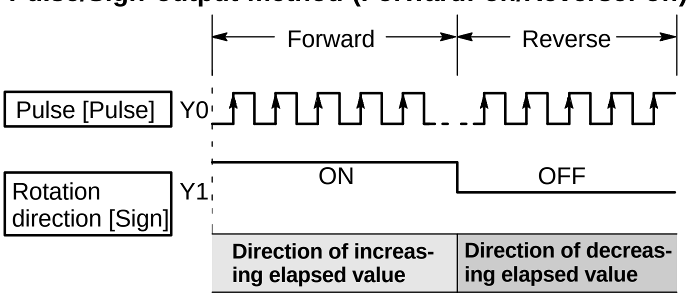


This is a method in which control is carried out using one pulse output to specify the speed, and on/off signals to specify the direction of rotatin.

In this mode, forward rotation is carried out when the rotation direction (Sign) signal is off.

Figure 86: FPΣ Pulse output function – Pulse/sign output method 1

Pulse/Sign output method (Forward: on/Reverse: off)



This is a method in which control is carried out using one pulse output to specify the speed, and on/off signals to specify the direction of rotatin.

In this mode, forward rotation is carried out when the rotation direction (Sign) signal is on.

Figure 87: FPΣ Pulse output function – Pulse/sign output method 2

5.4.3 I/O Allocation

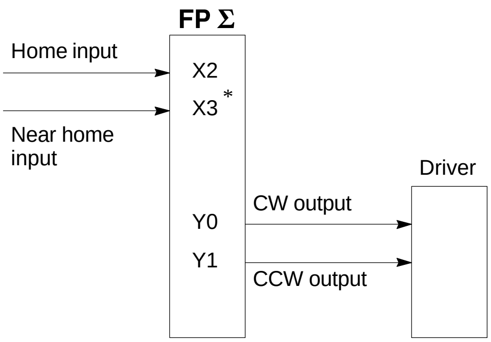
Double pulse input driver (CW pulse input and CCW pulse input method)

Two output contact are used as a pulse output for “CW, CCW”.

The I/O allocation of pulse output terminal and home input is determined by the channel used. (See the table of specifications on page 5 - 6.)

Set the control code for **F171 (SPDH)** instruction to “CW/CCW”.

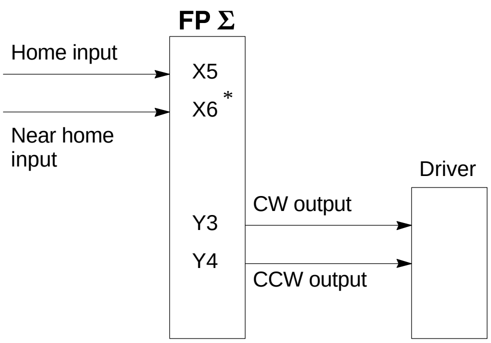
When using CH0



* X3 or other desired input can be specified for the near home input.

Figure 88: FPΣ Pulse output function – I/O allocation when using CH0 (double pulse input)

When using CH2



* X6 or other desired input can be specified for the near home input.

Figure 89: FPΣ Pulse output function – I/O allocation when using CH2 (double pulse input)

Single pulse input driver (pulse input and directional switching input method)

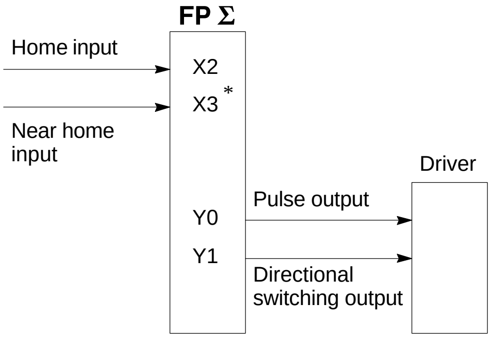
One output point is used as a pulse output and the other output is used as a direction output.

The I/O allocation of pulse output terminal, direction output terminal, and home input is determined by the channel used. (See the table of specifications on page 5 - 6.)

Near home input is substituted by allocating the desired contact and turning on and off the specified bit of special data register DT90052.

Up to two driver systems can be connected.

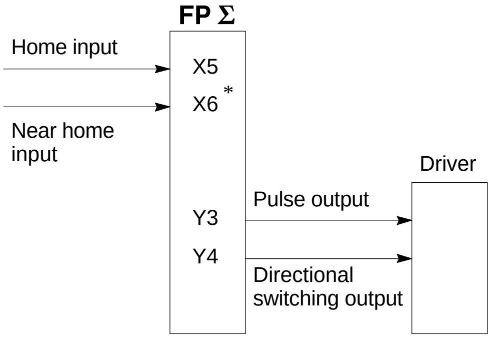
When using CH0



* X3 or other desired input can be specified for the near home input.

Figure 90: FPΣ Pulse output function – I/O allocation when using CH0 (single pulse input)

When using CH2



* X6 or other desired input can be specified for the near home input.

Figure 91: FPΣ Pulse output function – I/O allocation when using CH2 (single pulse input)

Notes

- **Precautions when the Pulse and Sign type of driver is being used**
  With some motor drivers, it takes some time for pulse input to be accepted after the directional output has gone on. (For detailed information, please contact the manufacturer of the motor driver.) As a result, when the FPΣ is used in the directional output mode, and a fast frequency has been specified for the initial speed, there may be times when pulses are skipped if pulse output starts instantaneously.
  If this happens, set the initial speed setting for the FPΣ to a slower frequency. Pulse output from the FPΣ starts from the off state when the FPΣ is booted, so more time leeway can be created by setting a slower frequency.

- **Calculating the frequency**
  Frequency F (Hz), duty (on width) D%, motor driver setup time Tm(s)
  $F < (100 - D) \div (Tm \times 100)$

  Example:
  When the motor driver setup time is $Tm = 100\ \mu s = 100 \times 10^{-6}$ (s), the frequency F must be set to 5,000 Hz or less when the duty is 50% (1/2). If the duty is 25% (1/4), the frequency F must be set to 7,500 Hz or less.

5.4.4 Control Mode

Incremental <relative value control>

Outputs the pulses set with the target value.

Selected mode / Target value	CW/CCW	PLS and SIGN Forward off/Reverse on	PLS and SIGN Forward on/Reverse off	Elapsed value of high–speed counter
Positive	Pulse output from CW	Pulse output when direction output is off	Pulse output when direction output is on	Increment
Negative	Pulse output from CCW	Pulse output when direction output is on	Pulse output when direction output is off	Decrement

Absolute <absolute value control>

Outputs a number of pulses equal to the difference between the set target value and the current value.

Selected mode / Target value	CW/CCW	PLS and SIGN Forward off/Reverse on	PLS and SIGN Forward on/Reverse off	Elapsed value of high–speed counter
Target value greater than current value	Pulse output from CW	Pulse output when direction output is off	Pulse output when direction output is on	Increment
Target value less than current value	Pulse output from CCW	Pulse output when direction output is on	Pulse output when direction output is off	Decrement

Home return

Until the home input (X2 or X5) is entered by executing **F171 (SPDH)** instruction, the pulse is continuously output.

To decelerate the movement when near the home, set the bit corresponding to the special data register DT90052 to off → on → off with the near home input.

The differential counter clear output can be output when the return to the home position has been completed.

JOG operation

Pulses are output from the specified channel while the trigger for **F172 (PLSH)** instruction is in the on state.

The direction output and output frequency are specified by **F172 (PLSH)** instruction.

5.4.5 Instructions Used with Pulse Output Function

Positioning control instruction (F171) (trapezoidal control)

Automatically performs trapezoidal control according to the specified data table.

Generates a pulse from output Y0 at an initial speed of 500Hz, a maximum speed of 5,000Hz, an acceleration/deceleration time of 200ms, and a movement amount of 10,000 pulses.

```
 X8
-| |-(DF )-[ F1 DMV, H1100,  DT100  ]
           [ F1 DMV, K500,   DT102  ]
           [ F1 DMV, K5000,  DT104  ]
           [ F1 DMV, K200,   DT106  ]
           [ F1 DMV, K10000, DT108  ]
           [ F1 DMV, K0,     DT110  ]
           [ F171 SPDH, DT100, K0   ]
```

Figure 92: FPΣ Program of positioning control instruction “F171”

When the program is run, the positioning data table and the pulse output diagram will be as shown below.

Positioning data table

DT100 DT101	Control code *1	:H 1100
DT102 DT103	Initial speed *2	:500 Hz
DT104 DT105	Maximum speed *2	:5,000 Hz
DT106 DT107	Acceleration/deceleration time *3	:200 ms
DT108 DT109	Target value *4	:10,000 pulses
DT110 DT111	Pulse stop	:K0

Pulse output diagram

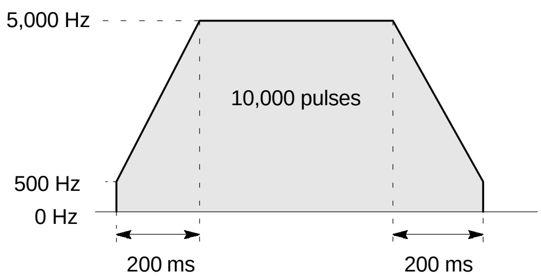


Figure 93: FPΣ Pulse output diagram of “F171” instruction

(*1): **Control code**

H □ □ □ □ □ □ □ □

0: Fixed

Duty (on width)

0: Duty 1/2 (50%)
1: Duty 1/4 (25%)

Frequency range (*2)

0: 1.5 Hz to 9.8 kHz
1: 48 Hz to 100 kHz
2: 191 Hz to 100 kHz

Operation mode and output type

00: Incremental	CW/CCW	
02: Incremental	PLS and SIGN	(forward off / reverse on)
03: Incremental	PLS and SIGN	(forward on / reverse off)
10: Absolute	CW/CCW	
12: Absolute	PLS and SIGN	(forward off / reverse on)
13: Absolute	PLS and SIGN	(forward on / reverse off)

(*2): Frequency (Hz) “K constant”
1.5 Hz to 9.8 KHz [K1 to K9800 (units: Hz)]
(Maximum error near 9.8 kHz approximately –1 kHz)
48 Hz to 100 KHz [K48 to K100000 (units: Hz)]
(Maximum error near 100 kHz approximately –3 kHz)
191 Hz to 100 KHz [K191 to K100000 (units: Hz)]
(Maximum error near 100 kHz approximately –0.8 kHz)
* Set “K1” to specify 1.5 Hz..

(*3): Acceleration/deceleration time (ms) “K constant”
K30 to K32767

(*4): Target value “K constant”
K–2147483648 to K2147483647

Figure 94: FPΣ Control code of “F171” instruction

Pulse output instruction (F172) (JOG operation)

This instruction is for JOG operation by obtaining a pulse from the desired output when the execution condition (trigger) turns on.

While XB is in the on state, a pulse of 300Hz is output from Y0.

```
  XB
--| |----[ F1  DMV,  H1110,   DT300   ]
         [ F1  DMV,  K300,    DT302   ]
         [ F172 PLSH, DT300, K0       ]
```

Figure 95: FPΣ Program of pulse output instruction “F172”

When the program is run, the data table and the pulse output diagram will be as shown below.

Data table

DT300 DT301	Control code *1	:H 1110
DT302 DT303	Frequency *2	:300 Hz

Pulse output diagram

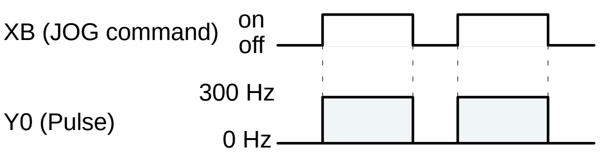


Figure 96: FPΣ Pulse output diagram of “F172” instruction

(*1): **Control code**

H □□□□□□□□

0: Fixed

Duty (on width)

0: Duty 1/2 (50%)
1: Duty 1/4 (25%)

Frequency range (*2)

0: 1.5 Hz to 9.8 kHz
1: 48 Hz to 100 kHz
2: 191 Hz to 100 kHz

Operating mode and output type

00: No counting	CW
01: No counting	CCW
10: Incremental counting	CW
12: Incremental counting	Directional output off
13: Incremental counting	Directional output on
21: Decremental counting	CCW
22: Decremental counting	Directional output off
23: Decremental counting	Directional output on

(*2): Frequency (Hz) “K constant”
1.5 Hz to 9.8 kHz [K1 to K9800 (units: Hz)]
(Maximum error near 9.8 kHz approximately –1 kHz)
48 Hz to 100 kHz [K48 to K100000 (units: Hz)]
(Maximum error near 100 kHz approximately –3 kHz)
191 Hz to 100 kHz [K191 to K100000 (units: Hz)]
(Maximum error near 100 kHz approximately –0.8 kHz)
* Set “K1” to specify 1.5 Hz.

During execution of an instruction, if a value is written for the frequency area that is outside of the allowable range, the frequency will be corrected to the minimum or maximum value for the pertinent frequency range before being output. The data that was written will not be corrected, however.

Figure 97: FPΣ Control code of “F172” instruction

Positioning control instruction (F171) (home return)

Performs home return according to the specified data table.

Pulses are output from Y1 and a return to the home position is carried out at an initial speed of 100 Hz, a maximum speed of 2,000 Hz, and an acceleration/deceleration time of 150 ms.

```
 XA
-| |-(DF )-[ F1  DMV,  H1121,   DT200 ]
           [ F1  DMV,  K100,    DT202 ]
           [ F1  DMV,  K2000,   DT204 ]
           [ F1  DMV,  K150,    DT206 ]
           [ F1  DMV,  K0,      DT208 ]
           [ F171  SPDH,  DT200,  K0  ]
```

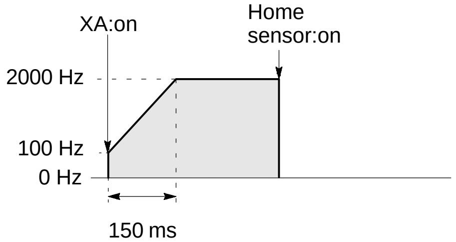
Figure 98: FPΣ Program of positioning control instruction "F171"

When the program is run, the positioning data table and the pulse output diagram will be as shown below.

Positioning data table

DT200 DT201	Control code *1	:H 1121
DT202 DT203	Initial speed *2	:100 Hz
DT204 DT205	Maximum speed *2	:2000 Hz
DT206 DT207	Acceleration/deceleration time *3	:150 ms
DT208 DT209	Deviation counter clear signal *4	:Not used

Pulse output diagram (when near home input is not used)



Pulse output diagram (when near home input is used)

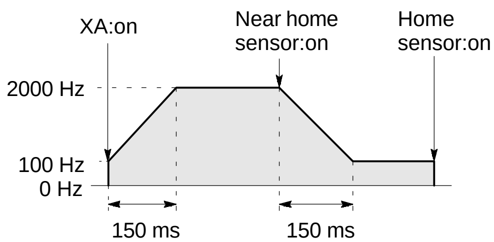


Figure 99: FPΣ Pulse output diagram of "F171" instruction

(*1): **Control code**

H□□□□□□□□

0: Fixed

Duty (on width)

0: Duty 1/2 (50%)
1: Duty 1/4 (25%)

Frequency range (*2)

0: 1.5 Hz to 9.8 kHz
1: 48 Hz to 100 kHz
2: 191 Hz to 100 kHz

Operation mode and output type

20: Type I home return	CW
21: Type I home return	CCW
22: Type I home return	Direction output off
23: Type I home return	Direction output on
24: Type I home return	CW and deviation counter reset
25: Type I home return	CCW and deviation counter reset
26: Type I home return	Direction output off and deviation counter reset
27: Type I home return	Direction output on and deviation counter reset
30: Type II home return	CW
31: Type II home return	CCW
32: Type II home return	Direction output off
33: Type II home return	Direction output on
34: Type II home return	CW and deviation counter reset
35: Type II home return	CCW and deviation counter reset
36: Type II home return	Direction output off and deviation counter reset
37: Type II home return	Direction output on and deviation counter reset

(*2): Frequency (Hz) "K constant"
1.5 Hz to 9.8 KHz [K1 to K9800 (units: Hz)]
(Maximum error near 9.8 kHz approximately –1 kHz)
48 Hz to 100 KHz [K48 to K100000 (units: Hz)]
(Maximum error near 100 kHz approximately –3 kHz)
191 Hz to 100 KHz [K191 to K100000 (units: Hz)]
(Maximum error near 100 kHz approximately –0.8 kHz)
* Set "K1" to specify 1.5 Hz..

(*3): Acceleration/deceleration time (ms) "K constant"
K30 to K32767

(*4): Deviation counter clear signal (ms) "K constant"
0.5 ms to 100 ms [K0 to K100] Set value and error (0.5 ms or less)
Specify "K0" when not using or when specifying 0.5 ms.
If a value is written that exceeds the specified range of the deviation counter clear signal, it will be revised to a value within the range.

Figure 100: FPΣ Control code of "F171" instruction

Tip

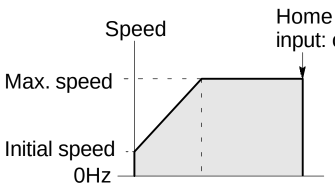
Home return operation modes

There are two operation modes for a home return with the FPΣ, a Type I home return and a Type II home return.

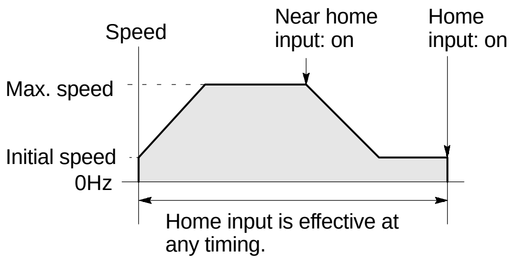
Type I home return

The home return input is effective regardless of whether or not there is near home input, whether deceleration is taking place, or whether deceleration has been completed. In this mode, near home input is not used.

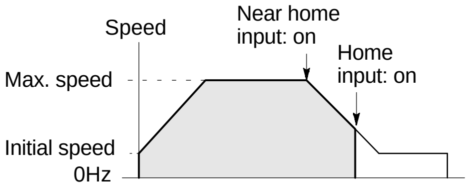
When near home input is not used



When near home input is used



When home input is input while the near home input is decelerating



Type II home return

In this mode, the home return input is effective only after deceleration based on the near home input has been completed.

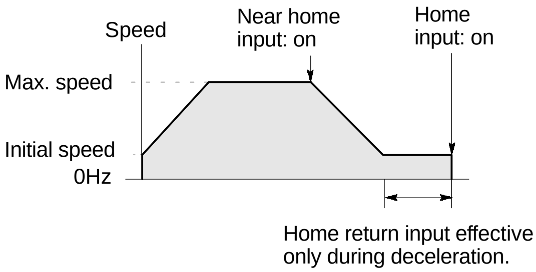


Figure 101: FPΣ Home return operation modes

Pulse output control instruction (F0)

This instruction is used for resetting the built–in high–speed counter, stopping the pulse outputs, and setting and resetting the near home input.

Specify this **F0 (MV)** instruction together with the special data register DT90052.

Once this instruction is executed, the settings will remain until this instruction is executed again.

Example 1: Enable the near home input during home return operations and begin deceleration. In the program, the near home input is enabled in step ① and 0 is entered just after that in step ② to perform the preset operations.

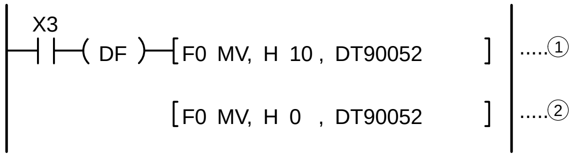


Figure 102: FPΣ Program 1 of pulse output control instruction “F0”

Example 2: Performing a forced stop of the pulse output.

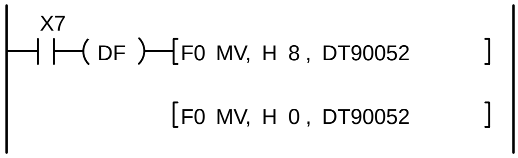
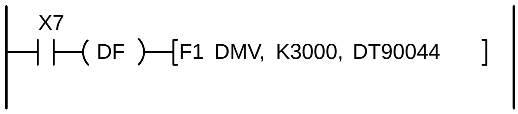


Figure 103: FPΣ Program 2 of pulse output control instruction “F0”

Elapsed value write and read instruction (F1)

This instruction is used to read the pulse number counted by the built–in high–speed counter.
Specify this **F1 (DMV)** instruction together with the special data register DT90044.
The elapsed value is stored as 32–bit data in the combined area of special data registers DT90044 and DT90045.
Use only this **F1 (DMV)** instruction to set the elapsed value.

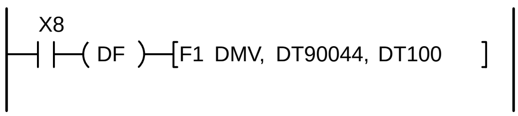
Example 1: Writing the elasped value



Set the initial value of K3000 in the high–speed counter.

Figure 104: FPΣ Program 1 of elapsed value write and read instruction “F1”

Example 2: Reading the elapsed value



Reads the elapsed value of the high–speed counter to DT100 and DT101.

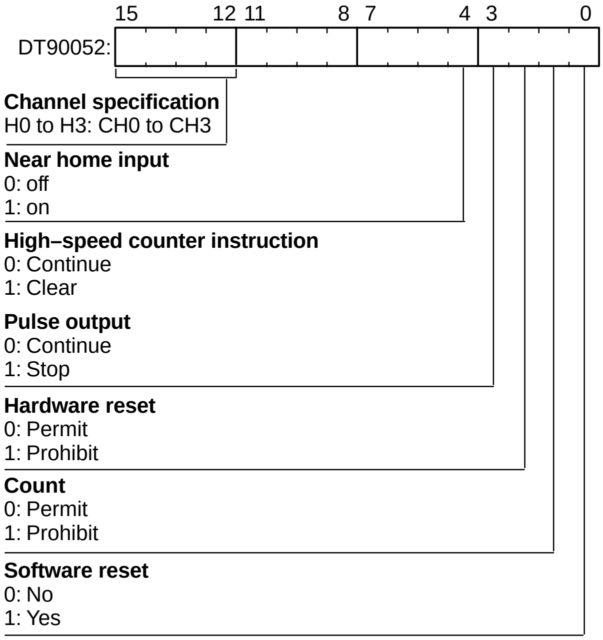
Figure 105: FPΣ Program 2 of elapsed value write and read instruction “F1”

Tip

The area DT90052 for writing channels and control codes is allocated as shown below.

Control codes written with an **F0(MV)** instruction are stored by channel in special data registers DT90190 to DT90193.

High–speed counter control flag area of FPΣ



For information on the special data register for high–speed counter function and pulse output function, see pages 5 - 5 and 5 - 6.

5.4.6 Sample Program for Positioning Control

Wiring example

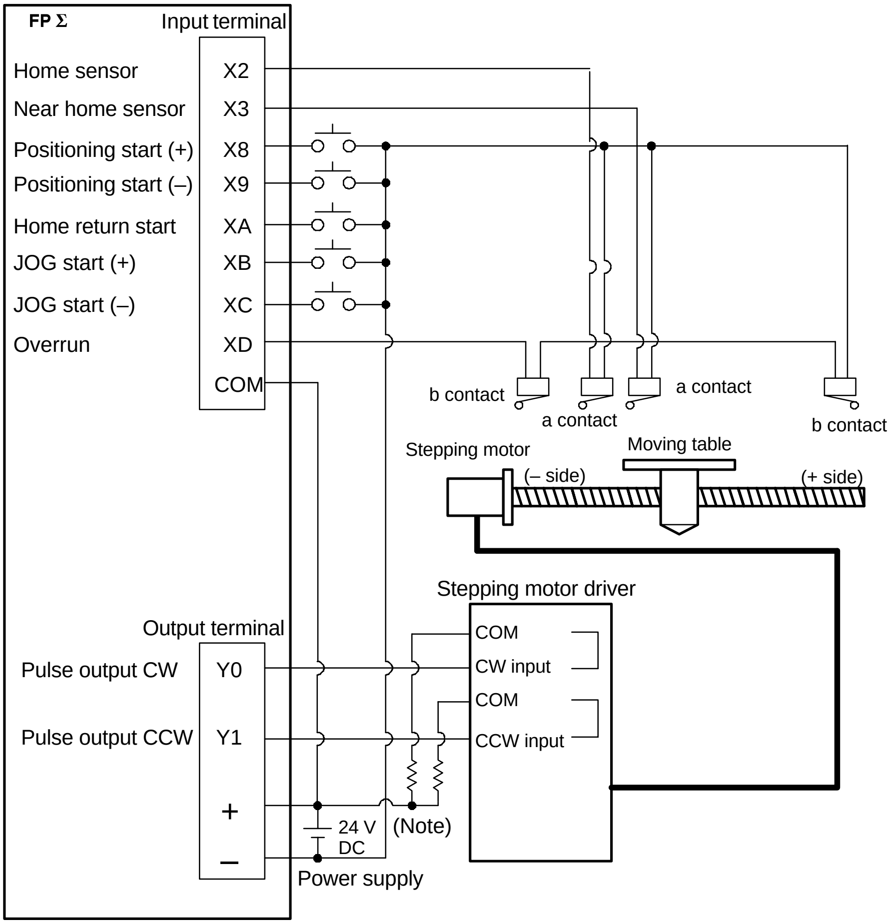


Figure 106: FPΣ Pulse output function – sample program (wiring)

Note

When the stepping motor input is a 5 V optical coupler type, connect a 2 kΩ 1/4 W resister.

Table of I/O allocation

I/O No.	Description	I/O No.	Description
X2	Home sensor input	**XD**	Overrnning signal
X3	Near home sensor input	**Y0**	Pulse output CW
X8	Positioning start signal (+)	**Y1**	Pulse output CCW
X9	Positioning start signal (–)	**R10**	Positioning in progress
XA	Home return start signal	**R11**	Positioning operation start
XB	JOG start signal (+)	**R12**	Positioning done pulse
XC	JOG start signal (–)	**R903A**	High–speed counter control flag for CH0

Relative value positioning operation (plus direction)

When X8 turns on, the pulse is output from CW output “Y0” of specified channel “CH0”.

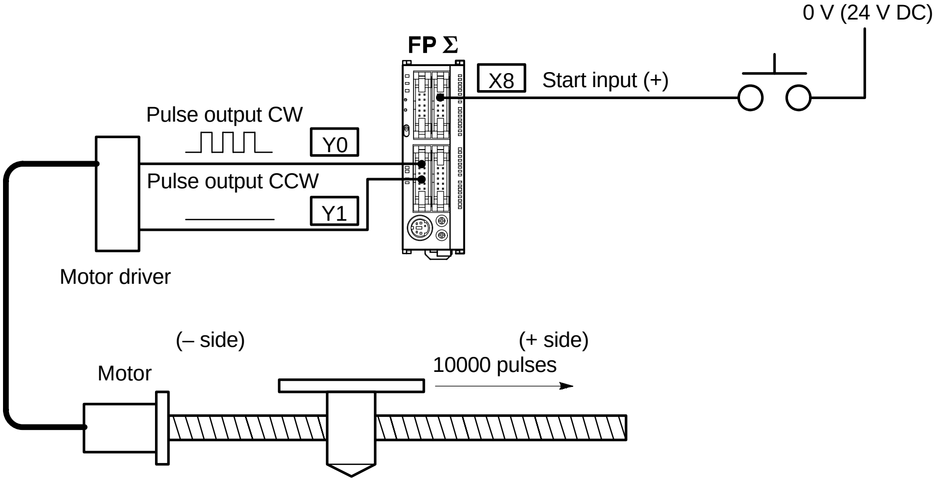
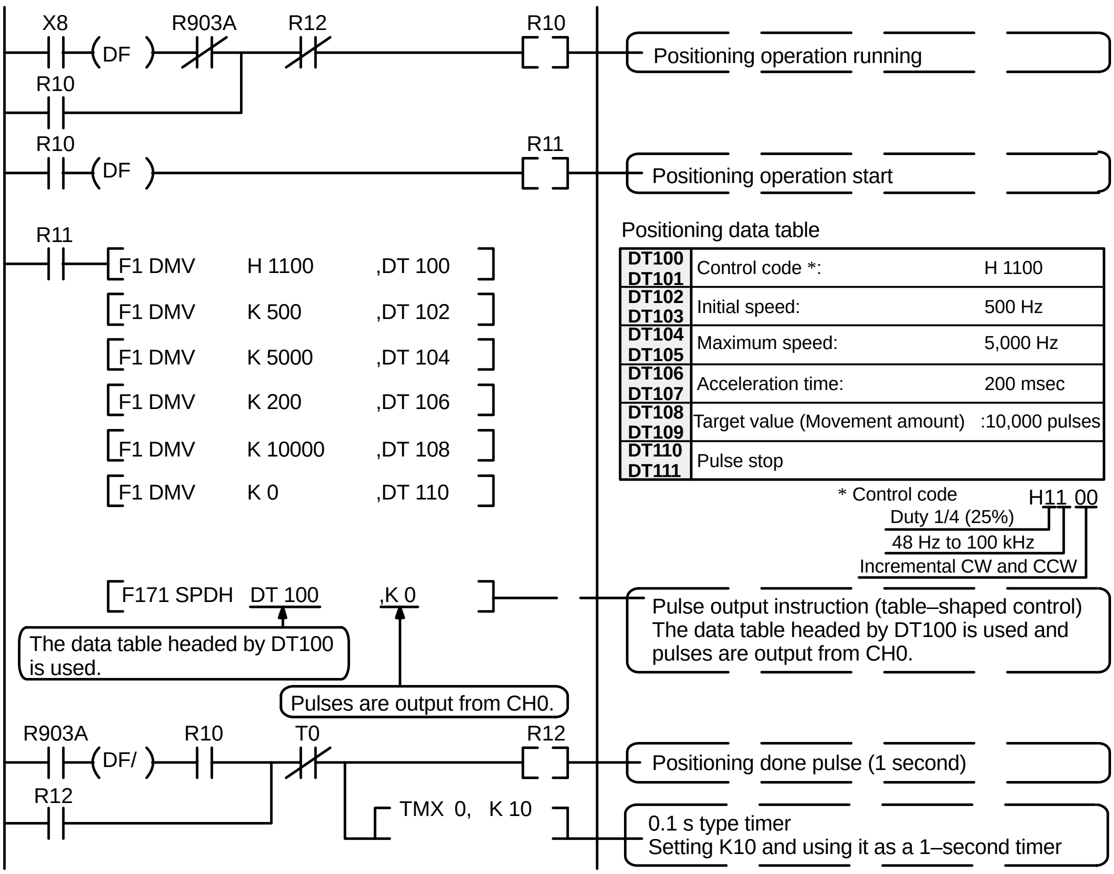


Figure 107: FPΣ Sample program – relative value positioning operation (+ direction)

Program



Positioning data table

DT100 DT101	Control code *:	H 1100
DT102 DT103	Initial speed:	500 Hz
DT104 DT105	Maximum speed:	5,000 Hz
DT106 DT107	Acceleration time:	200 msec
DT108 DT109	Target value (Movement amount)	:10,000 pulses
DT110 DT111	Pulse stop	

Figure 108: FPΣ Sample program – relative value positioning operation (program)

Pulse output diagram

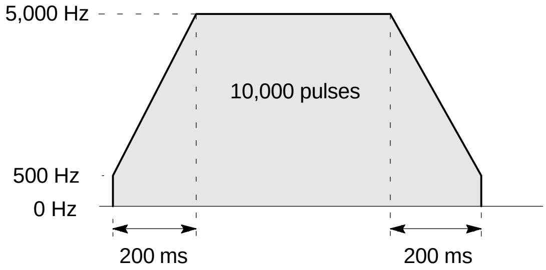


Figure 109: FPΣ Sample program – pulse output diagram

Relative value positioning operation (minus direction)

When X9 turns on, the pulse is output from CCW output “Y1” of specified channel CH0.

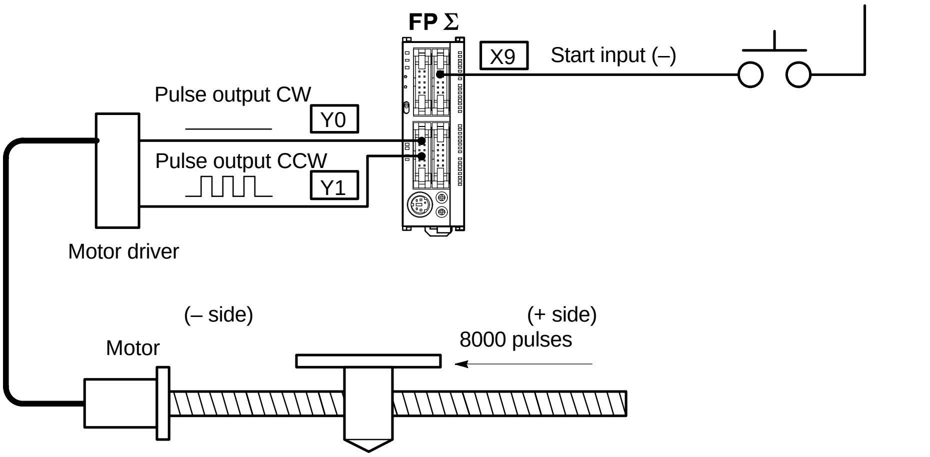
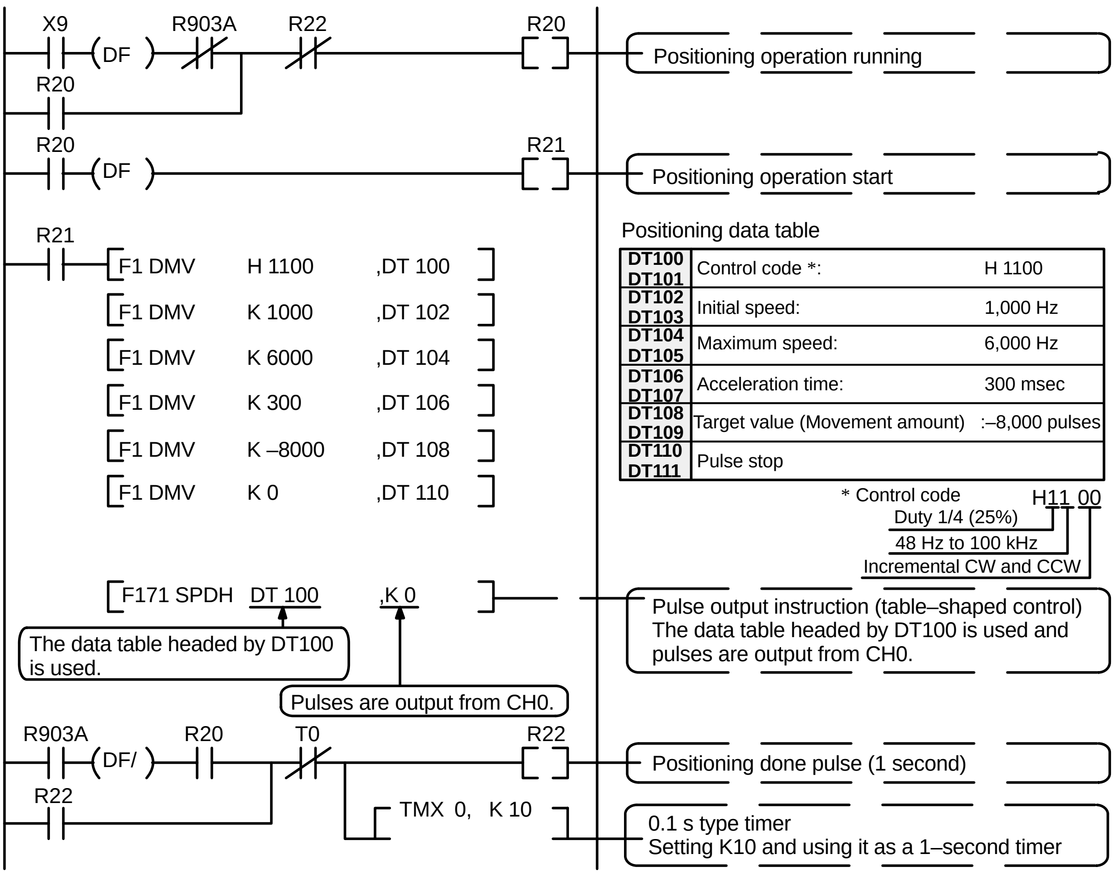


Figure 110: FPΣ Sample program – relative value positioning operation (– direction)

Program



Positioning data table

DT100 DT101	Control code *:	H 1100
DT102 DT103	Initial speed:	1,000 Hz
DT104 DT105	Maximum speed:	6,000 Hz
DT106 DT107	Acceleration time:	300 msec
DT108 DT109	Target value (Movement amount)	:–8,000 pulses
DT110 DT111	Pulse stop	

Figure 111: FPΣ Sample program – relative value positioning operation (program)

Pulse output diagram

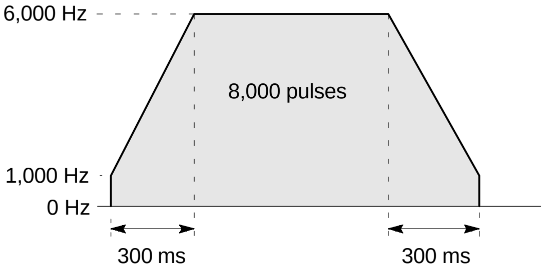
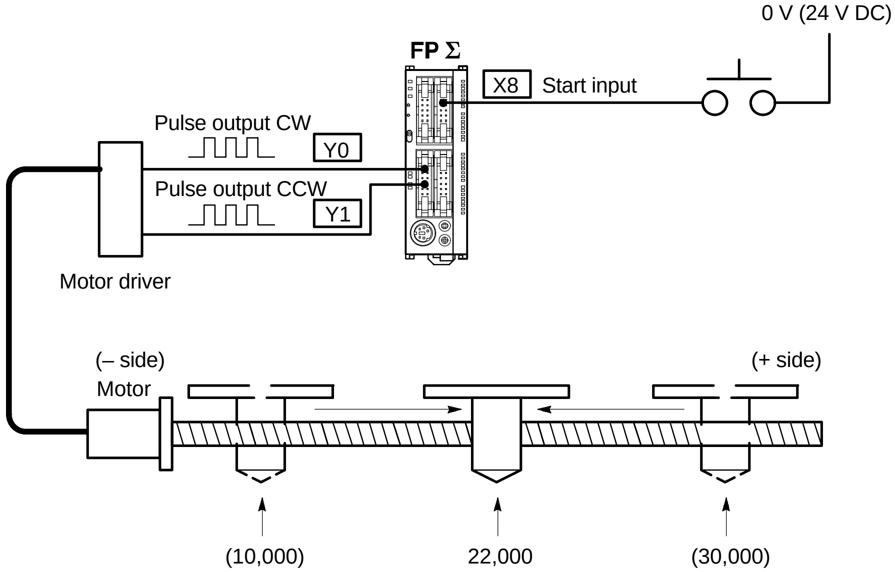


Figure 112: FPΣ Sample program – pulse output diagram

Absolute value positioning operation

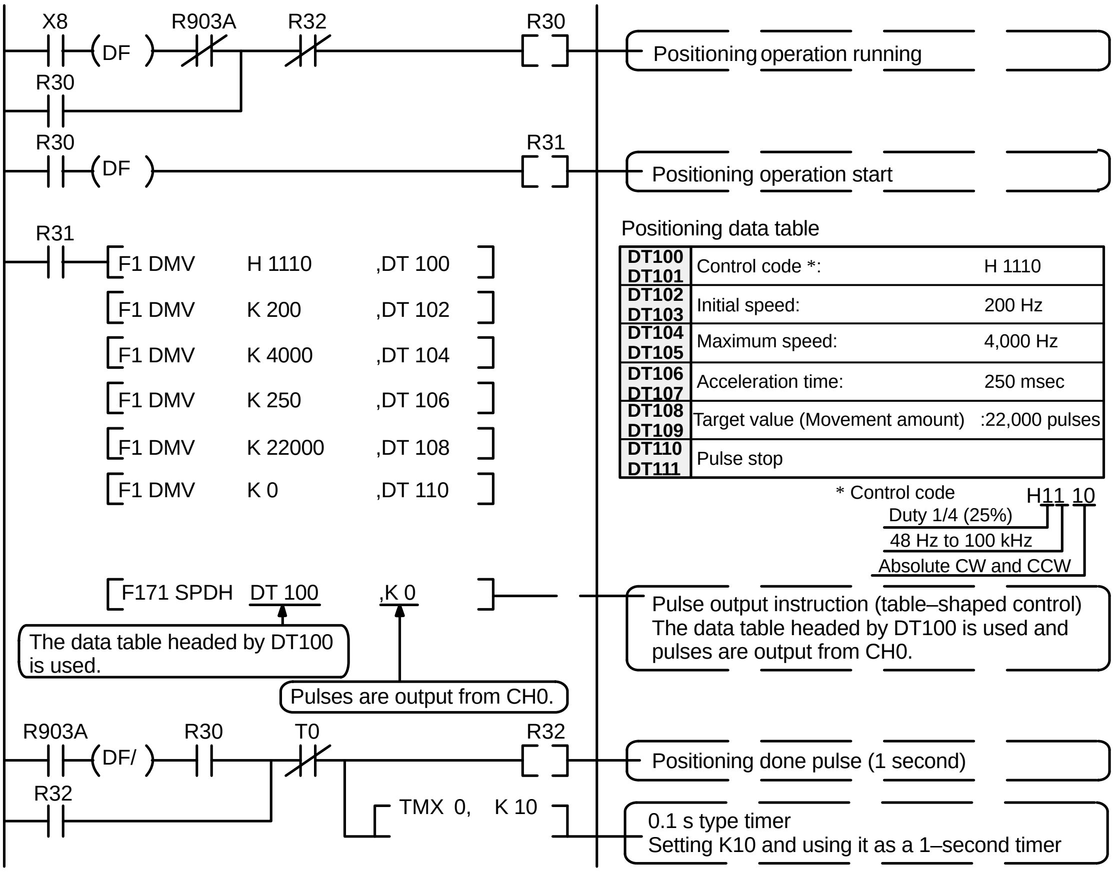
When X1 is turned on, pulses are output from CW output “Y0” or CCW output “Y1” of specified channel CH0. If the current value at that point is larger than “22,000”, the pulses are output from Y1, and if the value is smaller than “22,000”, the pulses are output from Y2.



Regardless of the current value, its movement is towards position “22,000.”

Figure 113: FPΣ Sample program – absolute value positioning operation

Program



DT100 DT101	Control code *:	H 1110
DT102 DT103	Initial speed:	200 Hz
DT104 DT105	Maximum speed:	4,000 Hz
DT106 DT107	Acceleration time:	250 msec
DT108 DT109	Target value (Movement amount)	:22,000 pulses
DT110 DT111	Pulse stop	

Figure 114: FPΣ Sample program – absolute value positioning operation (program)

Pulse output diagram

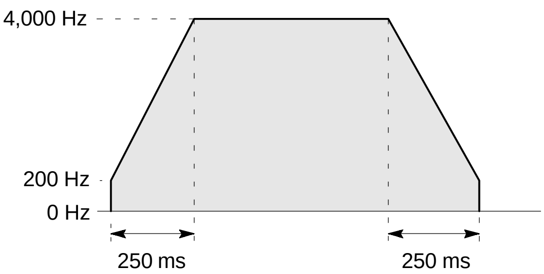


Figure 115: FPΣ Sample program – pulse output diagram

Home return operation (minus direction)

When XA turns on, the pulse is output from CCW output “Y1” of specified channel “CH0” and the return to home begins. When X3 turns on, deceleration begins, and when X2 turns on, home return is completed. After the return to home is completed, the elapsed value area “DT90044 and DT90045” are cleared to 0.

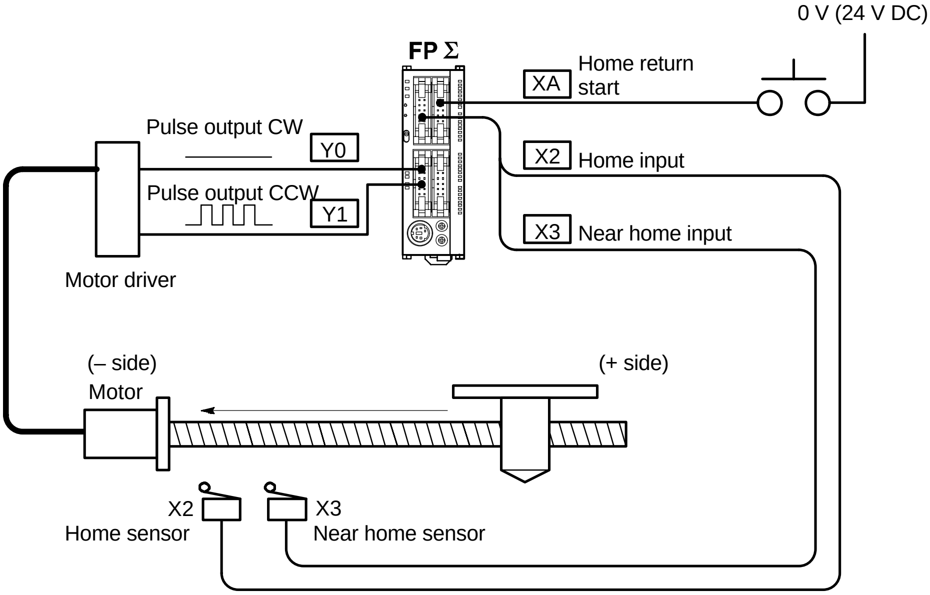
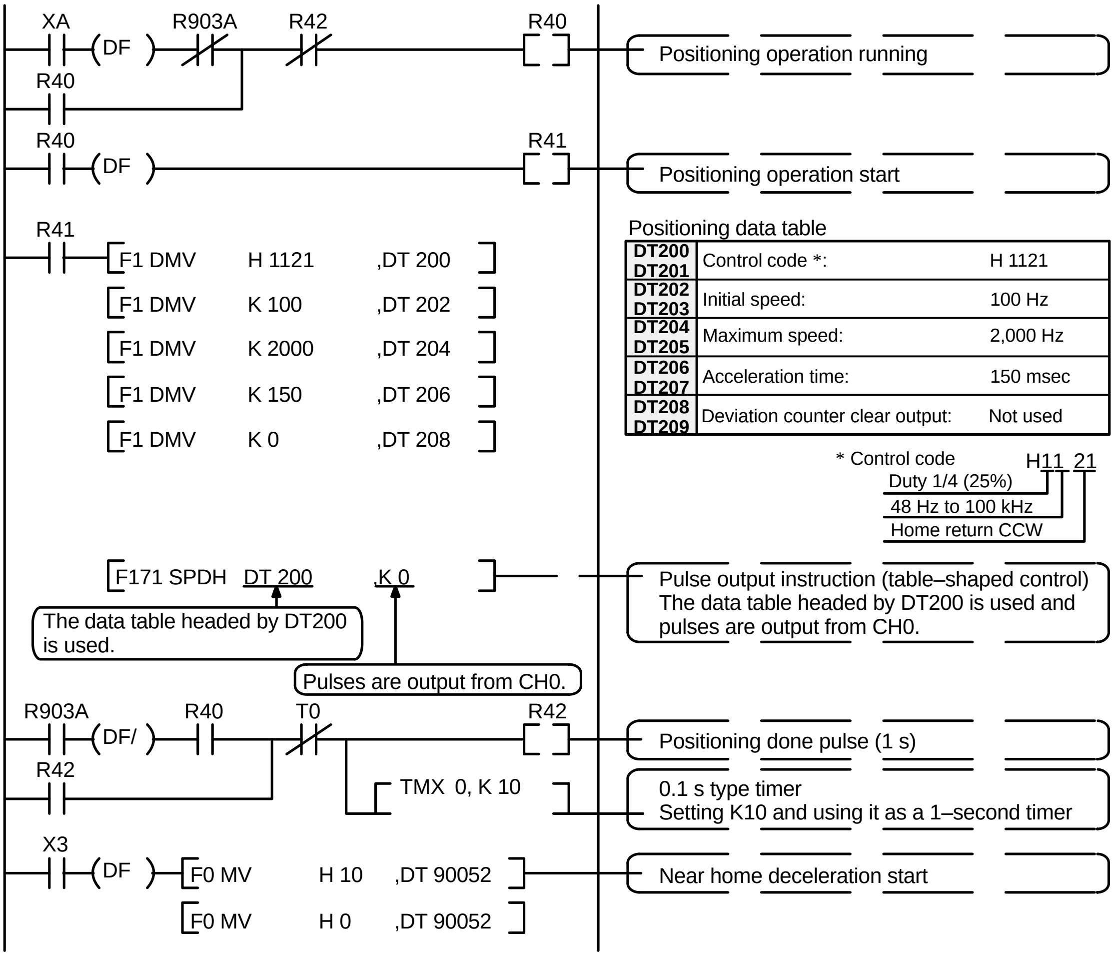


Figure 116: FPΣ Sample program – home return operation (– direction)

Program



Positioning data table

DT200 DT201	Control code *:	H 1121
DT202 DT203	Initial speed:	100 Hz
DT204 DT205	Maximum speed:	2,000 Hz
DT206 DT207	Acceleration time:	150 msec
DT208 DT209	Deviation counter clear output:	Not used

Figure 117: FPΣ Sample program – home return operation (program)

Pulse output diagram

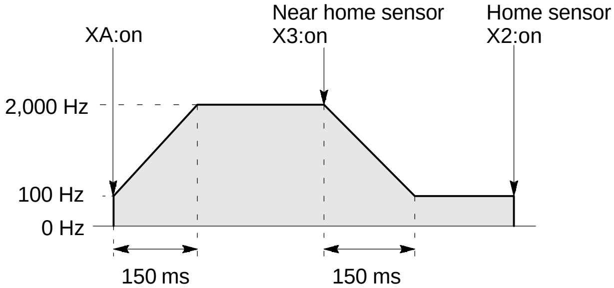


Figure 118: FPΣ Sample program – home return operation (pulse output diagram)

Home return operation (plus direction)

When XA turns on, a pulse is output from CW output “Y0” of specified channel “CH0” and the return to home begins. When X3 turns on, deceleration begins, and when X2 turns on, home return is completed. After the return to home is completed, the elapsed value area “DT90044 and DT90045” are cleared to 0.

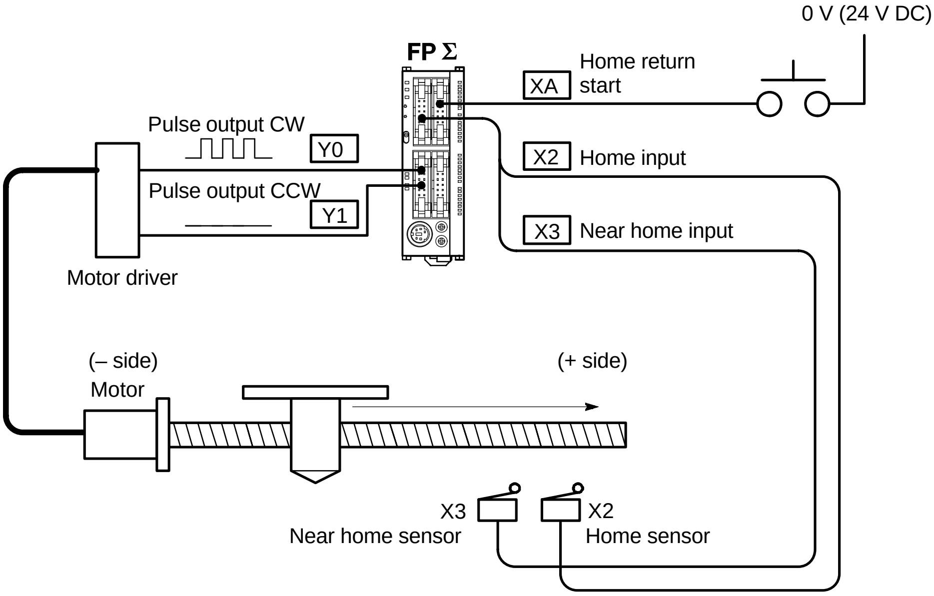
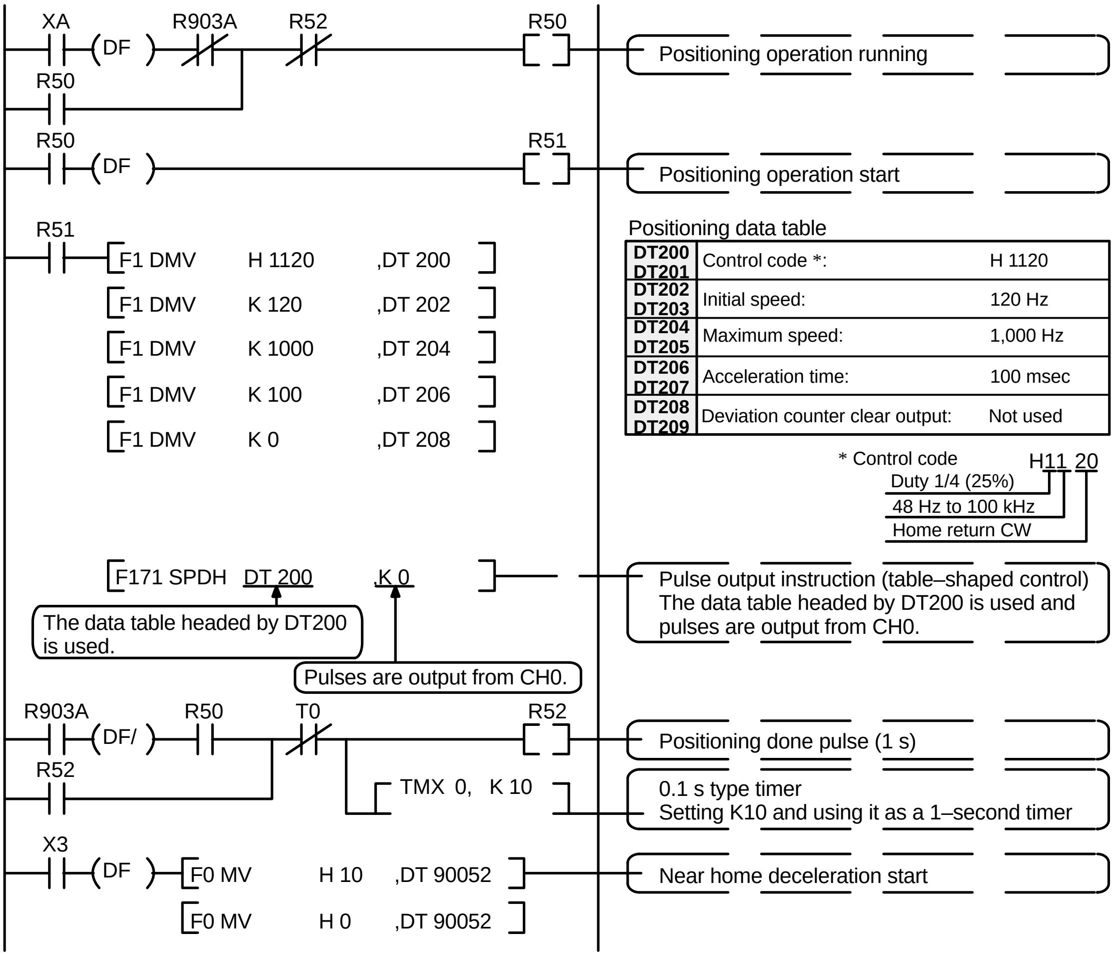


Figure 119: FPΣ Sample program – home return operation (+ direction)

Program



Positioning data table

DT200 DT201	Control code *:	H 1120
DT202 DT203	Initial speed:	120 Hz
DT204 DT205	Maximum speed:	1,000 Hz
DT206 DT207	Acceleration time:	100 msec
DT208 DT209	Deviation counter clear output:	Not used

Figure 120: FPΣ Sample program – home return operation (program)

Pulse output diagram

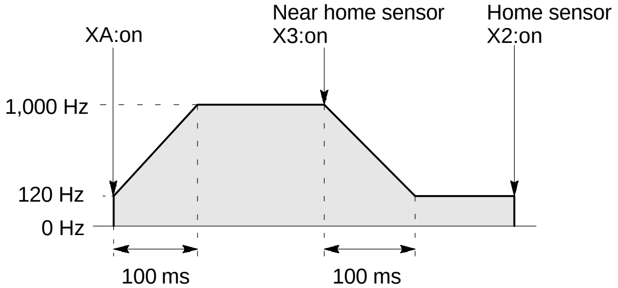


Figure 121: FPΣ Sample program – home return operation (pulse output diagram)

JOG operation (plus direction)

While X8 is in the on state, a pulse is output from CW output “Y0” of specified channel “CH0”.

Program

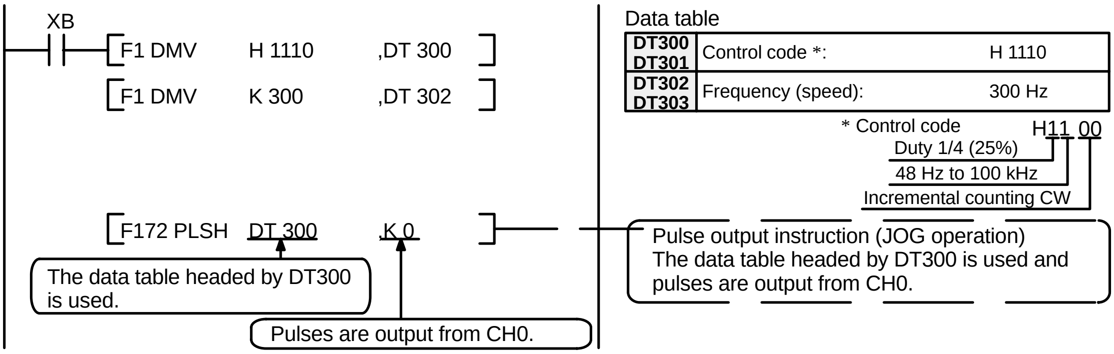


Figure 122: FPΣ Sample program – JOG operation (+ direction) (program)

Pulse output diagram

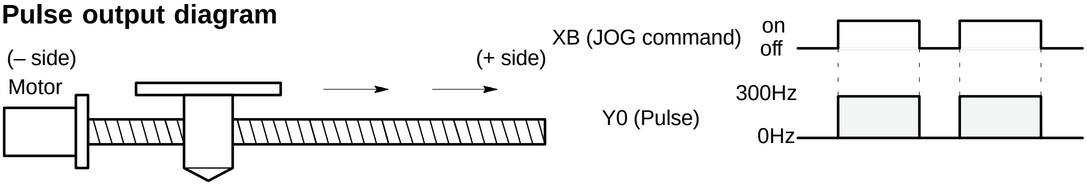


Figure 123: FPΣ Sample program – JOG operation (pulse output diagram)

JOG operation (minus direction)

While XC is in the on state, a pulse is output from CCW output “Y1” of specified channel “CH0”.

Program

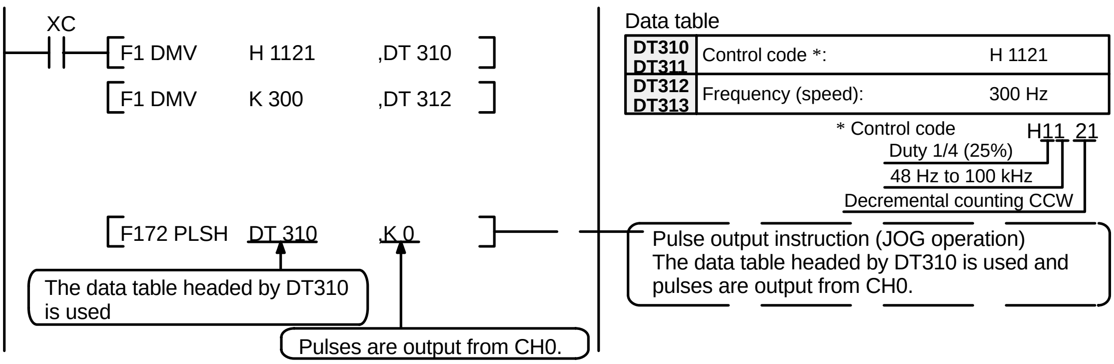


Figure 124: FPΣ Sample program – JOG operation (– diagram) (program)

Pulse output diagram

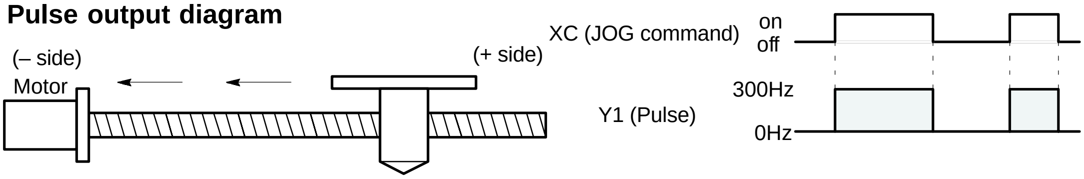


Figure 125: FPΣ Sample program – JOG operation (pulse output diagram)

Emergency stop (over limit)

If XD turns off while a pulse is being output from Y0, the output of the pulse is stopped.

Program

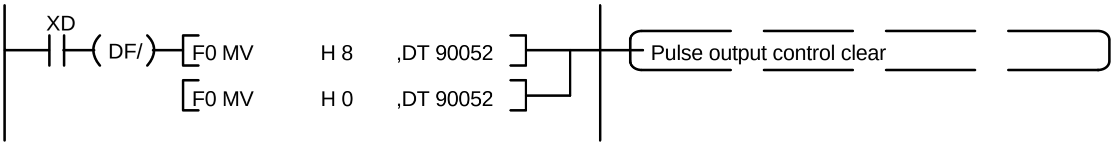


Figure 126: FPΣ Sample program – emergency stop (program)

5.5 PWM Output Function

This section explains about the PWM output function of FPΣ.

5.5.1 Overview of PWM Output Function

PWM output function

With the **F173 (PWMH)** instruction, the pulse width modulation output of specified duty ratio is obtained.

Setting the system register

When using the PWM output function, set the channels “CH0 and CH2” corresponding to system registers 400 and 401 to “Do not use high–speed counter.”

5.5.2 Instruction Used with PWM Output Function

PWM output instruction (F173)

While X6 is in the on state, a pulse with a period of 502.5ms and duty ratio of 50% is output from Y0 of specified channel “CH2”.

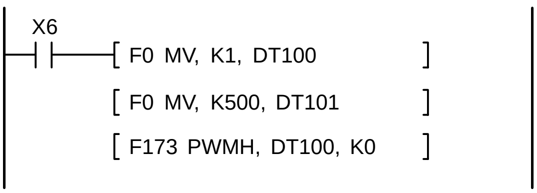


Figure 127: FPΣ PWM output instruction “F173” (program)

When the program is run, the data table will be as shown below.

Data table

DT100	Control code *1	:K 1
DT101	Duty *2	:50%

*1: Specify the control code by setting the K constant.

Resolution of 1000

K	Frequency (Hz)	Period (ms)
K0	1.5	666.7
K1	2.0	502.5
K2	4.1	245.7
K3	6.1	163.9
K4	8.1	122.9
K5	9.8	102.4
K6	19.5	51.2
K7	48.8	20.5
K8	97.7	10.2
K9	201.6	5.0
K10	403.2	2.5
K11	500.0	2.0
K12	694.4	1.4
K13	1.0 k	1.0
K14	1.3 k	0.8
K15	1.6 k	0.6
K16	2.1 k	0.5
K17	3.1 k	0.3
K18	6.3 k	0.2
K19	12.5 k	0.1

Resolution of 100

K	Frequency (Hz)	Period (ms)
K20	15.6 k	0.06
K21	20.8 k	0.05
K22	25.0 k	0.04
K23	31.3 k	0.03
K24	41.7 k	0.02

*2: Specification of duty (specify using K constant)
If the control code is K0 to K19, the duty is K0 to K999 (0.0% to 99.9%).
If the control code is K20 to K24, the duty is K0 to K990 (0% to 99%).
Values are specified in units of 1% (K10) (digits below the decimal point are rounded off).

Note

If a value outside the specified range is written for the duty area while the instruction is being executed, the frequency that is output will be uncorrected. Written data is not corrected, however.

Chapter 6

Communication Cassette

6.1 Communication Functions of FPΣ

This section explains about the communication functions and type of the optional communication cassette.

6.1.1 Functions of Communication Cassette

There are three types of communication functions made possible by the FPΣ communication cassette, as described below.

Computer link

The computer link is used to carry out communication with a computer connected to the PLC that has a transmission right. Instructions (command messages) are output to the PLC, and the PLC responds (sends response messages) based on the received instructions.
A MEWNET exclusive protocol called "MEWTOCOL–COM" is used to exchange data between the computer and PLC. Two communication methods are available, 1:1 and 1:N. A network using the 1:N connection is called a C–NET.
The PLC sends back responses automatically in reply to commands from the computer, so no program is necessary on the PLC side in order to carry out communication.

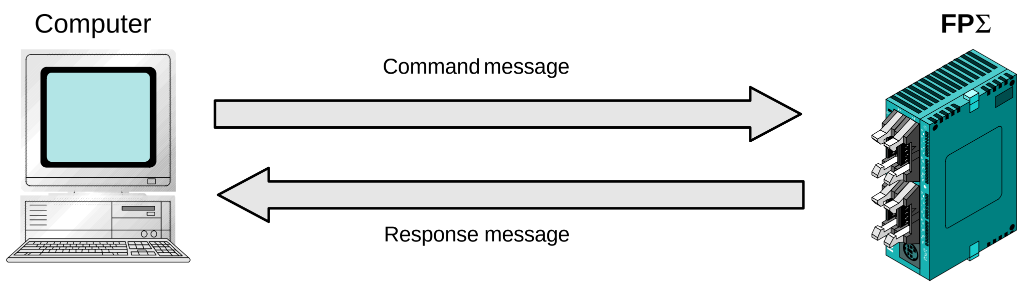


Figure 128: FPΣ Computer link function

Applicable communication cassette

For 1:1 communication . . . . 1–channel RS232C type (Part No. FPG–COM1)
2–channel RS232C type (Part No. FPG–COM2)
For 1:N communication . . . 1–channel RS485 type (Part No. FPG–COM3)

General–purpose serial communication

General–purpose serial communication enables data to be sent back and forth between an image processing device connected to the COM. port and an external device such as a bar code reader.
Reading and writing of data is done using a ladder program in the FPΣ, while reading and writing of data from an external device connected to the COM. port is handled through the FPΣ data registers.

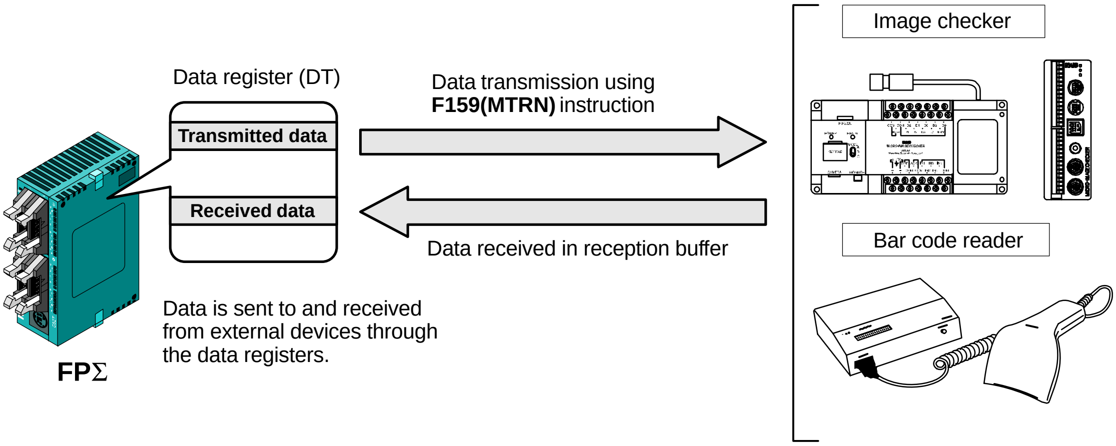


Figure 129: FPΣ General–purpose serial communication function

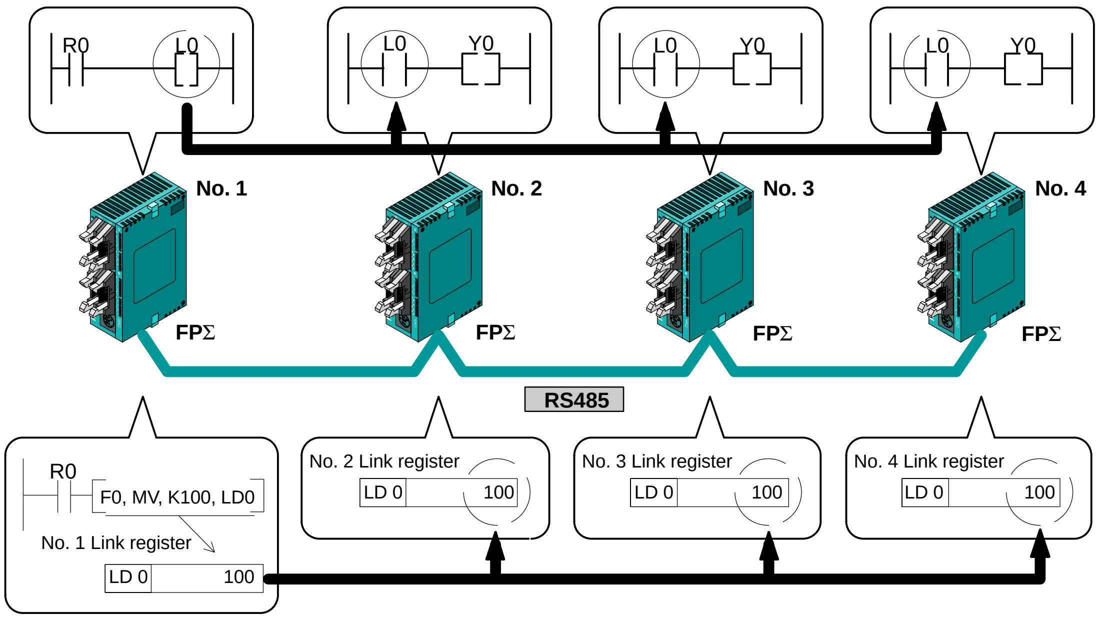
Applicable communication cassette

For 1:1 communication . . . . 1–channel RS232C type (Part No. FPG–COM1)
2–channel RS232C type (Part No. FPG–COM2)
For 1:N communication . . . 1–channel RS485 type (Part No. FPG–COM3)

PLC link

Data is shared with PLCs connected through the MEWNET, using dedicated internal relays “Link relays (L)” and data registers “Link registers (LD)”.
When using link relays, if the link relay contact for one PLC goes on, the same link relay also goes on in each of the other PLCs connected to the network.
With link registers, if the contents of a link register are rewritten in one PLC, the change is made in the same link register of each of the other PLCs connected to the network.
With a PLC link, the status of the link relays and link registers in any one PLC are fed back to all of the other PLCs connected to the network, so control of data that needs to be consistent throughout the network, such as target production values and type codes, can easily be implemented to coordinate the data, and all of the units are booted at the same timing.

Link relay
When the link relay “L0” of the master station (No. 1) is turned on, that signal is converted by the ladder programs of the other stations, and the Y0 of the other stations are output.



Link register
If a constant of 100 is written to LD0 of the master station (No. 1), the contents of LD0 in the other station (No. 2) are also changed to a constant of 100.

Figure 130: FPΣ PLC link function

Applicable communication cassette

For 1:N communication . . . 1–channel RS485 type (Part No. FPG–COM3)

6.2 Communication Cassette

This section explains about the optional communication cassette for FPΣ.

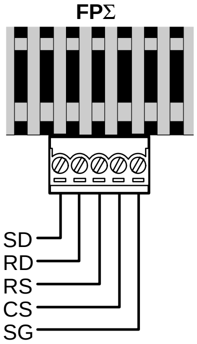
6.2.1 Type of Communication Cassette

The communication cassette contains the following three types, which can be selected based on the application involved.

1–channel RS232C type (Part No. : FPG–COM1)

This communication cassette is a 1–channel unit with a five–wire RS232C port.
It supports 1:1 computer links and general–purpose serial communication. RS/CS control is possible.

Terminal layout



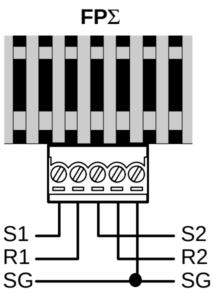
Abbreviation	Name	Signal direction
SD	Transmitted data	Unit → External device
RD	Received data	Unit ← External device
RS	Request to Send	Unit → External device
CS	Clear to Send	Unit ← External device
SG	Signal Ground	—

Figure 131: FPΣ 1–channel RS232C type communication cassette

2–channel RS232C type (Part No. : FPG–COM2)

This communication cassette is a 2–channel unit with a three–wire RS232C port.
It supports 1:1 computer links and general–purpose serial communication.
Communication with two external devices is possible.

Terminal layout



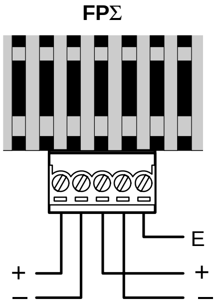
Abbreviation	Name	Signal direction
S1	Transmitted data 1	Unit → External device
R1	Received data 1	Unit ← External device
S2	Transmitted data 2	Unit → External device
R2	Received data 2	Unit ← External device
SG	Signal Ground	—

Figure 132: FPΣ 2–channel RS232C type communication cassette

1–channel RS485 type (Part No. : FPG–COM3)

This communication cassette is a 1–channel unit with a two–wire RS485 port.
It supports 1:N computer link (C–NET), general–purpose serial communication, and a PLC link.

Terminal layout



Abbreviation	Name	Signal direction
+	Transmission line (+)	—
–	Transmission line (–)	—
+	Transmission line (+)	—
–	Transmission line (–)	—
E	Terminal station setting	—

Figure 133: FPΣ 1–channel RS485 type communication cassette

6.2.2 Names and Principle Applications of the Ports

The tool port provided as a standard feature of the FPΣ is treated as the COM. 0 port. The ports in which the communication cassettes are installed are treated as the COM. 1 port and COM. 2 port. The principle applications of the various ports are as described below.

Port name	When using only the FPΣ contorl unit	When the 1–channel RS232C type has been added	When the 2–channel RS232C type has been added	When the 1–channel RS485 type has been added
COM. 0 port	Tool port Computer link	Tool port Computer link	Tool port Computer link	Tool port Computer link
COM. 1 port	—	Computer link General–purpose serial communication	Computer link General–purpose serial communication	C–NET General–purpose serial communication PLC link
COM. 2 port	—	—	Computer link General–purpose serial communication	—

Notes

- **Communication using MEWTOCOL–COM is possible with ports and tool ports for which “Computer link” is noted above. With MEWTOCOL–COM, the same commands are supported on all three channels, and frames of up to 2,048 bytes (header <) are supported.**
- **General–purpose serial communication is possible only with the COM. 1 port and COM. 2 port.**

6.2.3 Communication Specifications of Communication Cassette

Serial communication specifications (1:1 communication) (*Note 1)

Item	Specification
Communication method	Half–duplex communication
Synchronous method	Start–stop synchronous system
Transmission line	RS232C
Transmission distance (Total length)	3m/9.84 ft.
Transmission speed (Baud rate)	9600 bits/s to 115.2 k bits/s (*Note 2)
Transmission code	ASCII
Transmission data format	Stop bit: 1–bit/2–bit, Parity: None/Even/Odd Data length (Character bits): 7–bit/8–bit (*Note 2)
Interface	Conforming to RS232C (Connection using terminal block)

Notes

1) **The RS232C type of communication cassette is necessary in order to use the serial communication function (1:1 communication).**

2) **The transmission speed (baud rate) and transmission format are specified using the system registers.**

Serial communication specifications (1:N communication) (*Note 1)

Item	Specification
Communication method	Two–wire half–duplex communication
Synchronous method	Start–stop synchronous system
Transmission line	Twisted pair cable or VCTF
Transmission speed (Baud rate)	9600 bits/s to 115.2 k bits/s (*Note 2)
Transmission code	ASCII
Transmission data format	Stop bit: 1–bit/2–bit, Parity: None/Even/Odd Data length (Character bits): 7–bit/8–bit (*Note 2)
Number of unit (station)	Max. 32 units (stations)
Interface	Conforming to RS485 (Connection using terminal block)

Notes

1) **The RS485 type of communication cassette is necessary in order to use the serial communication function (1:N communication).**

2) **The transmission speed (baud rate) and transmission format are specified using the system registers.**

3) **Unit (Station) numbers are specified using the system registers. Up to 31 units (stations) can be specified using the switches.**

PLC link function specifications (*Note 1)

Item	Specification
Communication method	Token bus
Transmission method	Floating master
Transmission line	Twisted pair cable
Transmission distance (Total length)	800 m/2,625 ft.
Transmission speed (Baud rate)	115.2 kbps
Number of units (stations)	Max. 16 units (stations) (*Note 2)
PLC link capacity	Link relay: 1,024 points, Link register: 128 words
Interface	Conforming to RS485 (Connection using terminal block)

Notes

1) **The RS485 type of communication cassette is necessary in order to use the PLC link function.**

2) **Unit (Station) numbers are specified using the switches or the system registers.**

6.3 Attachment of Communication Cassette

This section explains about the attachment procedure of optional communication cassette.

6.3.1 Attachment Procedure

1. Insert a screwdriver under the cover to remove it.

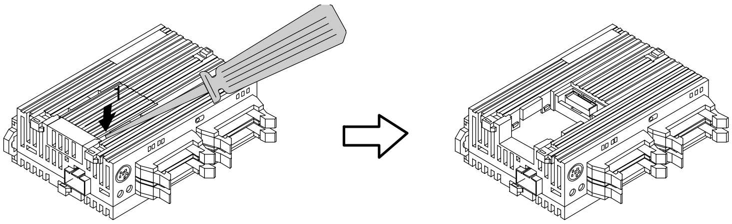


Figure 134: FPΣ Communication cassette attachment procedure 1

2. Install the communication cassette.

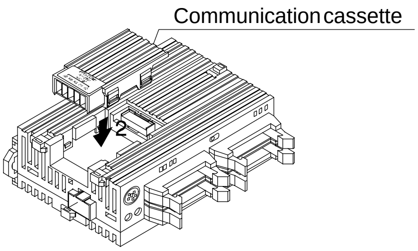


Figure 135: FPΣ Communication cassette attachment procedure 2

3. Plug in the communication connector.

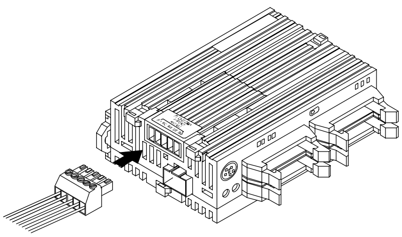


Figure 136: FPΣ Communication cassette attachment procedure 3

Note

Turn off the power supply to the control unit before installing the communication cassette.

6.4 Wiring of Communication Cassette

This section explains about the wiring of optional communication cassette.

6.4.1 Wiring the Connector with the Communication Cassette

The communication connector (provided with the communication cassette) has a screw–type terminal block. Use the following for wiring.

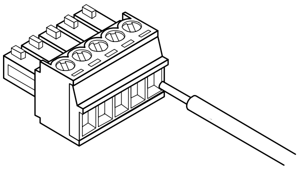


Figure 137: FPΣ Communication connector

Accessory communication connector

The communication connector made by Phoenix Contact Co. should be used.

Number of pin	Model No. of Phoenix Contact Co.	
	Model No.	Product No.
5 pins	MC1,5/5–ST–3,5	1840396

Suitable wire (Twisted wire)

Size	Cross–sectional area
AWG#28 to 16	0.08 mm^2 to 1.25 mm^2

Pole terminal with a compatible insulation sleeve

If a pole terminal is being used, the following models are marketed by Phoenix Contact Co.

Manufacturer	Cross-sectional area	Size	Product number
Phoenix Contact Co.	0.25 mm^2	AWG#24	AI 0,25–6 YE
	0.50 mm^2	AWG#20	AI 0,50–6 WH
	0.75 mm^2	AWG#18	AI 0,75–6 GY
	1.00 mm^2	AWG#18	AI 1–6 RD

Pressure welding tool for pole terminals

Manufacturer	Model No. of Phoenix Contact Co.	
	Model No.	Product No.
Phoenix Contact Co.	CRIMPFOX UD6	12 04 43 6

6.4.2 Tool for Tightening Communication Connector Terminal Block

When tightening the terminals of the communication connector, use a screwdriver “Phoenix Contact Co., Product No. 1205037, blade size of 0.4   2.5, model No. SZS 0,4 x 2,5” or screwdriver “Part No. AFP0806”. The tightening torque should be 0.22 to 0.25 N·m or less.

6.4.3 Wiring Method

Procedure:

1. **Remove a portion “7 mm/0.276 in.” of the wire’s insulation.**

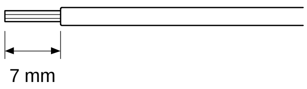


Figure 138: FPΣ Communication connector wiring method 1

2. **Insert the wire into the terminal block until it contacts the back of the block, and then tighten the screw clockwise to fix the wire in place.**

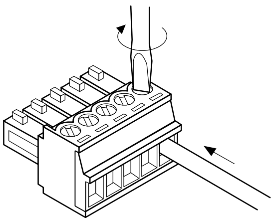


Figure 139: FPΣ Communication connector wiring method 2

6.4.4 Cautions Regarding Wiring

The following items should be observed, taking care not to cut or disconnect the wiring.

– When removing the wire’s insulation, be careful not to scratch the core wire.
– Do not twist the wires to connect them.
– Do not solder the wires to connect them. The solder may break due to vibration.
– After wiring, make sure stress is not applied to the wire.
– In the terminal block socket construction, if the wire closes upon counter-clockwise rotation, the connection is faulty. Disconnect the wire, check the terminal hole, and then re-connect the wire.

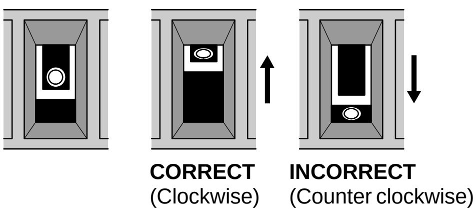


Figure 140: Cautions regarding wiring

Chapter 7

Communication Function 1 Computer Link

7.1 Computer Link

This section contains overview of computer link function.

7.1.1 Overview of Function

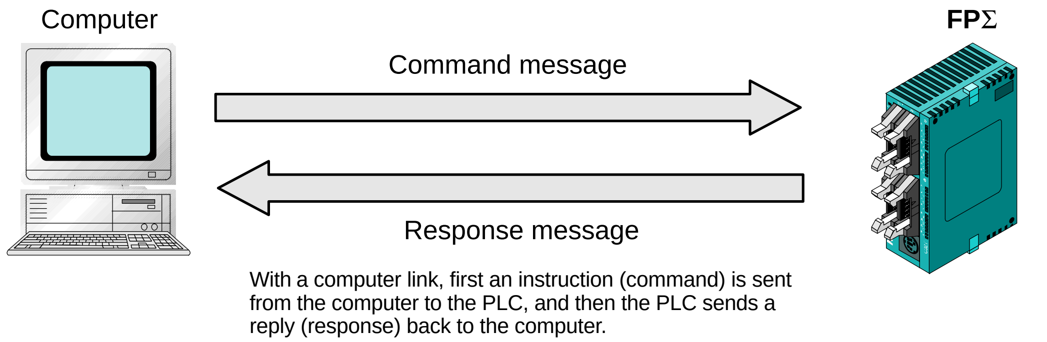


Figure 141: FPΣ Overview of computer link function

What is the computer link?

A computer link is a function that carries out communication between a computer and PLC, making it possible to monitor and control the PLC operating status from a computer.

Conversation is carried out between the two by instructions (commands) being sent from the computer to the PLC, and the PLC replying (sending response messages) back to the computer.

A MEWNET exclusive protocol called “MEWTOCOL–COM” is used to exchange data between the computer and PLC.

The communication speed and transmission format are specified using system registers No. 413 (COM. 1 port) and No. 414 (COM. 2 port).

Program for computer link

To use a computer link, a program should be created that enables command messages to be sent and response messages to be received on the computer side. No communication program is required on the PLC side.

Programs for the computer side should be written in BASIC or C language, based on the MEWTOCOL–COM format. MEWTOCOL–COM contains the commands used to monitor and control PLC operation.

7.1.2 Explanation of Operation when Using a Computer Link

Command and Response

Instructions pertaining to the PLC are called “commands”. These should be issued by the computer, to the PLC.

Messages sent back to the computer from the PLC are called “responses”. When the PLC receives a command, it processes the command regardless of the sequence program, and sends a response back to the computer. The computer uses the response to confirm the results of the command being executed.

MEWTOCOL–COM sketch

Communication is carried out in a conversational format, based on the MEWTOCOL–COM communication procedures.

Data is sent in ASCII format.

The computer has the first right of transmission.

The right of transmission shifts back and forth between the computer and PLC each time a message is sent.

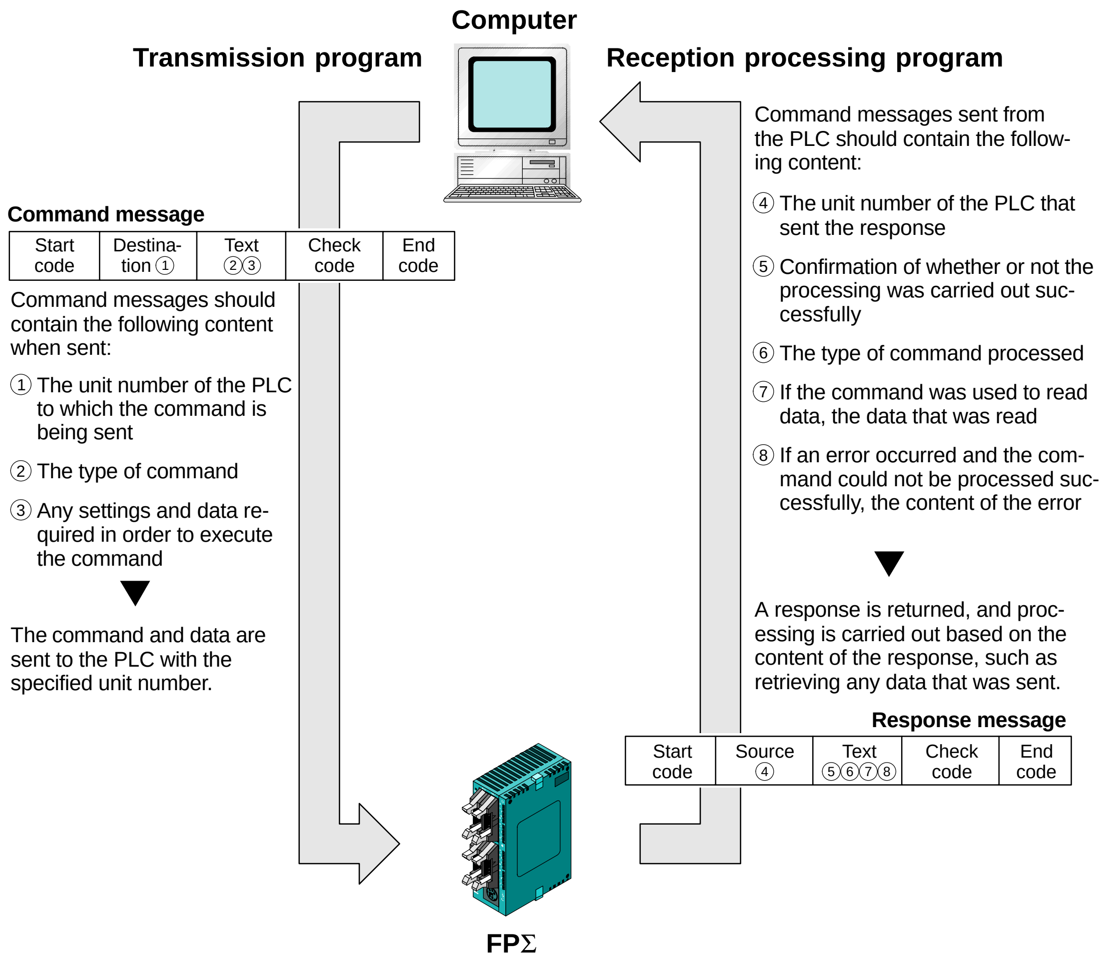


Figure 142: FPΣ MEWTOCOL–COM

7.1.3 Format of Command and Response

Command message

Items necessary for commands should be noted in the text segment, and the unit number specified before sending the command.

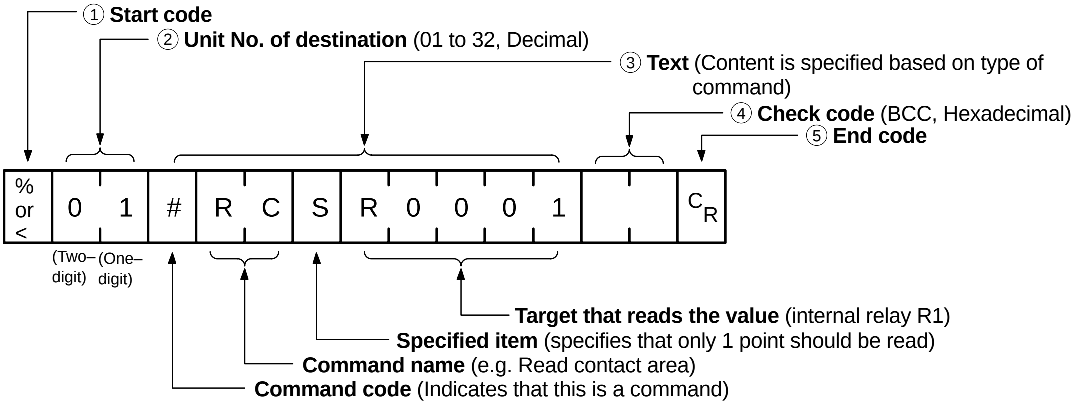


Figure 143: FPΣ Command message (format)

① Start code (Header)

Commands must always have a “%” (ASCII code: H25) or a “<” (ASCII code: H3C) at the beginning of a message.

② Unit No.

Any PLC connected to the C–NET has a unit number specified for it. The unit number of the PLC to which the command is being sent should be specified. When using 1:1 communication, “01” should be specified.

③ Text

The content differs depending on the command. The content should be noted in all upper–case characters, following the fixed formula for that particular command.

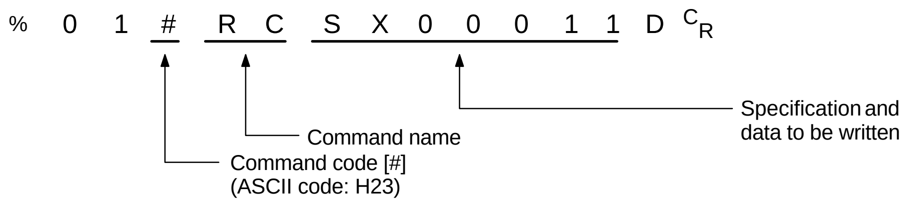


Figure 144: FPΣ Command message (text)

④ Check code

This is the BCC (block check code) used to detect errors using horizontal parity. It should be created so that it targets all of the text data from the start code to the last text character.
The BCC starts from the start code and checks each character in sequence, using the exclusive OR operation, and replaces the final result with character text. It is normally part of the calculation program, and is created automatically.
The parity check can be skipped by entering “ * * ” ASCII code: H2A2A) instead of the BCC.

⑤ End code (Terminator)

Messages must always end with a “C_R” (ASCII code: H0D).

☛ next page

Notes

Precautions when writing messages

- **The method for writing text segments in the message varies depending on the type of command.**
- **If there is a large number of characters to be written, they may be divided and sent as several commands. If there is a large number of characters in the value that was loaded, they may be divided and several responses sent.**

Response message

The PLC that received the command in the previous page sends the results of the processing to the computer.

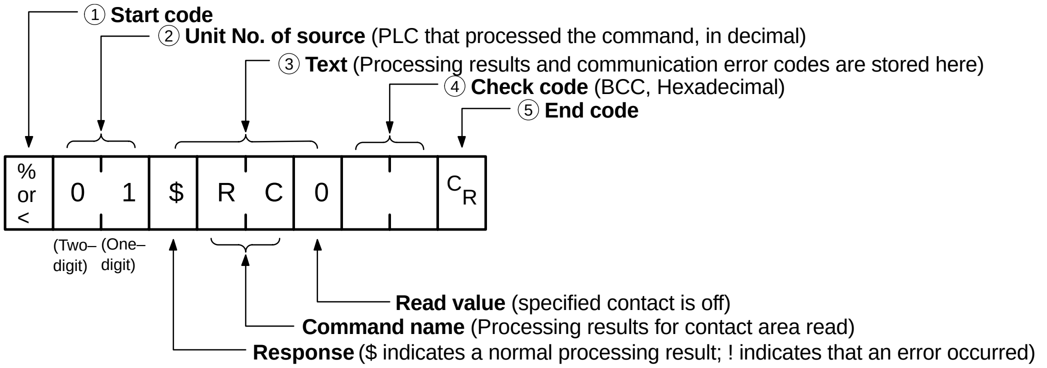


Figure 145: FPΣ Response message (overview)

① Start code (Header)

A “%” (ASCII code: H25) or “<” (ASCII code: H3C) must be at the beginning of a message. The response must start with the same start code that was at the beginning of the command.

② Unit No.

The unit number of the PLC that processed the command is stored here. If 1:1 communication is being used, “01” will be stored here.

③ Text

The content of this varies depending on the type of command. The value should be read based on the content. If the processing is not completed successfully, an error code will be stored here, so that the content of the error can be checked.

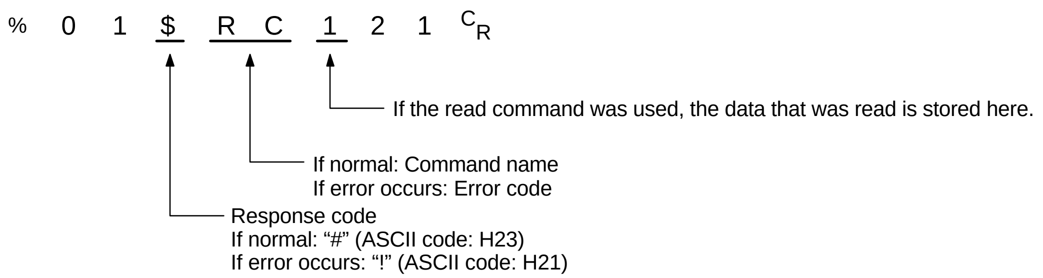


Figure 146: FPΣ Response message (text)

④ **Check code**

This is the BCC (block check code) used to detect errors using horizontal parity. The BCC starts from the start code and checks each character in sequence, using the exclusive OR operation, and replaces the final result with character text.

⑤ **End code (Terminator)**

There is always a "C_R" (ASCII code: H0D) at the end of the message.

Notes

Precautions when reading data

- **If no response is returned, the command may not have arrived at the PLC, or the PLC may not be functioning. Check to make sure all of the communication specifications, such as the communication speed, data length, and parity, match between the computer and the PLC.**
- **If the received response contains a "!" instead of a "$", the command was not processed successfully. The response will contain a communication error code, so confirm the content of the error.**
- **The unit number and command name will be the same for a command and its corresponding response, as shown in the figure below. This makes the correspondence between the command and the response clear.**

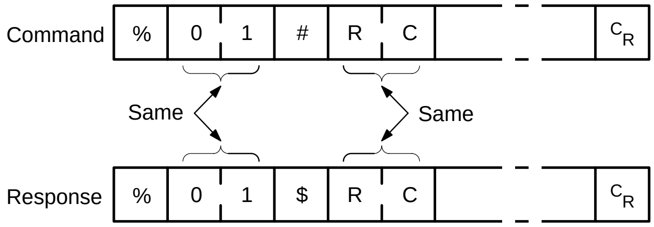


Figure 147: FPΣ Command & response message (note)

7.1.4 Types of Commands that Can Be Used

Command name	Code	Description
Read contact area	RC (RCS) (RCP) (RCC)	Reads the on and off status of contacts. – Specifies only one point – Specifies multiple contacts. – Specifies a range in word units.
Write contact area	WC (WCS) (WCP) (WCC)	Turns contacts on and off. – Specifies only one point – Specifies multiple contacts. – Specifies a range in word units.
Read data area	RD	Reads the contents of a data area.
Write data area	WD	Writes data to a data area.
Read timer/counter set value area	RS	Reads the value set for a timer/counter.
Write timer/counter set value area	WS	Writes a timer/counter setting value.
Read timer/counter elapsed value area	RK	Reads the timer/counter elapsed value.
Write timer/counter elapsed value area	WK	Writes the timer/counter elapsed value.
Register or Reset contacts monitored	MC	Registers the contact to be monitored.
Register or Reset data monitored	MD	Registers the data to be monitored.
Monitoring start	MG	Monitors a registered contact or data using MD and MC.
Preset contact area (fill command)	SC	Embeds the area of a specified range in a 16–point on and off pattern.
Preset data area (fill command)	SD	Writes the same contents to the data area of a specified range.
Read system register	RR	Reads the contents of a system register.
Write system register	WR	Specifies the contents of a system register.
Read the status of PLC	RT	Reads the specifications of the programmable controller and error codes if an error occurs.
Program block read	RP	The PLC program is read on the computer side.
Program block write	WP	The program read by the RP is written to the PLC.
Remote control	RM	Switches the operation mode of the programmable controller.
Abort	AB	Aborts communication.

Tip

– Commands and responses used with the FPΣ have a dedicated header (start code) added to the “MEWTOCOL–COM” communication protocol of the FP series PLC.

– The contents of the specified header vary depending on the communication conditions.

– With the FPΣ, in addition to ordinary MEWTOCOL–COM, an expansion header is also supported that enables single frames of up to 2,048 characters to be sent.

Type of header	No. of characters that can be sent in 1 frame
%	Max. 118 characters
<	Max. 2048 characters

– The number of characters that can be sent is restricted by the type of header and the command.

7.1.5 Setting the Communication Parameters when Using a Computer Link

Setting of communication speed (baud rate) and communication format

The settings for the COM. port communication speed and communication format are specified using the FPWIN GR programming tool. Select “PLC Configuration” under “Options” on the menu bar, and click on the “COM.1 and 2 Port” tab. There are separate settings for COM. 1 and COM. 2.

PLC Configuration setting dialog box

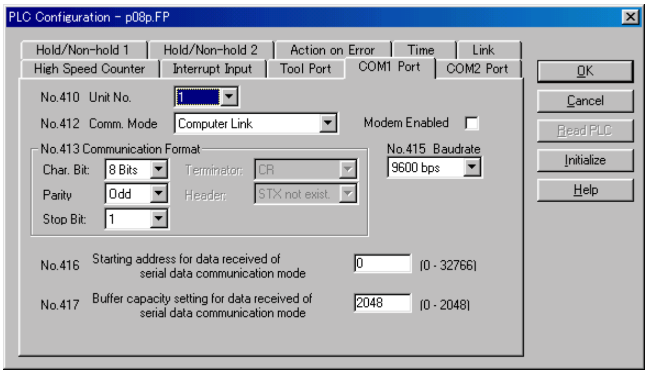


Figure 148: FPWIN GR PLC Configuration setting dialog box

No. 412 Communication (Comm.) Mode

Select the COM. port operation mode.

Click on the ▼ button and select “Computer Link” from the displayed pull–down menu.

No. 413 (for COM.1 port), No. 414 (for COM.2 port) Communication Format setting

The default settings for the communication format are as shown at the right.
To change the communication format to match an external device connected to the COM. port, enter the settings for the various items.

Char. Bit	8 Bits
Parity	Odd
Stop Bit	1 Bit
Terminator	CR
Header	STX not exist

No. 415 Baud rate (communication speed) setting

The default setting for the communication speed for the various ports is “9600 bps”. Change the communication speed to match the external device connected to the COM. port.

Click on the ▼ button, and select one of the values from “2400 bps, 4800 bps, 9600 bps, 19200 bps, 38400 bps, 57600 bps, 115200 bps” on the displayed pull–down menu.

7.1.6 Restriction

Either the computer link mode or the general–purpose serial communication mode can be used for the communication cassette COM. port.

There are no restrictions when multiple ports are used.

7.2 Connection Example with External Device

This section contains the connection example with external device for computer link.

7.2.1 Connection Example with External Device (1:1 communication with computer)

Outline

To use a 1:1 computer link with a computer, an RS232C cable is used to set up a 1:1 connection between the FPΣ and the computer. Communication is carried out by the PLC sending responses to commands sent from the computer side.

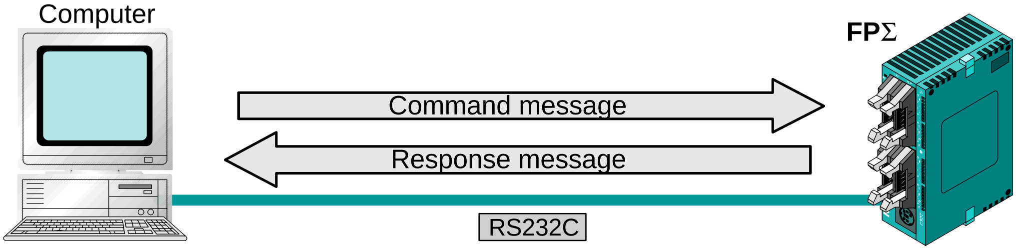


Figure 149: FPΣ Computer link–connection example (computer)

Communication cassette used for 1:1 communication

The following types of communication cassettes can be used for 1:1 computer link communication.

Name	Description	Part No.
FPΣ Communication cassette 1–channel RS232C type	This communication cassette is a 1–channel unit with a five–wire RS232C port. It supports 1:1 computer links and general–purpose serial communication. RS/CS control is possible.	FPG–COM1
FPΣ Communication cassette 2–channel RS232C type	This communication cassette is a 2–channel unit with a three–wire RS232C port. It supports 1:1 computer links and general–purpose serial communication. Communication with two external devices is possible.	FPG–COM2

Setting of system register

To carry out 1:1 communication using a computer link, the system registers should be set as shown below.

Settings when using the COM. 1 port

No.	Name	Set value
No. 410	Unit No. for COM.1 port	1
No. 412	Communication mode for COM.1 port	Computer link
No. 413	Communication format for COM.1 port	Character bit: . . . . . 8 bits Parity check: . . . . . Odd Stop bit: . . . . 1 bit Terminator: . . . . CR Header: . . . . STX not exist
No. 415	Baud rate setting for COM.1 port	9600 bits/s to 115.2 k bits/s

Settings when using the COM. 2 port

No.	Name	Set value
No. 411	Unit No. for COM.2 port	1
No. 412	Communication mode for COM.2 port	Computer link
No. 414	Communication format for COM.2 port	Character bit: . . . . . 8 bits Parity check: . . . . . Odd Stop bit: . . . . 1 bit Terminator: . . . . CR Header: . . . . STX not exist
No. 415	Baud rate setting for COM.2 port	9600 bits/s to 115.2 k bits/s

Notes

- **The communication format and baud rate (communication speed) should be set to match the connected computer.**
- **For information on setting the system registers to use a computer link, please refer to page 7 - 10.**

Connection example with computer

When using the 1–channel RS232C type of communication cassette

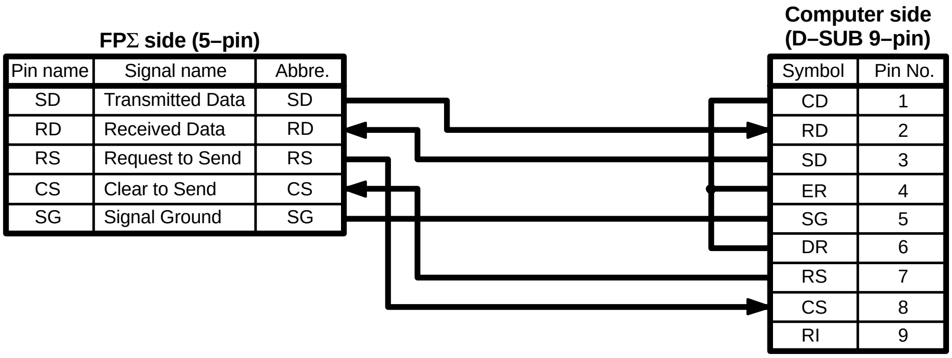


Figure 150: FPΣ Computer link – connection example 1 (computer)

When using the 2–channel RS232C type of communication cassette

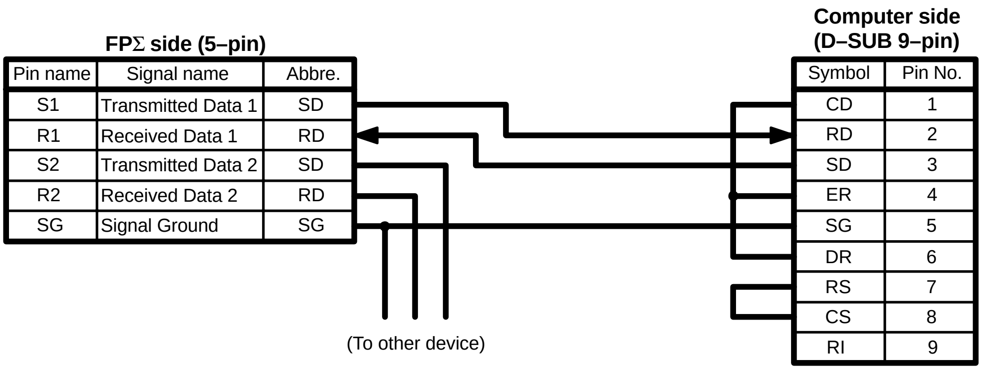


Figure 151: FPΣ Computer link – connection example 2 (computer)

Programming for a computer link

To use a computer link, a program should be created that enables command messages to be sent and response messages to be received on the computer side. The PLC automatically sends back a response to commands. No communication program is required on the PLC side.

Also, if a software program such as PCWAY is used on the computer side, PLC data can be easily compiled, without having to think about the MEWTOCOL–COM.

7.2.2 Connection Example with External Device (1:1 communication with programmable display "GT10")

Outline

A 1:1 computer link with a programmable display panel (GT10) connects the FPΣ and a programmable display, using an RS232C cable. Communication is carried out by the PLC sending responses to commands from the programmable display side.
No program is required for communication. Operation can be carried out using the programmable display, simply by setting the mutual communications settings.

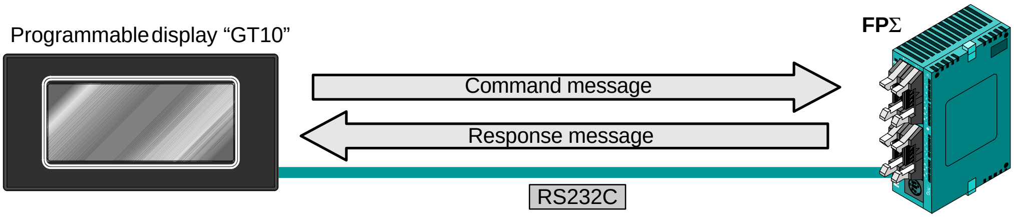


Figure 152: FPΣ Computer link – connection example (GT10)

Communication cassette used for 1:1 communication

The following types of communication cassettes can be used for 1:1 computer link communication.

Name	Description	Part No.
FPΣ Communication cassette 1–channel RS232C type	This communication cassette is a 1–channel unit with a five–wire RS232C port. It supports 1:1 computer links and general–purpose serial communication. RS/CS control is possible.	FPG–COM1
FPΣ Communication cassette 2–channel RS232C type	This communication cassette is a 2–channel unit with a three–wire RS232C port. It supports 1:1 computer links and general–purpose serial communication. Communication with two external devices is possible.	FPG–COM2

Setting of system register

To carry out 1:1 communication using a computer link, the system registers should be set as shown below.

Communication format setting for FPΣ side

• Settings when using the COM. 1 port

No.	Name	Set value
No. 410	Unit No. for COM.1 port	1
No. 412	Communication mode for COM.1 port	Computer link
No. 413	Communication format for COM.1 port	Character bit: . . . . . 8 bits Parity check: . . . . . Odd Stop bit: . . . . 1 bit Terminator: . . . . CR Header: . . . . STX not exist
No. 415	Baud rate setting for COM.1 port	19200 bits/s

• Settings when using the COM. 2 port

No.	Name	Set value
No. 411	Unit No. for COM.2 port	1
No. 412	Communication mode for COM.2 port	Computer link
No. 414	Communication format for COM.2 port	Character bit: . . . . . 8 bits Parity check: . . . . . Odd Stop bit: . . . . 1 bit Terminator: . . . . CR Header: . . . . STX not exist
No. 415	Baud rate setting for COM.2 port	19200 bits/s

Notes

The communication format and baud rate (communication speed) should be set to match the connected programmable display.

For information on setting the system registers to use a computer link, please refer to page 7 - 10.

Communication format setting for GT10

When the GT10 is shipped from the factory, the communication format settings are as shown below. “GT Configuration” settings should be changed to match the application at hand.

Item	Description
Baud rate	19200 bits/s
Data length	8 bits
Stop bit	1 bit (fixed)
Parity bit	Odd

☛ next page

Communication condition settings are specified using the parameter settings for the GT10 and the “GT Configuration” item in the GTWIN screen creation tool. For detailed information, please see the technical manual for the GT10.

GTWIN GT Configuration settings “Communication Parameters” screen

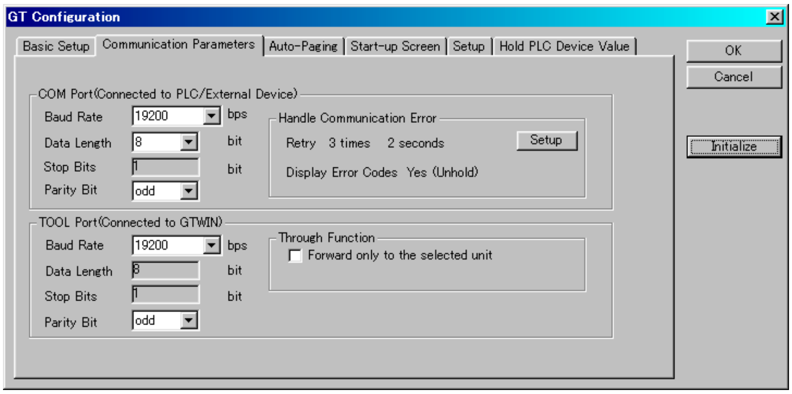


Figure 153: GTWIN GT Configuration setting screen (communication prameters)

Connection example with programmable display “GT10”

When using the 1–channel RS232C type of communication cassette

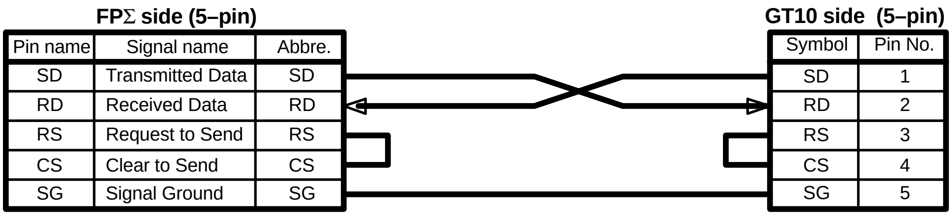


Figure 154: FPΣ Computer link – connection example 1 (GT10)

When using the 2–channel RS232C type of communication cassette

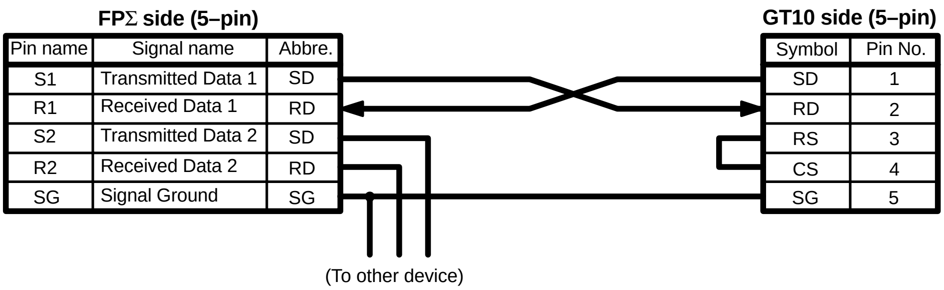


Figure 155: FPΣ Computer link – connection example 2 (GT10)

Basic communication area setting for GT10

To carry out communication with a PLC, the “Basic Communication Area” setting for the internal device area in the PLC reserved by the GT10 in advance should be specified in the GT10 configuration settings.

When the GT10 is shipped from the factory, the basic communication area is set as shown below. “GT Configuration” settings should be changed to match the application at hand.

Item	Description
Word area	DT0 to DT2
Bit area	WR0 to WR2

The basic communication area is changed using the parameter settings for the GT10 and the “GT Configuration” item in the GTWIN screen creation tool. For detailed information, please see the technical manual for the GT10.

GTWIN GT Configuration settings “Basic Setup” screen

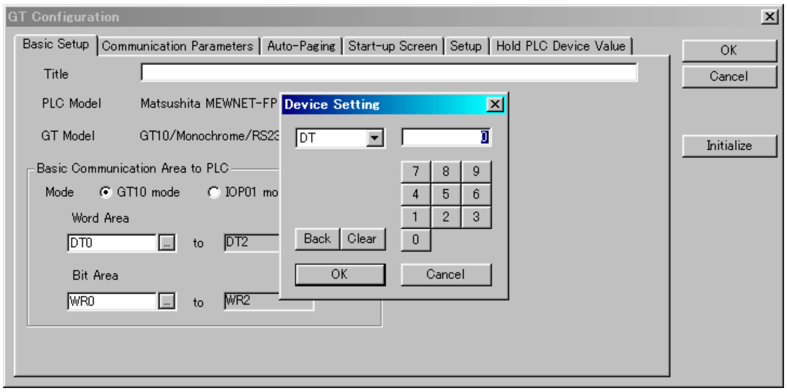


Figure 156: GTWIN GT Configuration setting screen (basic setup)

7.3 Computer Link (1:N communication)

This section contains the 1:N communication of computer link.

7.3.1 Overview of 1:N Communication

For a 1:N computer link, the computer and the FPΣ are connected through a C–NET adapter, and the respective PLCs are wired using an RS485 cable.
Communication is carried out by the command specifying the unit number being sent from the computer side, and the PLC with that unit number sending a response back to the computer.

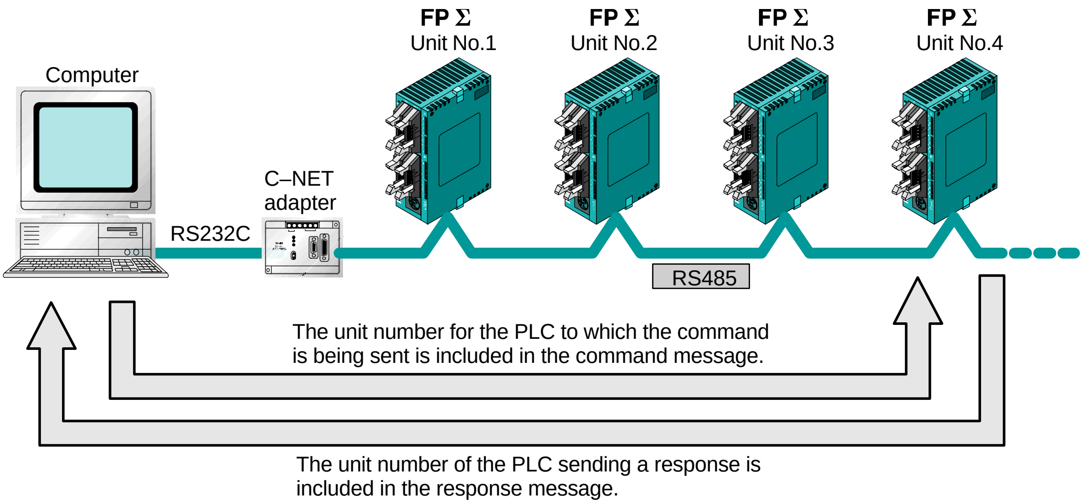


Figure 157: FPΣ Overview of compute link function (1:N communication)

Tip

If the FPΣ is used in combination with a communication cassette (the 1–channel RS485 type), no C–NET adapter is necessary on the PLC side.

7.3.2 Communication Cassette Used for 1:N Communication

The following types of communication cassettes can be used for 1:N communication with a computer link.

Name	Description	Part No.
FPΣ Communication cassette 1–channel RS485 type	This communication cassette is a 1–channel unit with a two–wire RS485 port. It supports 1:N computer links (C–NET), general–purpose serial communication, and a PLC link.	FPG–COM3

7.3.3 Settings of System Register and Unit No.

Setting of system register

To carry out 1:N communication with a computer link, the system registers should be set as shown below.

COM. 1 port settings

No.	Name	Set value
No.410	Unit No. for COM.1 port	1 to 32 (Set the desired unit No.)
No.412	Communication mode for COM.1 port	Computer Link
No.413	Communication format for COM.1 port	Character bit: . . . . 8 bits Parity check: . . . . . Odd Stop bit: . . . . 1 bit Terminator: . . . . CR Header: . . . . STX not exist
No.415	Baud rate setting for COM.1 port	9600 bits/s

Note

The communication format and baud rate (communication speed) should be set to match the connected computer.

Setting of unit No. (station number)

The "Unit No." parameter for each of the communication ports is set to "1" in the system register default settings. There is no need to change this if 1:1 communication is being used, but if 1:N communication is being used to connect multiple PLCs to transmission line, such as in a C–NET, the "Unit No." must be specified so that the system can identify the unit targeted for communication.

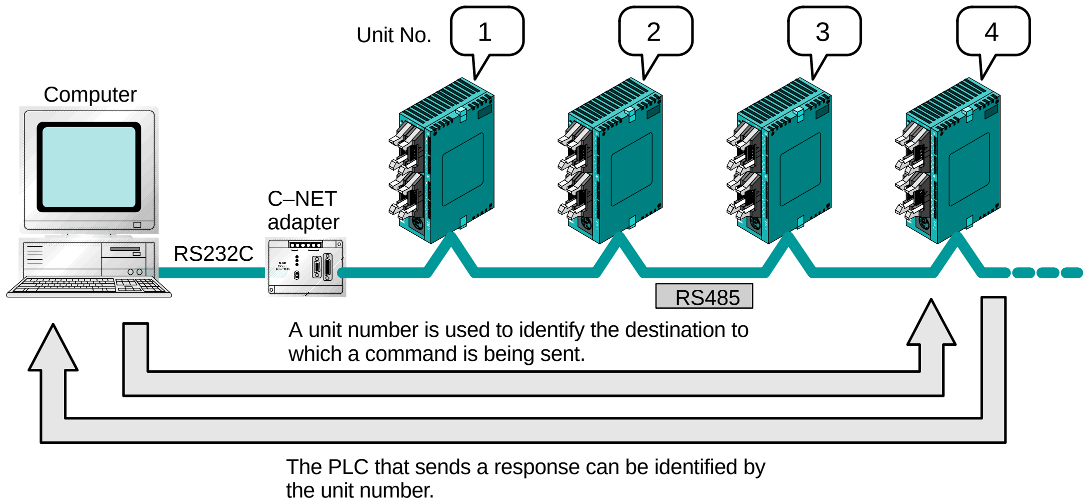


Figure 158: FPΣ Computer link – setting of unit No. (station No.)

Setting method

The unit number is specified using the unit number setting switch on the side of the FPΣ control unit, or the system register settings. Setting the unit number setting switch to “0” makes the system register setting valid

To set unit numbers with the FPWIN GR, select “PLC Configuration” under “Option” on the menu bar, and then click on the “COM. Port” tab. There are two settings, one for the COM.1 port and one for the COM.2 port.

PLC Configuration setting dialog box

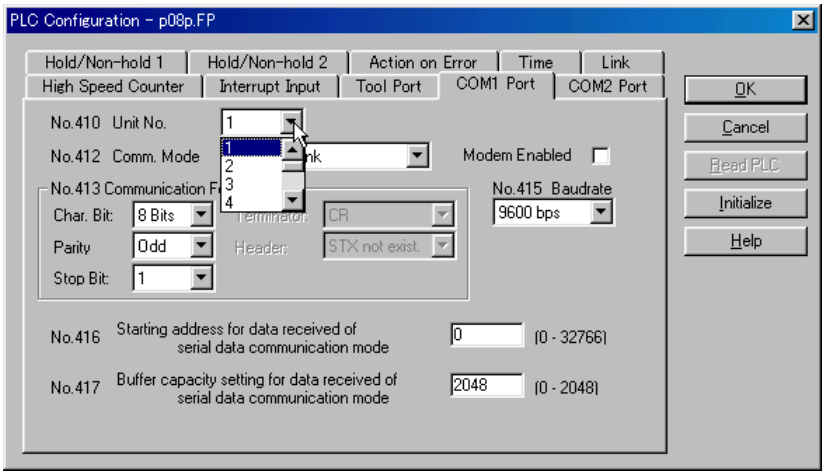


Figure 159: FPWIN GR PLC Configuration setting dialog box

No. 410 (for COM.1 port), No.411 (for COM.2 port) Unit No. Setting

Click on the ▼ button, and select a unit number from among the numbers 1 to 32 displayed on the pull–down menu.

Unit No. setting using unit (station) No. setting switch

The unit number setting switch is located inside the cover on the left side of the FPΣ control unit. The selector switch and the dial can be used in combination to set a unit number between 1 and 31.

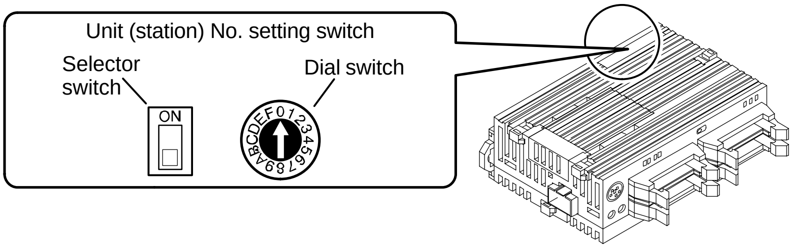


Figure 160: FPΣ Computer link – unit (station) No. setting

Relationship between unit number setting switch and unit numbers

Dial switch position	Unit No.	
	Selector switch: off	**Selector switch: on**
0	—	16
1	1	17
2	2	18
3	3	19
4	4	20
5	5	21
6	6	22
7	7	23
8	8	24
9	9	25
A	10	26
B	11	27
C	12	28
D	13	29
E	14	30
F	15	31

– The range of numbers that can be set using the unit number setting switch is from 1 to 31.

– Setting the unit number setting switch to “0” makes the system register setting valid, so that a unit number between 1 and 31 can be set.

Tip

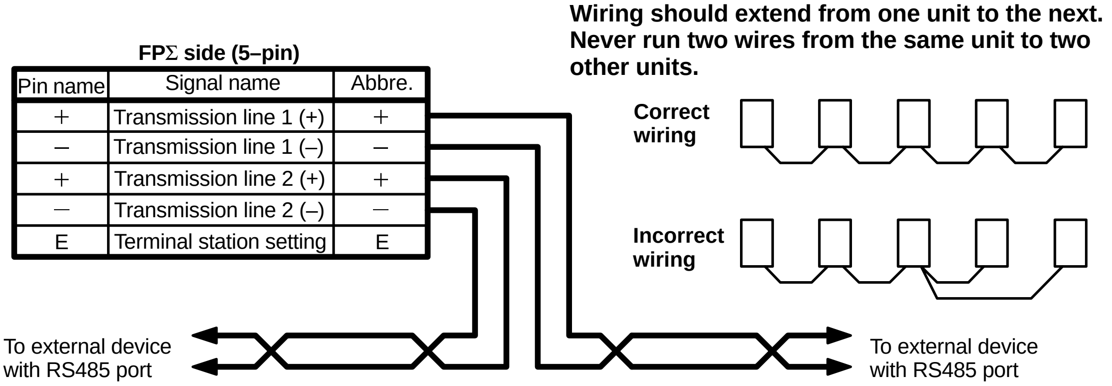
Unit numbers set using the unit number setting switch are valid only for the communication port of the communication cassette. Tool port unit numbers should be set using the system registers.

Note

To make the unit number setting in the FPWIN GR valid, set the unit number setting switch to “0”.

7.3.4 Connection with External Device

Connection diagram



Pin name	Signal name	Abbre.
+	Transmission line 1 (+)	+
–	Transmission line 1 (–)	–
+	Transmission line 2 (+)	+
–	Transmission line 2 (–)	–
E	Terminal station setting	E

Figure 161: FPΣ Computer link – connection diagram

With 1 : N communication, the various RS485 devices are connected using twisted pair cables. The (+) and (–) signals of transmission line 1 and transmission line 2 are connected inside the communication cassette, and either port may be used as COM.1 port.

Setting of terminal station

In the PLC that serves as the final unit (terminal station), the transmission line (–) and the E terminal should be shorted.

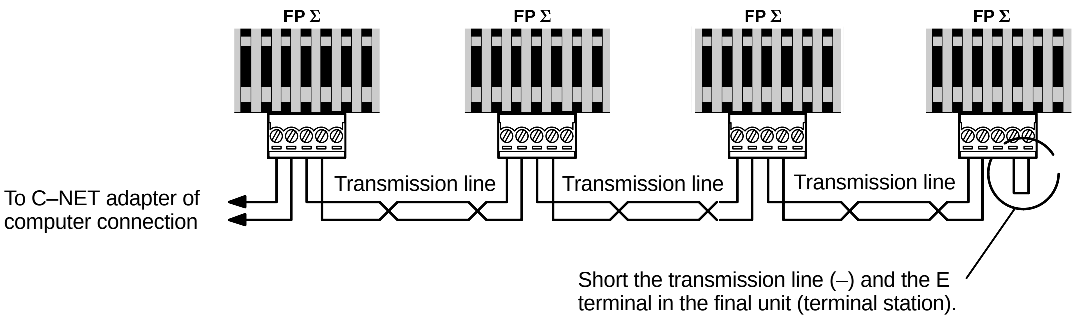


Figure 162: FPΣ Computer link – terminal station setting

Chapter 8

Communication Function 2
General–purpose Serial Communication

8.1 General–purpose Serial Communication

This section contains overview of general–purpose serial communication.

8.1.1 Overview of Function

What is the general–purpose serial communication?

Using the COM. ports, it sends and receives data to and from an external device such as an image processing unit or a bar code reader.
Data is read and written using the FPΣ ladder program, and data is read from and written to an external device connected to the COM. port by means of the FPΣ data registers.

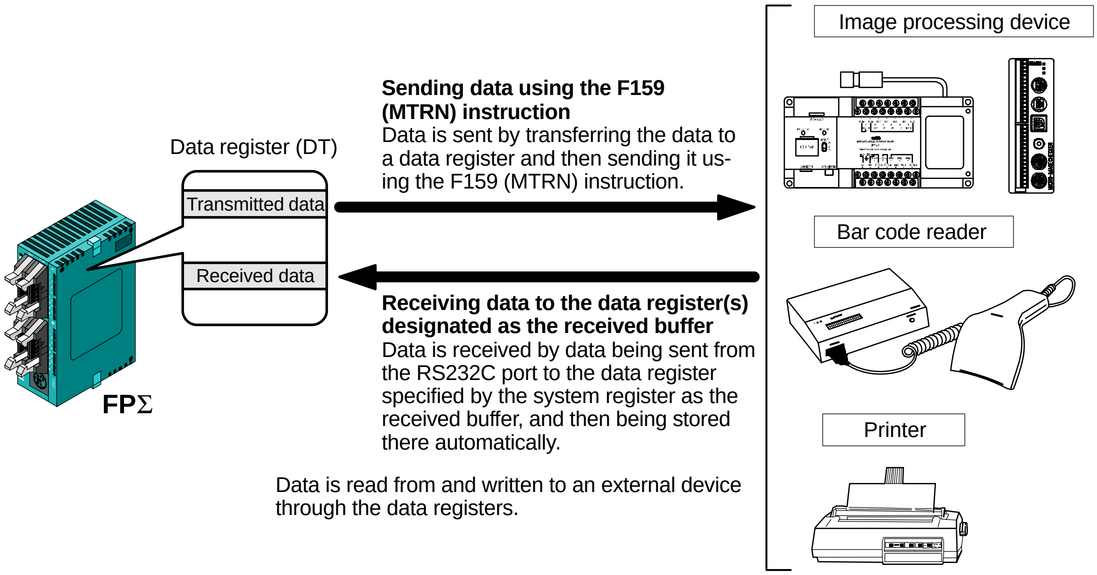


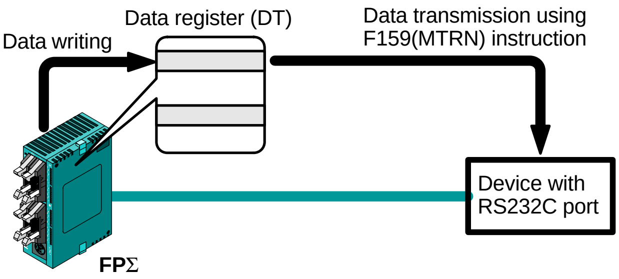
Figure 163: FPΣ General–purpose Serial Communication (overview)

Outline of operation

To send data to and receive it from an external device using the general–purpose serial communication function, the “Data transmission” and “Data reception” functions described below are used. The F159 (MTRN) instruction and the “Reception done” flag are used in these operations, to transfer data between the FPΣ and an external device.

Data transmission

Data to be output is stored in the data register used as the transmission buffer (DT), and when the F159 (MTRN) instruction is executed, the data is output from the COM. port.



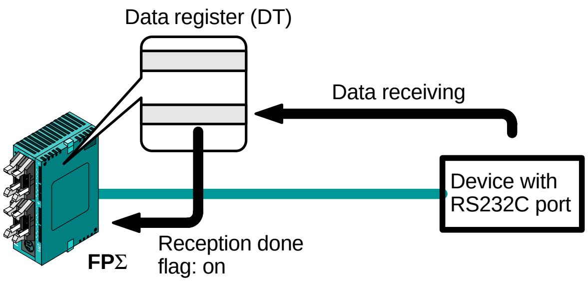
The end code specified by the system register is automatically added to the data that has been sent.

The maximum volume of data that can be sent is 2,048 bytes.

Figure 164: FPΣ Data transmission

Data reception

Input data from the COM. port is stored in the received buffer specified by the system register, and the “Reception done” flag goes on. Data can be received whenever the “Reception done” flag is off.



When data is received, the “Reception done” flag is controlled by the F159 (MTRN) instruction.

No end code is included in the stored data.

The maximum volume of data that can be received is 4,096 bytes.

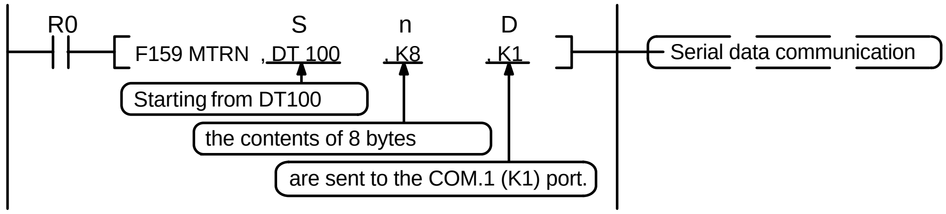
Figure 165: FPΣ Data reception

8.1.2 Program of General–purpose Serial Communication

The F159 (MTRN) instruction is used to send and receive data using the COM. port. The F159 (MTRN) instruction is used only with the FPΣ, and is an updated version of the earlier F144 (TRNS) instruction that allows multiple communication ports to be accommodated. Please be aware that the earlier F144 (TRNS) instruction cannot be used with the FPΣ.

F159 (MTRN) instruction

Data is sent to and received from an external device through the specified COM. port.



Devices that can be specified for S .... Only data registers (DT) can be specified as the transmission buffer.

Devices that can be specified by n .... WX, WY, WR, WL, SV, EV, DT, LD, I (I0 to ID), K, H

Devices that can be specified by D .... Only the K constants (only K1 and K2)

Figure 166: FPΣ F159 (MTRN) instruction (program)

Transmission of data

The amount of data specified by “n” is sent to the external device from among the data stored in the data table starting with the area specified by “S”, through the COM. port specified by “D”. Data can be sent with the start code and end code automatically attached. A maximum of 2,048 bytes can be sent. When the above program is run, the eight bytes of data contained in DT101 to DT104, stored in the transmission buffer starting from DT100, are sent from the COM. port 1.

Reception of data

Reception of data is controlled by turning the “Reception done” R9038 or R9048 flag on and off. The received data is stored in the received buffer specified by the system register. Data can be received when the F159 (MTRN) instruction turns the “Reception done” flag R9038 or R9048 off.

8.1.3 Communication Parameter Settings when Using General–purpose Serial Communications

Setting of baud rate and communication format

In the default settings, the COM. port is set to the computer link mode. When communication is carried out, system register settings should be entered for the following items.

Settings for the COM. port baud rate and transmission format are entered using the FPWIN GR programming tool. Select “PLC Configuration” under “Option (O)” on the menu bar, and click on the “COM. 1 & 2 Port” tab. There are separate settings for the COM.1 and COM.2 ports.

PLC Configuration setting dialog box

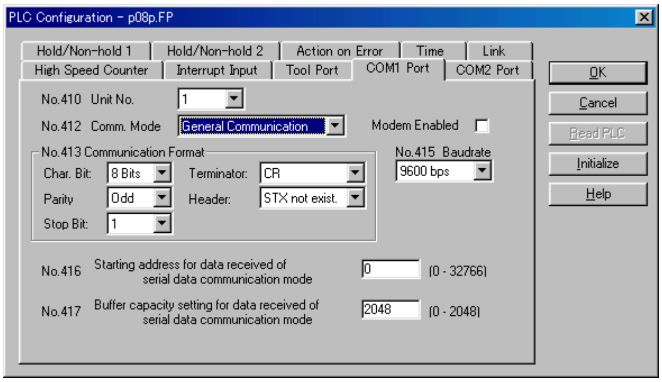


Figure 167: FPWIN GR PLC Configuration setting dialog box

No. 412 Communication mode

Select the COM. port operation mode.

Click on the  button, and select “General Communication” from the displayed pull–down menu.

No. 413 (for COM.1 port), No. 414 (for COM.2 port) Communication format setting

The default settings for the communication format are as shown at the right.
To change the communication format to match the external device connected to the COM. port, enter the appropriate settings for the various items.

Character Bit . . . 8 Bits
Parity . . . . Odd
Stop bit 1
Terminator . . . . . CR
Header . . . . STX not exist

No. 415 Baud rate setting

The default setting for the baud rates for the ports is “9600 bit/s”. Set the baud rate to match the external device connected to the COM. port.

Click on the ▼ button, and select one of the values from “2400 bit/s, 4800 bit/s, 9600 bit/s, 19200 bit/s, 38400 bit/s, 57600 bit/s, 115200 bit/s” on the displayed pull–down menu.

No. 416 (for COM.1 port), No. 418 (for COM.2 port)
Starting address for data received
No. 417 (for COM.1 port), No. 419 (for COM.2 port)
Buffer capacity setting for data received

To use general–purpose serial communication, the received buffer must be specified. In the default setting, the entire data register area is specified for use as the received buffer. To change the data register area used as the received buffer, specify the starting area using system register No. 416 (No. 418 for the COM. port 2) and the volume (number of words) using No. 417 (No. 419 for the COM. port 2). The received buffer layout is as shown below.

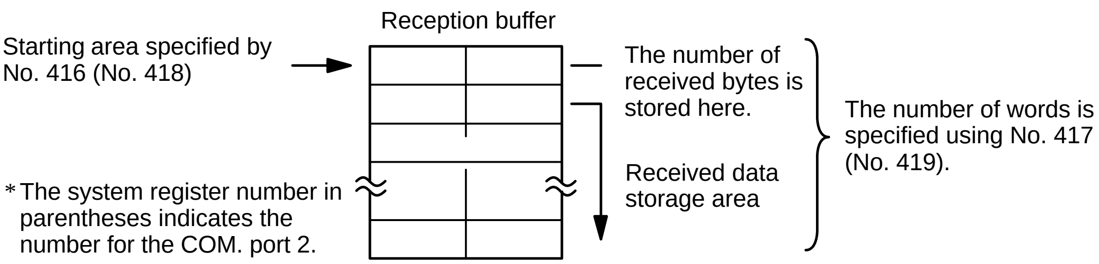


Figure 168: FPΣ Reception buffer

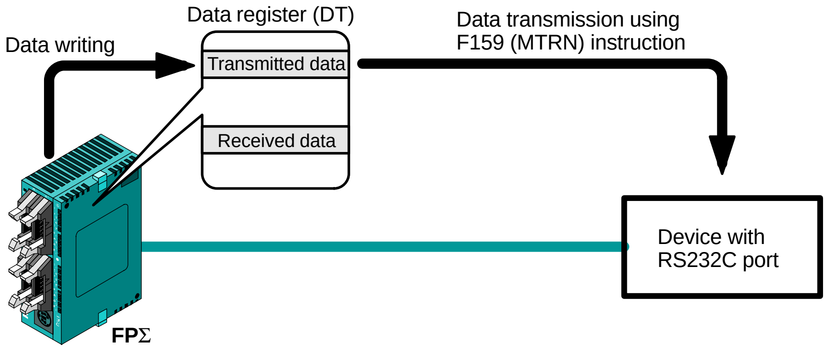
8.2 Overview of Communication with External Devices

This section contains overview of communication “data transmission” and “data reception” with external devices.

Communication with external device is handled through the data register.

8.2.1 Data Transmission to External Device

Overview of data transmission



Data to be output is stored in the data register used as the transmission buffer (DT), and when the F159 (MTRN) instruction is executed, the data is output from the COM. port.

Figure 169: FPΣ Overview of data transmission

Data table for transmission (transmission buffer)

DT100	K8		← When transmission begins: K8 When transmission ends: K0
DT101	H42(B)	H41(A)	Data is transmitted in order from the low order byte.
DT102	H44(D)	H43(C)	
DT103	H46(F)	H45(E)	
DT104	H48(H)	H47(G)	

Data table before transmission

Figure 170: FPΣ Data table for transmission (transmission buffer)

Sample program for data transmission

This program transmits the character “ABCDEFGH” to external device using COM.1 port.

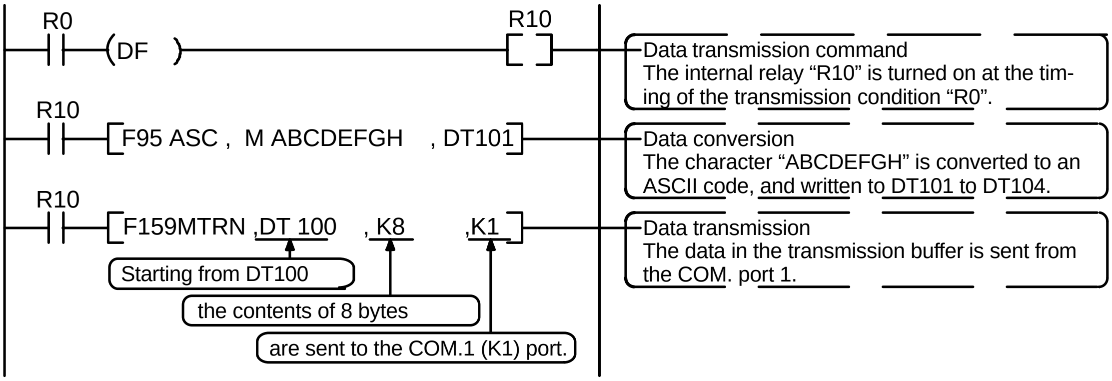


Figure 171: FPΣ Sample program for data transmission

The program described above is executed in the following sequence.

① “ABCDEFGH” is converted to an ASCII code and stored in a data register.

② That data is sent from the COM. port 1 using the F159 (MTRN) instruction.

Explanatory diagram

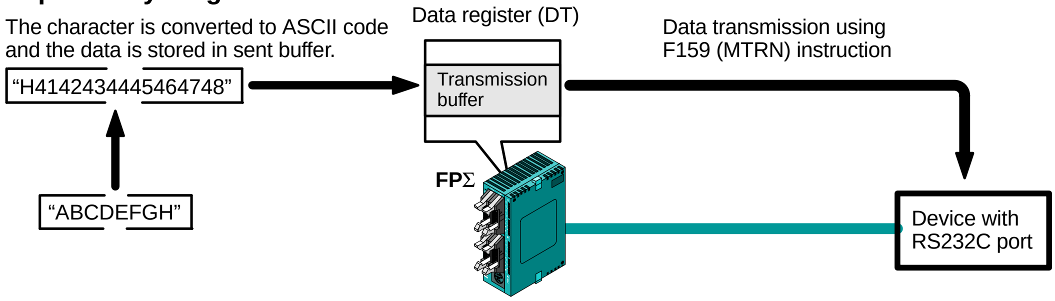


Figure 172: FPΣ Data transmission explanatory diagram

Explanation of data table

This is used as a data table for transmission, starting at the data register specified in “S”.

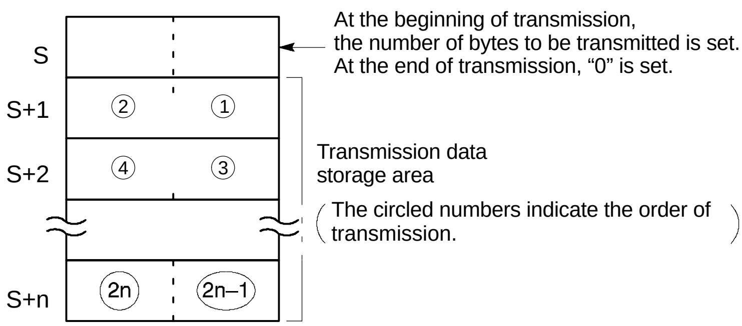


Figure 173: FPΣ Data table for transmission

Use an F0(MV) or F95(ASC) instruction to write the data to be transmitted to the transmission data storage area specified in “S”.

Explanation during transmission

This is used as a data table for transmission, starting at the data register specified in "S".

When the execution condition of the **F159(MTRN)** instruction turns on, operation is as follows when the transmission done flag "R9039/R9049" is on:

1. "n" is preset in "S". The reception done flag "R9038/R9048" is turned off, and the reception data number is cleared to "0".
2. The set data is transmitted in order from the lower–order byte in "S+1" of the table.
   - During transmission, the transmission done flag "R9039/R9049" turns off.
   - If system register 413 or 414 is set to header (start code) with STX, the header (start code) is automatically added to the beginning of the data.
   - The terminator (end code) specified in system register 413 or 414 is automatically added to the end of the data.

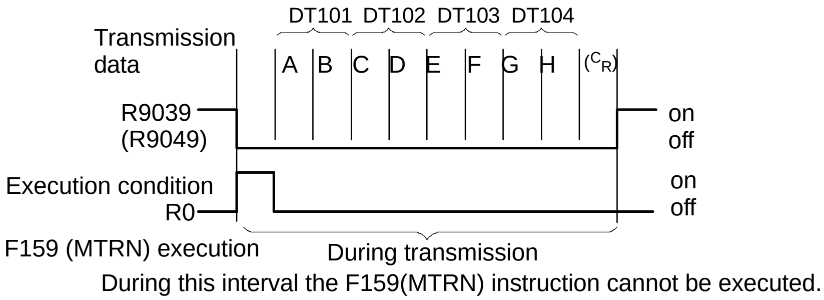


Figure 174: Explanation during transmission

3. When all of the specified quantity of data has been transmitted, the "S" value is cleared to "0" and the transmission done flag "R9039/R9049" turns on.

When you do not wish to add the terminator (end code) during transmissions, use one of the following methods:

Specify the number of bytes to be transmitted using a negative number.
If you also do not wish to add an end code to receptions, set system register 413 or 414 to Terminator "None".

Example:

Program for transmitting 8 bytes of data without adding the terminator (end code)

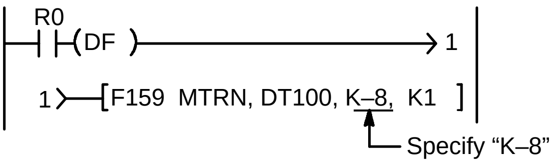


Figure 175: FPΣ Data transmission sample program

Tip

- Do not include the terminator (end code) in the transmission data. The terminator (end code) is added automatically.
- When “STX exist” is specified for the header (start code) in system register 413 or 414, do not add the header (start code) to the transmission data. The header (start code) is added automatically.
- When using the 1–ch RS232C type communication cassette, transmission does not take place until CS (Clear to Send) turns on. If you are not going to connect to the other device, connect to RS (Request to Send).
- The maximum number of transmission bytes “n” is 2048.
- Contact numbers in parentheses indicate COM. port 2 contacts.

8.2.2 Receiving Data from External Device

Overview of data reception

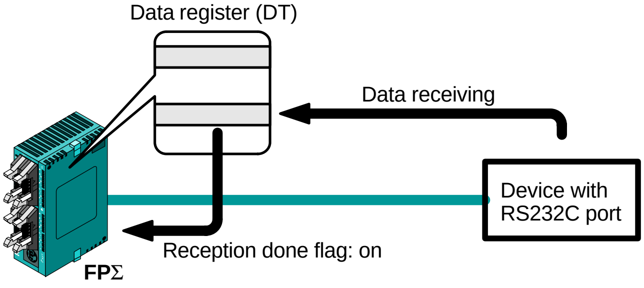


Figure 176: FPΣ Data reception

Data input from the COM. port is stored in the received buffer specified by the system register, and the “Reception done” flag goes on.
If the “Reception done” flag is off, data can be received at any time.

Sample program for data reception

Data “10 byte” received in the received buffer through the COM.1 port is read to DT0.

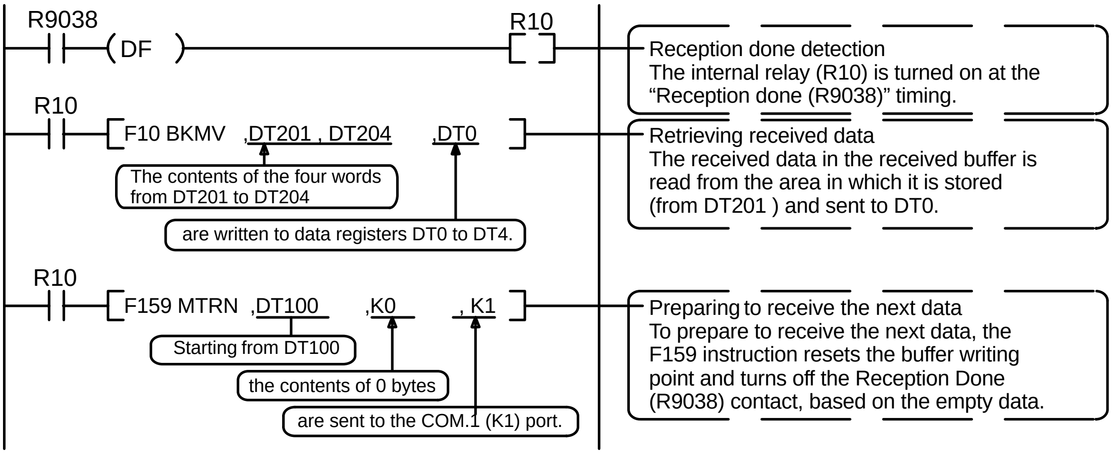


Figure 177: FPΣ Sample program for data reception

The program described above is executed in the following sequence.

1. Data is received from the RS232C device to the received buffer.
2. The “Reception done R9038 (R9048) contact” is turned on.
3. The received data is sent from the received buffer to the area starting with the data register DT0.
4. The F159 (MTRN) instruction based on the empty data is executed, which resets the buffer writing point and turns off the Reception Done (R9038 (R9048) contact.
   The system is then ready to receive the next data.

Explanatory diagram

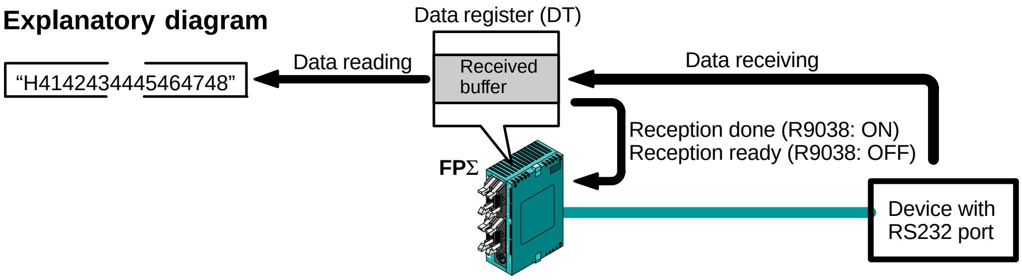
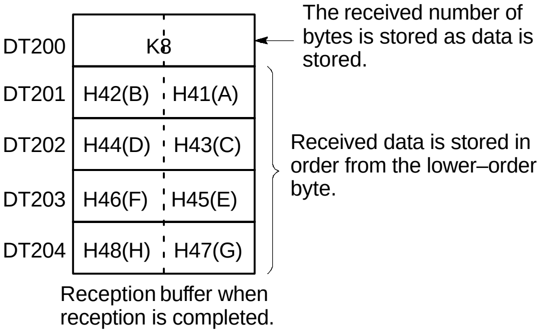


Figure 178: FPΣ Data reception explanatory diagram

Data table for reception (received buffer)

This shows the status of the data table when the above program is run.



DT200 to DT204 are used as the reception buffer. System register settings are as follows:

– System register 416: K200

– System register 417: K5

Figure 179: FPΣ Data table for reception (received buffer)

Explanation of data table

Data sent from an external device connected to the RS232C port is stored in the data registers that have been set as the reception buffer.

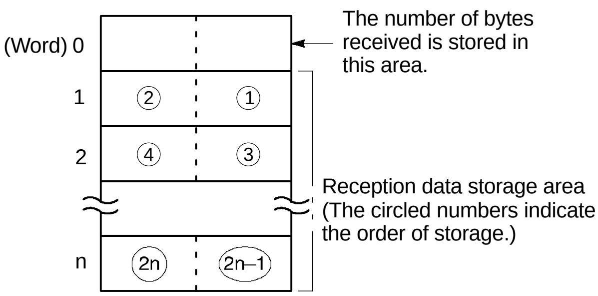


Figure 180: FPΣ Data table for reception

Data registers are used for the reception buffer. Specify the data registers in system registers 416 to 419.The number of bytes of data received is stored in the starting address of the reception buffer. The initial value is "0". Received data is stored in the received data storage area in order from the lower–order byte.

Explanation during reception

When the reception done flag R9038(R9048) is off, operation takes place as follows when data is sent from an external device. (The R9038(R9048) is off during the first scan after RUN).

1) Incoming data is stored in order from the lower–order byte of the 2nd–word area of the reception buffer.

Header and terminator (Start and end codes) are not stored.

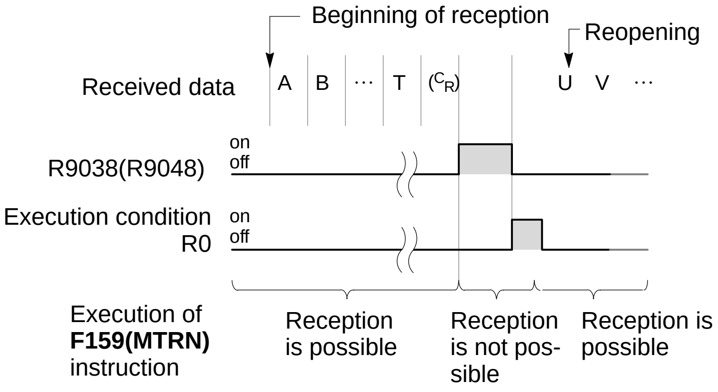


Figure 181: Explanation during reception

2) When the terminator (end code) is received, the reception done flag “R9038(R9048)” turns on. Reception of any further data is prohibited.

3) When an **F159(MTRN)** instruction is executed, the reception done flag “R9038(R9048)” turns off, the number of received bytes is cleared, and subsequent data is stored in order from the lower–order byte.

Tip

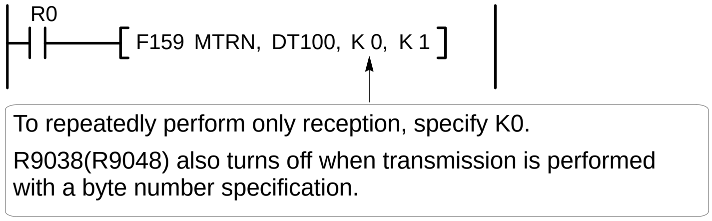
To perform repeated reception of data, refer to the following steps.

① Receive data
② Reception done (R9038/R9048: on, reception prohibited)
③ Process received data
④ Execute F159(MTRN) instruction (R9038/R9048: off, reception possible)
⑤ Receive subsequent data

Preparation of reception

The reception done flag “R9038(R9048)” turns on when data reception from the external device is completed. Reception of any further data is prohibited.

To receive subsequent data, you must execute an **F159(MTRN)** instruction to turn off the reception done flag “R9038(R9048)”.



8.3 Connection Example with External Devices

This section contains the connection example with external devices.

8.3.1 Connection Example with External Device (1:1 communication with Micro–Imagechecker)

Outline

The FPΣ and Micro–Imagechecker A200/A100 are connected using an RS232C cable, and the results of the scan are stored in the data registers of the FPΣ.

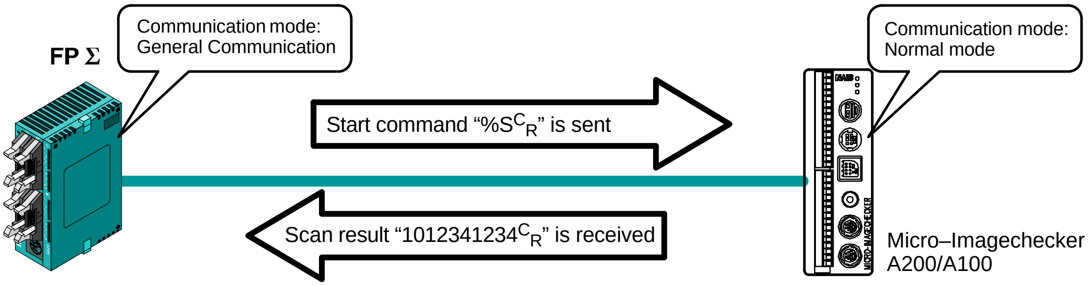


Figure 182: FPΣ Connection example with external device (micro–imagechecker)

When the scan start code "%S$^{C}_{R}$" is sent from the FPΣ side, the scan result is returned from the Micro–Imagechecker as the response.

Communication cassette used with 1:1 communication

The following types of communication cassettes can be used with 1 : 1 general–purpose serial communication.

Name	Description	Part No.
FPΣ Communication cassette 1–channel RS232C type	This communication cassette is a 1–channel unit with a five–wire RS232C port. It supports 1 : 1 computer links and general–purpose serial communication. RS/CS control is possible.	FPG–COM1
FPΣ Communication cassette 2–channel RS232C type	This communication cassette is a 2–channel unit with a three–wire RS232C port. It supports 1 : 1 computer links and general–purpose serial communication. Communication with two external devices is possible.	FPG–COM2

Setting of system register

In the default settings, the COM. port is set to the computer link mode. To carry out 1 :1 communication using general–purpose serial communication, the system registers should be set as shown below.

Communication format setting for FPΣ

• Settings when using the COM. port 1

No.	Name	Set value
No. 412	Communication mode	General communication
No. 413	Communication format	Character bit: . . . . . 8 bits Parity: . . . . Odd Stop bit: . . . . 1 bit Terminator: . . . . CR Header: . . . . STX not exist
No. 415	Baud rate	9600 bit/s
No. 416	Starting address for data received	DT200
No. 417	Buffer capacity setting for data received	100 byte

• Settings when using the COM. port 2

No.	Name	Set value
No. 412	Communication mode	General communication
No. 414	Communication format	Character bit: . . . . . 8 bits Parity: . . . . Odd Stop bit: . . . . 1 bit Terminator: . . . . CR Header: . . . . STX not exist
No. 415	Baud rate	9600 bit/s
No. 418	Starting address for data received	DT200
No. 419	Buffer capacity setting for data received	100 byte

Communication format setting for Micro–Imagechecker

To set the communication mode and transmission format settings for the Micro–Imagechecker, select “5: Communication” under “5: ENVIRONMENT”, and set the following items.

No.	Name	Set value
No. 51	Communication mode	Normal Mode
No. 52	RS232C	Baud rate (bps) . . . . . . 9600 Length . . . . 8 Stop bit . . . . 1 Parity . . . . Odd Flow Control . . . . None

Serial communication setting for Micro–Imagechecker

To enter settings relating to serial communication for the Micro–Imagechecker, select “53: Serial Output” under “5: Communication”, and set the following items.

No.	Name	Set value
No. 53	Serial Output	Output . . . . 5 Column Invalid Digit . . . . Repl. 0 Read End . . . . None Process End . . . . None Numerical Calculation . Output Judgment . . . . Output

Tip

– If “Del” is specified for the invalid processing parameter, zero suppression processing will be carried out on the output data, and the output format will be changed. Always make sure “Repl. 0” is specified.

– When outputting data to an external device, numerical calculation is required, so “Out” should be specified for the “Numerical calculation” parameter.

– When the above settings are specified, data with the contents shown below will be output from the Micro–Imagechecker.

1 0 1 2 3 4 5 CR

Terminator (End code)

Results of numerical calculation No.1

Judgment output No.2 0=NG

Judgment output No.1 1=OK

Connection example with Micro–Imagechecker “A200/A100”

• When using the RS232C 1–channel type of communication cassette

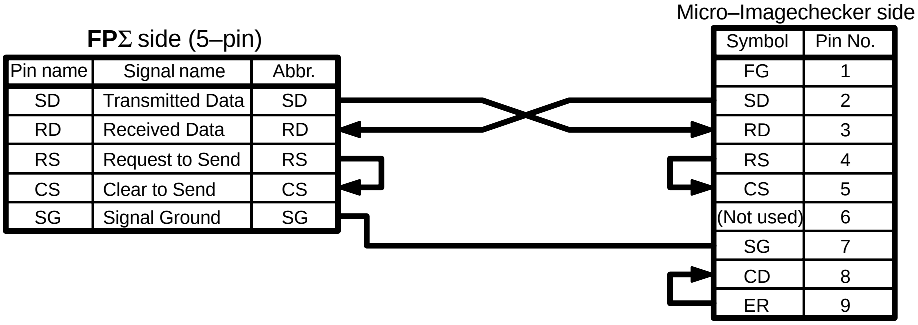


Figure 183: FPΣ Connection example with micro–imagechecker 1

• When using the RS232C 2–channel type of communication cassette

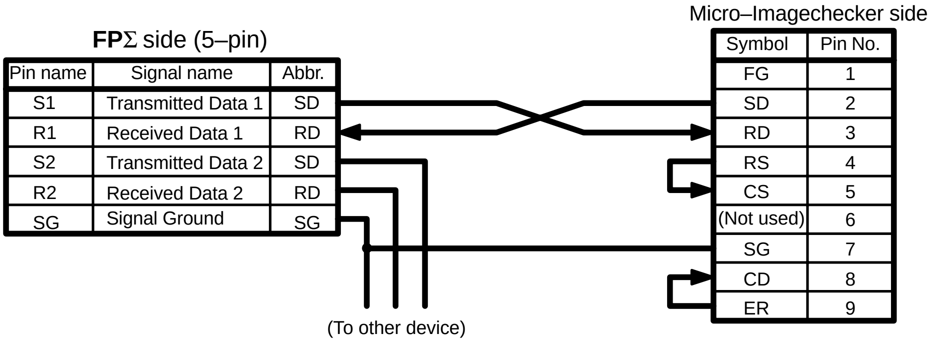


Figure 184: FPΣ Connection example with micro–imagechecker 2

Procedure of communication

In the following example, the Micro–Imagechecker is connected to the COM. 1 port.

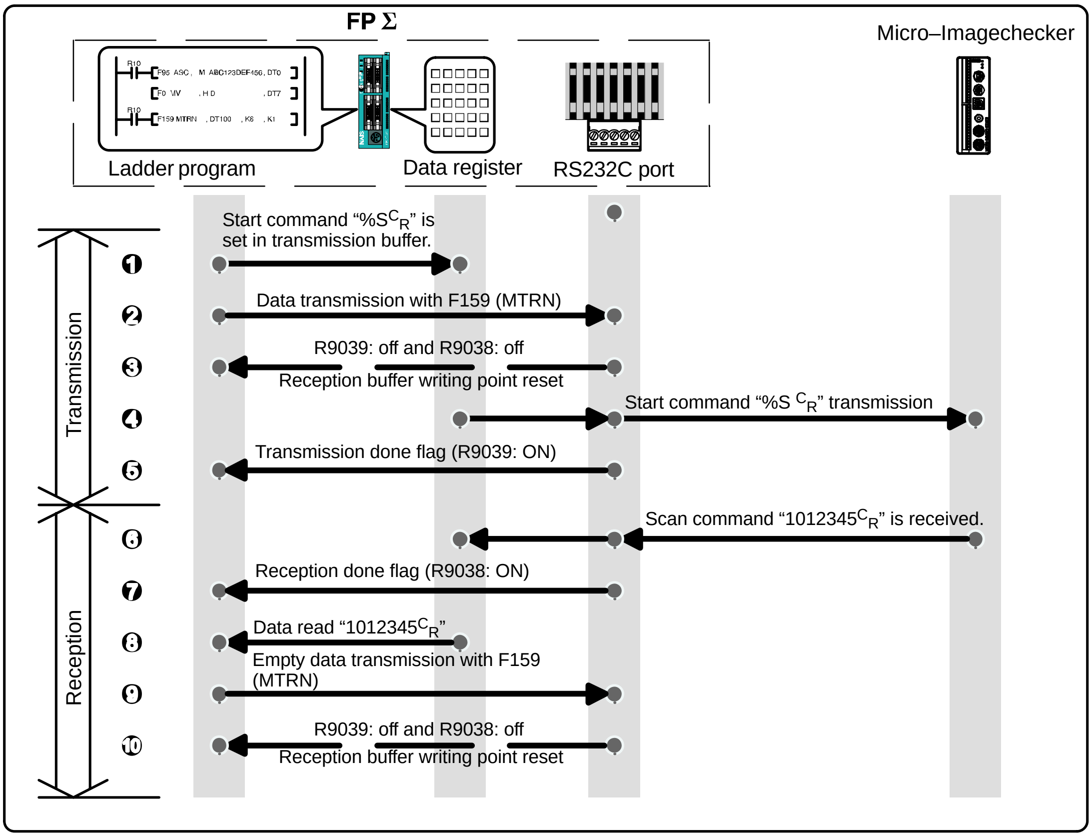


Figure 185: FPΣ Procedure of communication (micro–imagechecker)

Sample program

In the following example, the Micro–Imagechecker is connected to the COM. 1 port.

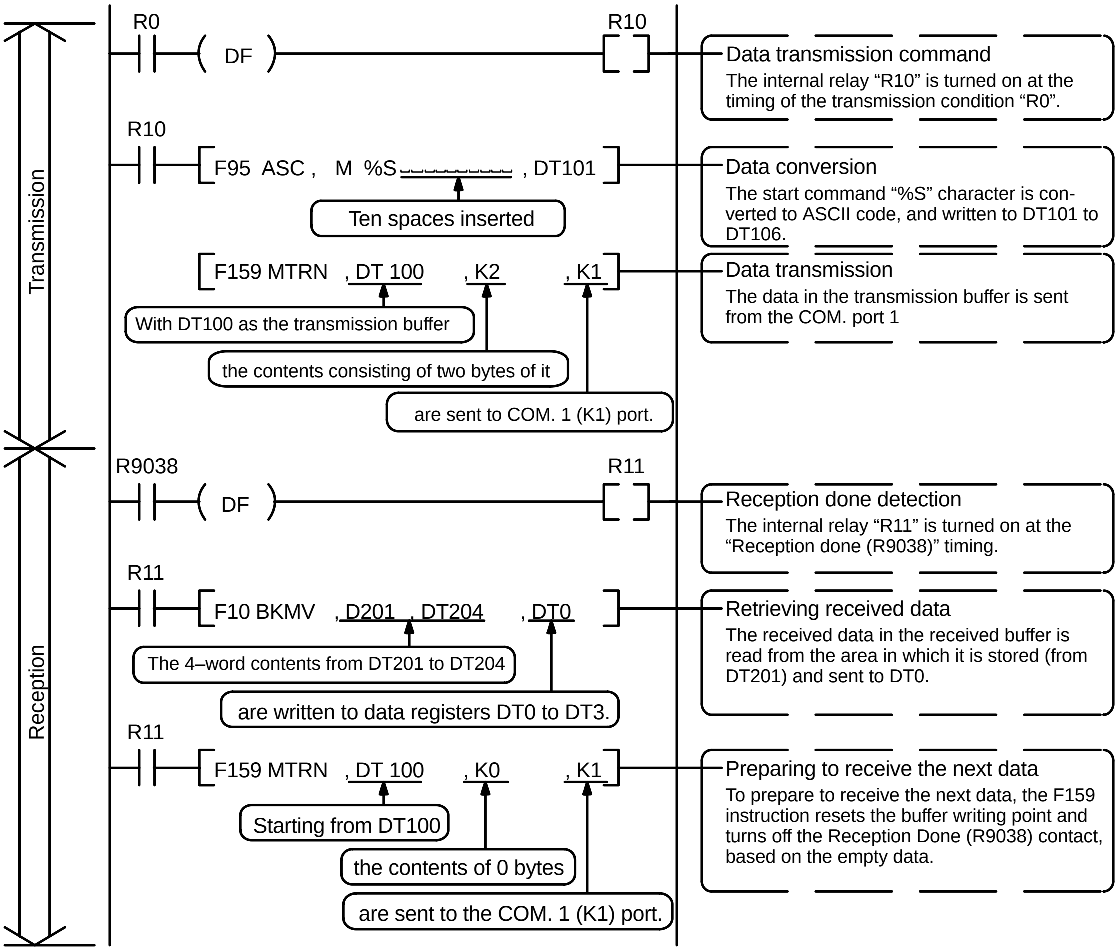


Figure 186: FPΣ Sample program (for micro–imagechecker)

The various buffer statuses

The following shows the statuses of the send and received buffers when the sample program is run.

Transmission buffer

DT100	K2	
DT101	H53 (S)	H25 (%)

← Number of bytes to be transmitted

(Condition before transmission)

Reception buffer

DT200	K7	
DT201	H30 (0)	H31 (1)
DT202	H32 (2)	H31 (1)
DT203	H34 (4)	H33 (3)
DT204		H35 (5)

← Received number of bytes

Received data is stored in order from the lower–order byte. (DT201 to DT204)

(Condition when reception is completed)

Figure 187: FPΣ Various buffer statuses

8.3.2 Connection Example with External Device (1:1 communication with FP series PLC)

Outline

Connect the FPΣ and the other FP series PLC using the RS232C interface, and carry out communication using the MEWTOCOL–COM communication protocol.

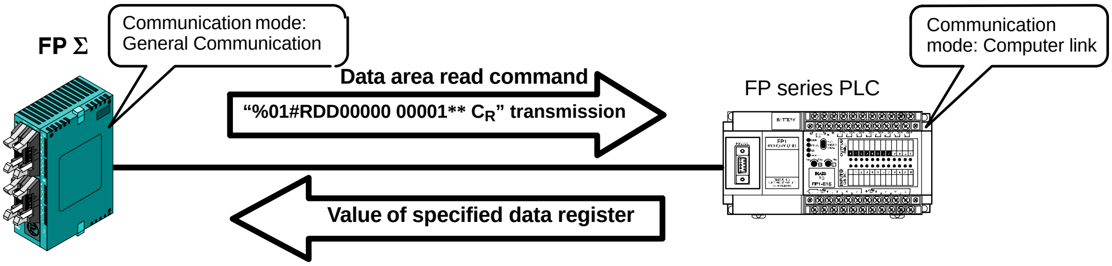


Figure 188: FPΣ Connection example with external device (FP series PLC)

When the data area read command "%01#RDD00000 00001** C_R" is sent from the FPΣ side, the values of the data register of the PLC connected to the system are sent as a response. For example, if the value K100 is stored in DT0 and the value K200 is stored in DT1 of the PLC, "%01$RD6400C8006F$C_R$" is sent as a response to the command. If there is an error, "%01! OO ** C_R" is returned (OO is the error code).

In addition to data area read and write commands, the MEWTOCOL–COM is also provided with contact area reading and writing, and many other commands.

When two FPΣ units are involved, data can easily be exchanged (shared) using the PLC link function that comes with the RS485 1–channel type communication cassette.

Communication cassette used with 1:1 communication

The following types of communication cassettes can be used with 1 : 1 general–purpose serial communication.

Name	Description	Part No.
FPΣ Communication cassette 1–channel RS232C type	This communication cassette is a 1–channel unit with a five–wire RS232C port. It supports 1 : 1 computer links and general–purpose serial communication. RS/CS control is possible.	FPG–COM1
FPΣ Communication cassette 2–channel RS232C type	This communication cassette is a 2–channel unit with a three–wire RS232C port. It supports 1 : 1 computer links and general–purpose serial communication. Communication with two external devices is possible.	FPG–COM2

Setting of system register

In the default settings, the COM. port is set to the computer link mode. To carry out 1 :1 communication using general–purpose serial communication, the system registers should be set as shown below.

Communication format setting for FPΣ

• Settings when using the COM. 1 port

No.	Name	Set value
No. 412	Communication mode	General communication
No. 413	Communication format	Character bit: . . . . . 8 bits Parity: . . . . Odd Stop bit: . . . . 1 bit Terminator: . . . . CR Header: . . . . STX not exist
No. 415	Baud rate setting	9600 bit/s
No. 416	Starting address for data received	DT200
No. 417	Buffer capacity setting for data received	100 byte

• Settings when using the COM. 2 port

No.	Name	Set value
No. 412	Communication mode	General communication
No. 414	Communication format	Character bit: . . . . . 8 bits Parity: . . . . Odd Stop bit: . . . . 1 bit Terminator: . . . . CR Header: . . . . STX not exist
No. 415	Baud rate setting	9600 bit/s
No. 418	Starting address for data received	DT200
No. 419	Buffer capacity setting for data received	100 byte

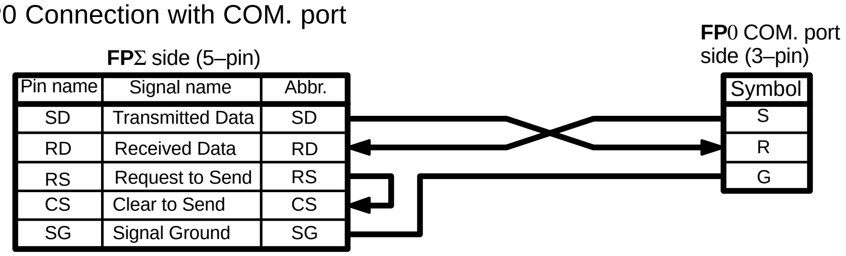
Communication format setting for FP series PLC (FP0, FP1)

No.	Name	Set value
No. 412	Communication mode for COM. port	Computer link
No. 413	Communication format for COM. port	Character bit: . . . . . 8 bits Parity: . . . . Odd Stop bit: . . . . 1 bit Terminator: . . . . CR Header: . . . . STX not exist
No. 414	Baud rate for COM. port	19200 bits/s

Connection example with FP series PLC (FP0, FP1)

• When using the RS232C 1–channel type of communication cassette

FP0 Connection with COM. port



FP1 Connection with COM. port

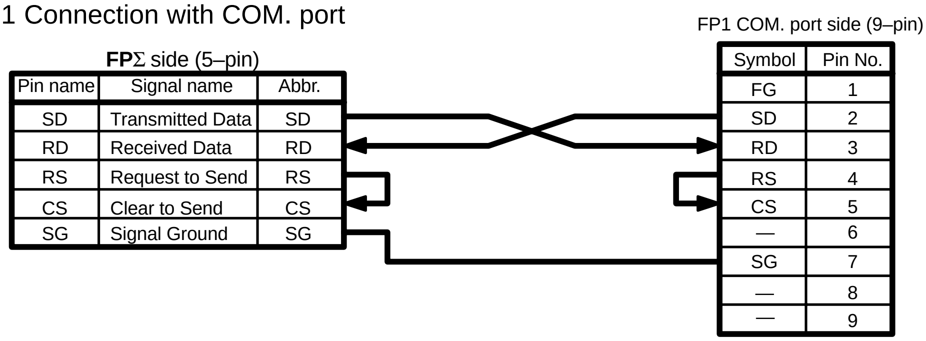
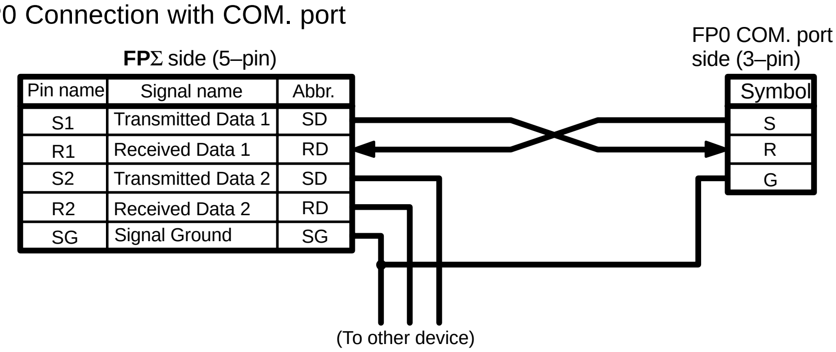


Figure 189: FPΣ Connection example with FP series PLC–1

• When using the RS232C 2–channel type of communication cassette

FP0 Connection with COM. port



FP0 Connection with COM. port

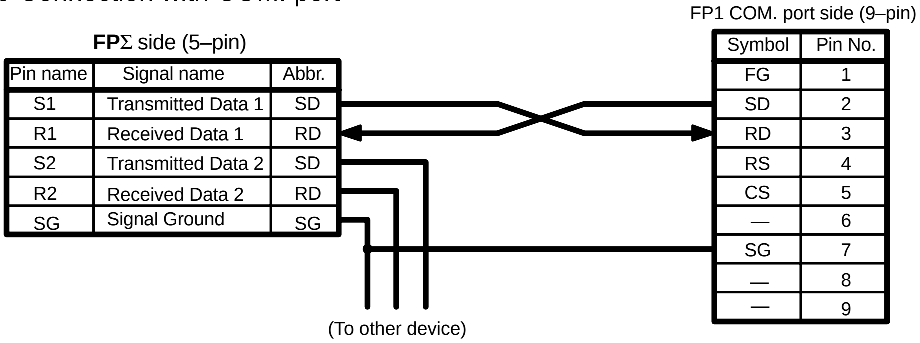


Figure 190: FPΣ Connection example with FP series PLC–2

Procedure of communication

In this example, an FP series PLC is connected to the COM. 1 port, and “K100” is being stored to DT0 of the PLC on the other end, and “K200” to DT1.

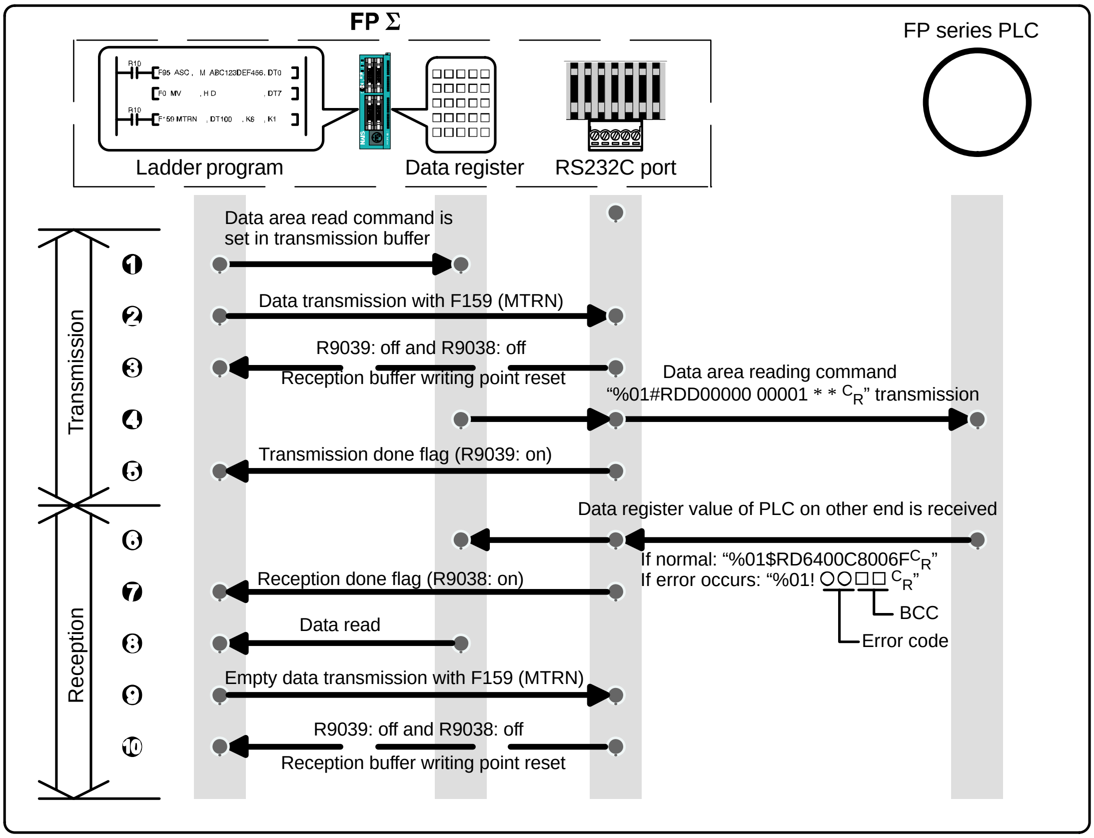


Figure 191: FPΣ Procedure of communication (FP series PLC)

Sample program

The following shows an example in which an FP series PLC is connected to the COM. 1 port.

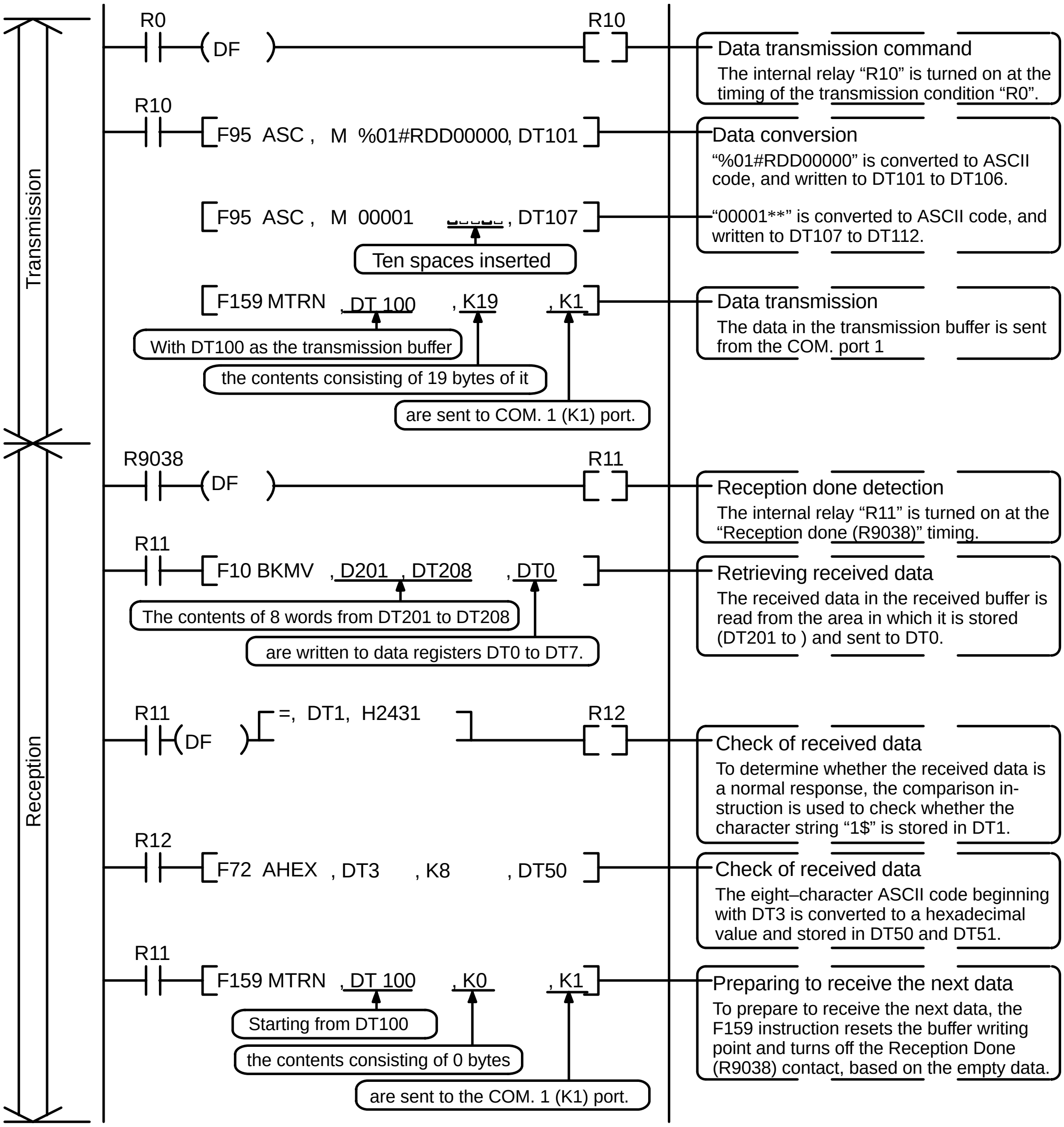


Figure 192: FPΣ Sample program (for FP series PLC)

The various buffer statuses

The following shows the statuses of the send and received buffers when the sample program is run.

Transmission buffer

DT100	K19	
DT101	H30 (0)	H25 (%)
DT102	H23 (#)	H31 (1)
DT103	H44 (D)	H52 (R)
DT104	H30 (0)	H44 (D)
DT105	H30 (0)	H30 (0)
DT106	H30 (0)	H30 (0)
DT107	H30 (0)	H30 (0)
DT108	H30 (0)	H30 (0)
DT109	H2A (*)	H31 (1)
DT110		H2A (*)

K19 ← Number of bytes to be transmitted

(Condition before transmission)

Reception buffer

DT200	K16	
DT201	H30 (0)	H31 (%)
DT202	H32 ($)	H31 (1)
DT203	H34 (D)	H33 (R)
DT204	H34 (4)	H36 (6)
DT205	H30 (0)	H30 (0)
DT206	H38 (8)	H43 (C)
DT207	H30 (0)	H30 (0)
DT208	H46 (F)	H36 (6)

K16 ← Received number of bytes

DT201–DT208: Received data is stored in order from the lower–order byte.

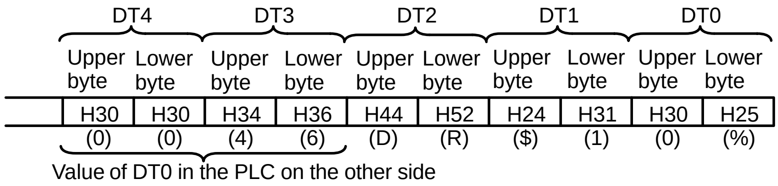
(Condition when reception is completed)

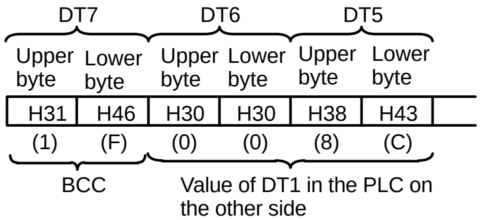
Figure 193: FPΣ Various buffer statuses

Tip

Contents of the response:

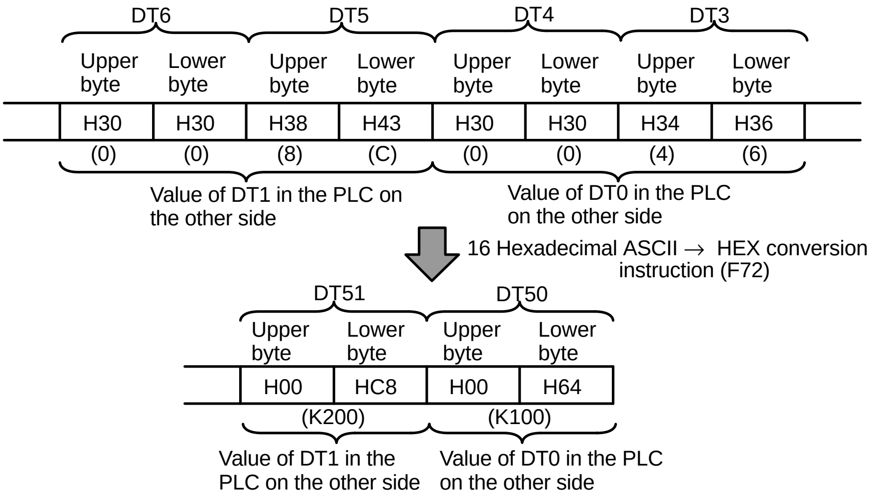
If K100 is stored in DT0 and K200 is stored in DT1 of the FP series PLC on the other side, "%01$RD6400C8006F$C_R$" is returned from the FP series PLC on the other side as the response when the program is executed. The received data is stored in the data registers as shown below.





Extracting the data register values from the PLC on the other side

In the program, the data segment of the response from the PLC on the other side is converted to hexadecimal data using the F72 (AHEX) (hexadecimal ASCII → HEX conversion) instruction and stored in DT50 and DT51, only if the character string "$1" stored in DT1 detected as a comparison instruction.



If an error occurs, "%01! ○○□□ C_R" is returned as the response. (○○ is the error code and □□ is the BCC.)

8.4 Data Transmitted and Received with the FPΣ

The following four points should be kept in mind when accessing data in the FPΣ transmission and received buffers.

- **Data in the transmission and received buffers, that is being sent and received, is in ASCII code.**
- **If the transmission format settings indicate that a start code will be used, the code STX (H02) will automatically be added at the beginning of the data being sent.**
- **An end code is automatically added to the end of the data being sent.**
- **There is no end code on the data stored in the received buffer.**

When sending data:

Data written to the transmission buffer will be sent just as it is.

Example: **When the data “12345” is transmitted as an ASCII code to a device with RS232C port.**

Data sent using the F95 (ASC) instruction should be converted to ASCII code data.

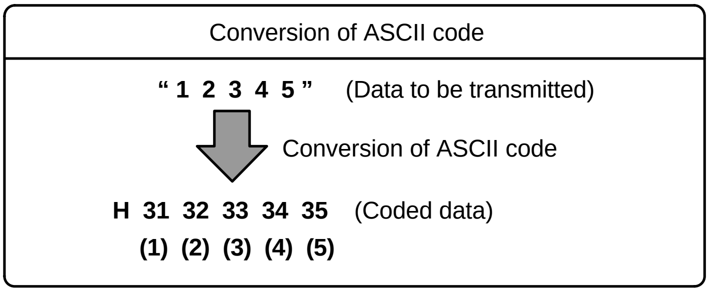


Figure 194: FPΣ Conversion of ASCII code

If DT100 is being used as the transmission buffer, data will be stored in sequential order in the data registers starting from the next register (DT101), in two–byte units consisting of the upper byte and lower byte.

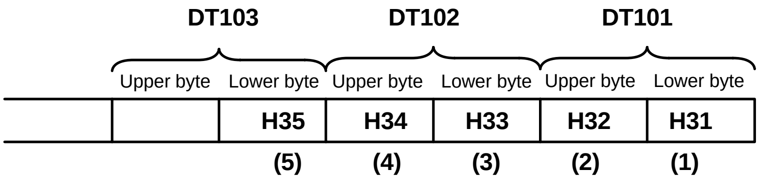


Figure 195: FPΣ Example (transmission buffer)

When receiving data:

The data of received area being read is ASCII code data.

Example: **When the data “12345$^{C}_{R}$” is transmitted from a device with RS232C port**

If DT200 is being used as the received buffer, received data will be stored in the registers starting from DT201, in sequential order of first the lower byte and then the upper byte.

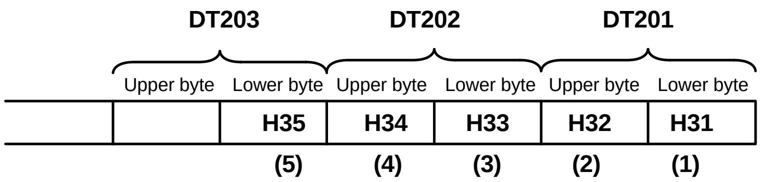


Figure 196: FPΣ Example (received buffer)

8.5 1:N communication

This section contains the overview of general–purpose serial communication (1:N communication)

8.5.1 Overview of 1:N Communication

The FPΣ and the external unit with the unit number are connected using an RS485 cable. Using the protocol that matches the external unit, the F159 (MTRN) instruction is used to send and receive data.

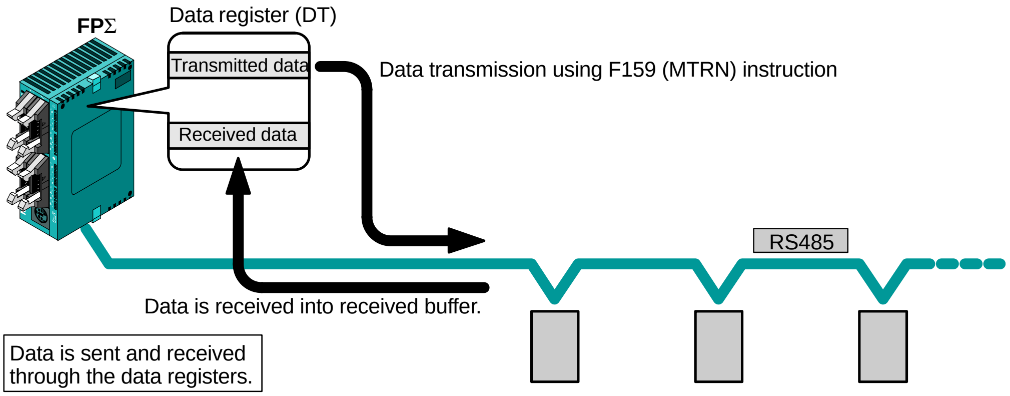


Figure 197: FPΣ General–purpose serial communication (1:N communication)

8.5.2 Communication Cassette Used with 1 : N Communication

The following types of communication cassettes can be used with 1: N general–purpose serial communication.

Name	Description	Part No.
FPΣ Communication cassette 1–channel RS485 type	This communication cassette is a 1–channel unit with a two–wire RS485 port. It supports 1 : N computer links (C–NET), general–purpose serial communication, and a PLC link.	FPG–COM3

8.5.3 Setting of System Register

The following types of communication cassettes can be used with 1: N general–purpose serial communication.

Settings when using the COM. 1 port

No.	Name	Set value
No. 410	Unit No.	1 to 32 (Set the desired unit No.)
No. 412	Communication mode for COM.1 port	General communication
No. 413	Communication format for COM.1 port	Character bit: . . . . . 8 bits Parity check: . . . . . Odd Stop bit: . . . . 1 bit Terminator: . . . . CR Header: . . . . STX not exist
No. 415	Baud rate setting	9600 bits/s
No. 416	Starting address for data received	Set the desired address.
No. 417	Buffer capacity setting for data received	Set the desired capacity. (Max. 2,048 byte)

Settings when using the COM. 2 port

No.	Name	Set value
No. 411	Unit No.	1 to 32 (Set the desired unit No.)
No. 412	Communication mode	General communication
No. 414	Communication format	Character bit: . . . . . 8 bits Parity check: . . . . . Odd Stop bit: . . . . 1 bit Terminator: . . . . CR Header: . . . . STX not exist
No. 415	Baud rate setting	9600 bits/s
No. 418	Starting address for data received	Set the desired address.
No. 419	Buffer capacity setting for data received	Set the desired capacity. (Max. 2,048 byte)

Note

The transmission format and baud rate should be set to match the device connected to the FPΣ.

8.6 Flag Operations When Using Serial Communication

8.6.1 When “STX not exist” is Set for Start Code and “CR” is Set for End Code

When receiving data:

The relationship between the various flags “Reception done flag and Transmission done flag” and the F159 (MTRN) instruction

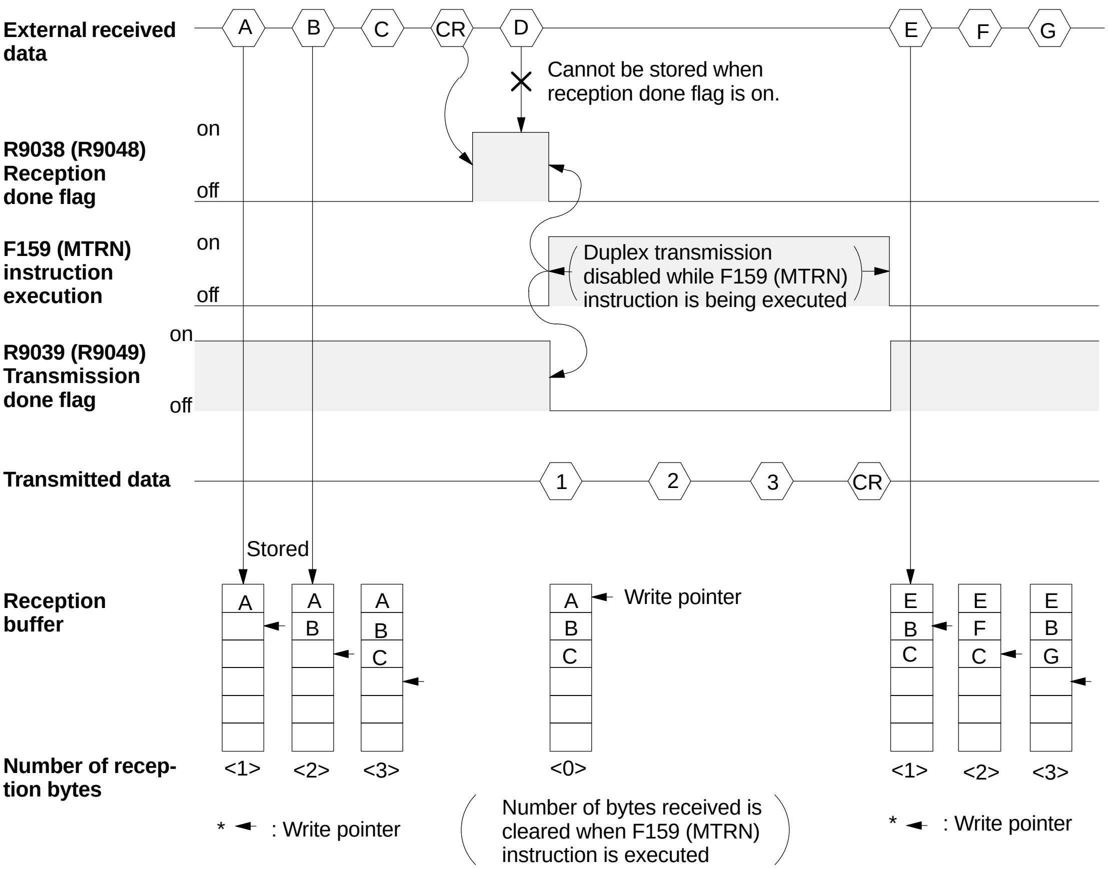


Figure 198: FPΣ Flag operation when receiving data (STX not exit and CR setting)

Half–duplex transmission method should be used for general–purpose serial communication. Reception is disabled when the reception done flag R9038 (R9048) is on.

When the **F159 (MTRN)** instruction is executed, the number of bytes received is cleared, and the address (write pointer) returns to the initial address in the reception buffer.

When the **F159 (MTRN)** instruction is executed, the error flag R9037 (R9047), reception done flag R9038 (R9048) and transmission done flag R9039 (R9049) go off.

Duplex transmission is disabled while the **F159 (MTRN)** instruction is being executed. Check the transmission done flag R9039(R9049).

Reception stops if the error flag R9037 (R9047) goes on. To resume reception, execute the **F159 (MTRN)** instruction and turns off the error flag.

Note

Be aware that the reception done flag R9038 (R9048) changes even while a scan is in progress.

Example: If the reception completed flag is used multiple times as an input condition, there is a possibility of different statuses existing within the same scan. To avoid this, an internal relay should be substituted at the beginning of the program.

8.6.2 When “STX” is Set for Start Code and “ETX” is Set for End Code

When receiving data:

The relationship between the various flags “Reception done flag and Transmission done flag” and the F159 (MTRN) instruction

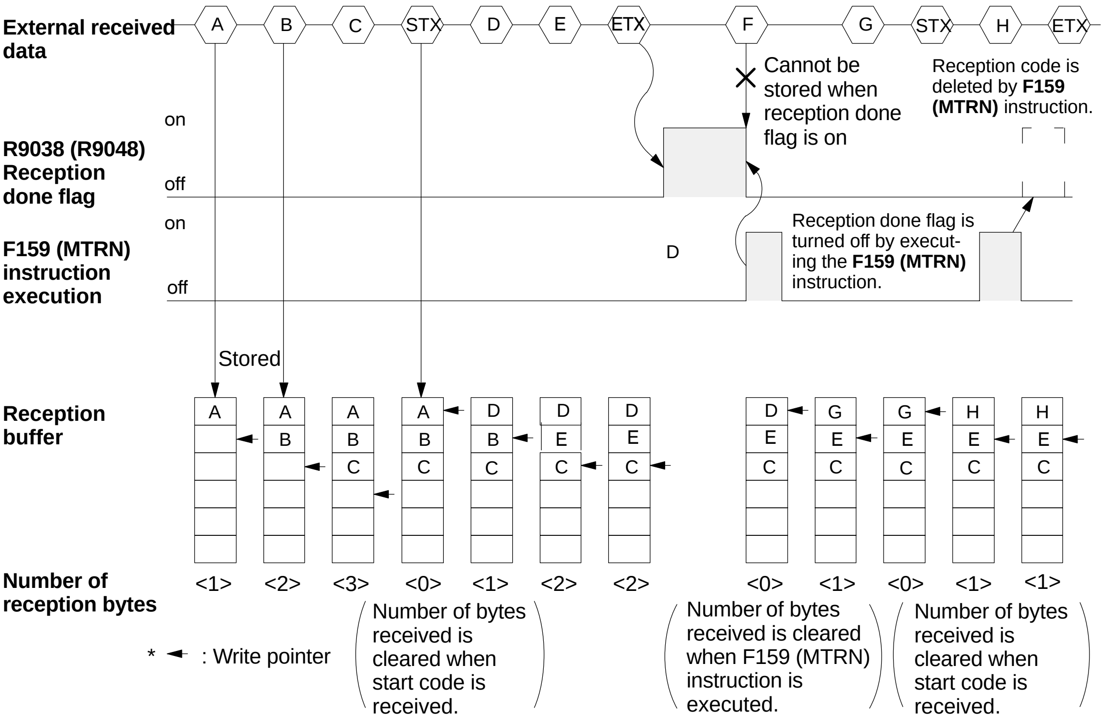


Figure 199: FPΣ Flag operation when receiving data (STX and ETX setting)

The data is stored in the reception buffer in sequential order, but at the point at which the start code is received, the number of bytes received is cleared, and the address (write pointer) is returned to the initial address in the reception buffer.

Reception is disabled while the reception done flag R9038 (R9048) is on.

When the **F159 (MTRN)** instruction is executed, the number of bytes received is cleared, and the address (write pointer) is returned to the initial address in the reception buffer.

If there are two start codes, data following the later start code is overwritten and stored in the reception buffer.

The reception done flag R9038 (R9049) is turned off by the **F159 (MTRN)** instruction. Because of this, if the **F159 (MTRN)** instruction is executed at the same time that the terminal code is received, the reception done flag will not be detected.

When sending data:

The relationship between the various flags “Reception done flag and Transmission done flag” and the F159 (MTRN) instruction

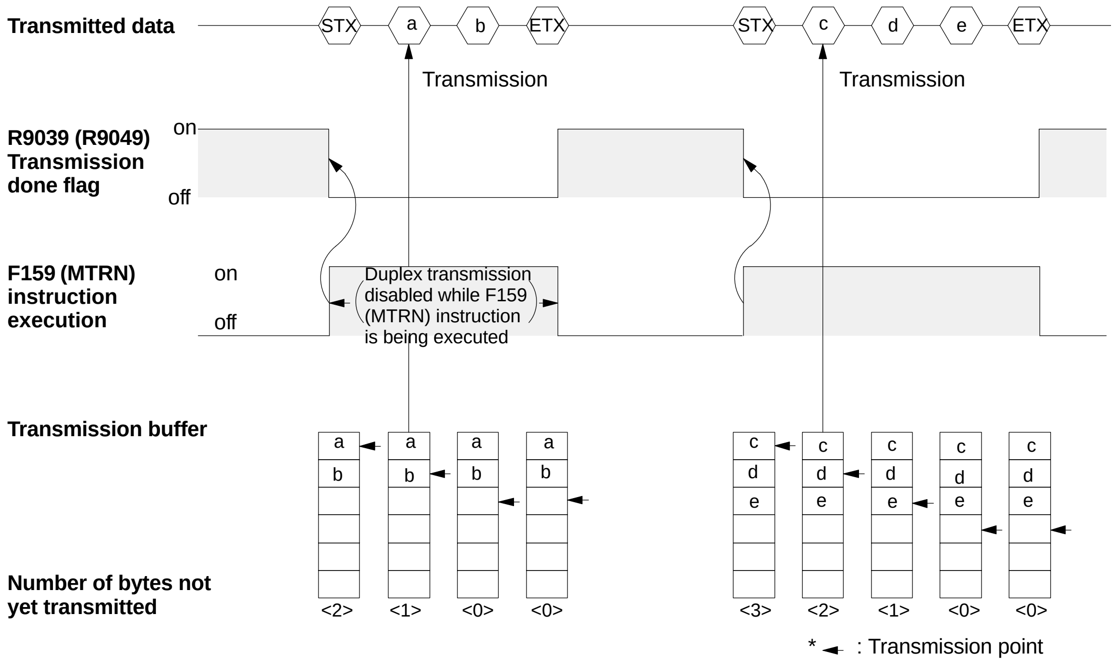


Figure 200: FPΣ Flag operation when sending data (STX and ETX setting)

Start code (STX) and end code (ETX) are automatically added to the data being transmitted, and the data is transmitted to an external device.

When the **F159 (MTRN)** instruction is executed, the transmission done flag R9039 (R9049) go off.

Duplex transmission is disabled while the **F159 (MTRN)** instruction is being executed. Check the transmission done flag R9039 (R9049).

8.7 Changing the Communication Mode of COM. Port

An **F159 (MTRN)** instruction can be executed to change between “general communication mode” and “computer link mode”. To do so, specify “H8000” in “n” (the number of transmission bytes) and execute the instruction.

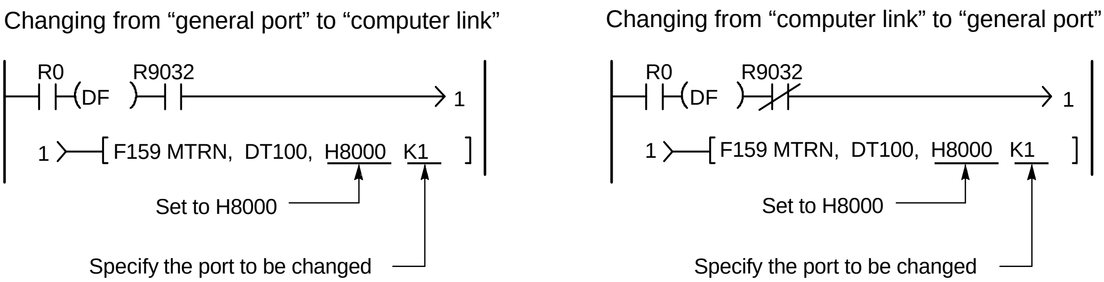


Figure 201: FPΣ Changing the communication mode of COM. port

RS232C port selection flag in R9032 or R9042.
Turns on when “general communication mode” is selected.

Note

When the power is turned on, the mode of use selected in system register No. 412 takes effect.

Chapter 9

Communication Function 3 PLC Link Function

9.1 PLC Link

This section contains the overview of PLC link function.

9.1.1 Overview of Function

What is the PLC Link?

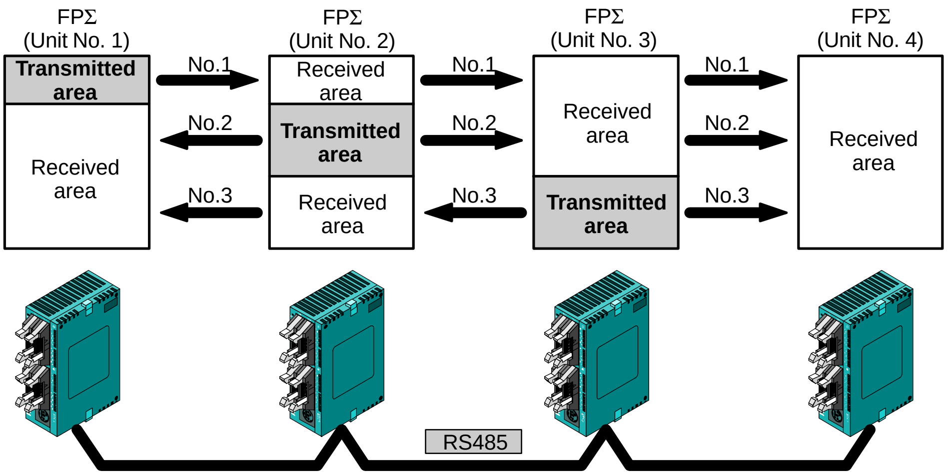
The PLC link is an economic way of linking two PLCs, using a twisted–pair cable.

Data is shared between the PLCs using a link relay (L) and a link register (LD).

With a PLC link, the statuses of the link relays and link registers for one PLC are automatically fed back to other PLCs on the same network, so data that needs to be consistent among all the PLCs on the network, such as the target production values and product codes, can be easily shared. Also, this allows easy control of processes that need to be booted at the same timing.

The PLC link is not set to be used in the default settings, so the setting of system register No. 412 should be changed to “PLC Link” in order to use the function.

The various PLC units and link areas are allocated using the system registers. For more detailed information, please see page 9 - 5, “Communication Parameter Settings When Using a PLC Link”.



The link relays and link registers of the various PLCs contain areas where data is sent and areas where data is received, and these are used to share data among the PLCs.

Figure 202: FPΣ PLC link function (overview)

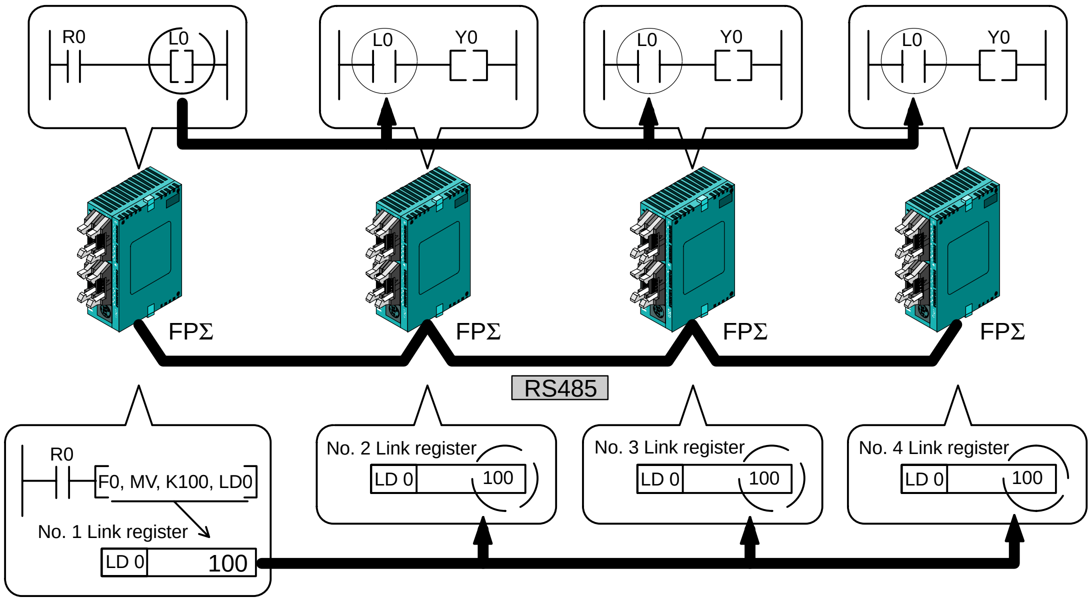
Overview of PLC link operation

Link relay: Turning on a link relay contact in one PLC turns on the same link relay in all of the other PLCs on the same network.

Link register: If the contents of a link register in one PLC are changed, the values of the same link register are changed in all of the PLCs on the same network.

Link relay

If the link relay L0 for the unit (No. 1) is turned on, the status change is fed back to the ladder programs of other units, and the Y0 of the other units is output.



Link register

If a constant of 100 is written to the LD0 of unit No. 1, the contents of LD0 in unit No. 2 are also changed to a constant of 100.

Figure 203: FPΣ Overview of PLC link operation

9.2 Communication Parameter Settings

This section contains the communication parameter settings “communication mode, communication format, unit No. and link area allocation” when using PLC link function.

9.2.1 Setting of Communication Mode

In the default settings, the COM. ports are not set so that communication is enabled. Communication mode settings are entered using the FPWIN GR programming tool. Select “PLC Configuration” under “Option (O)” on the menu bar, and click on the “COM. Port” tab. There are separate settings for the COM.1 and COM.2 ports.

PLC Configuration setting dialog box

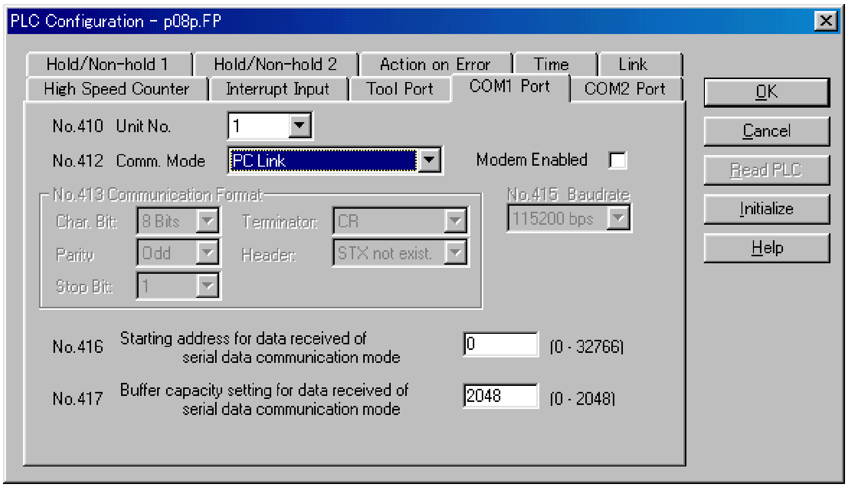


Figure 204: FPWIN GR – PLC Configuration setting dialog box

No. 412 Communication Mode (Comm. Mode)

Select the COM. port communication mode.
Click on the ▼ button, and select “PC Link” from the displayed pull–down menu.

Tip

When using a PLC link, the communication format and baud rate are fixed as shown below.

– Communication format; Character Bit: 8 bits, Parity: Odd, Stop Bit: 1
– Baud rate: 115200 bps

9.2.2 Setting of Unit No.

Unit No.

In the default settings in the system registers, the “Unit No.” parameter for the communication port is set to “1”.
In a PLC link that connects multiple PLCs on the same transmission line, the “Unit No.” parameter must be set in order to identify the various PLCs.

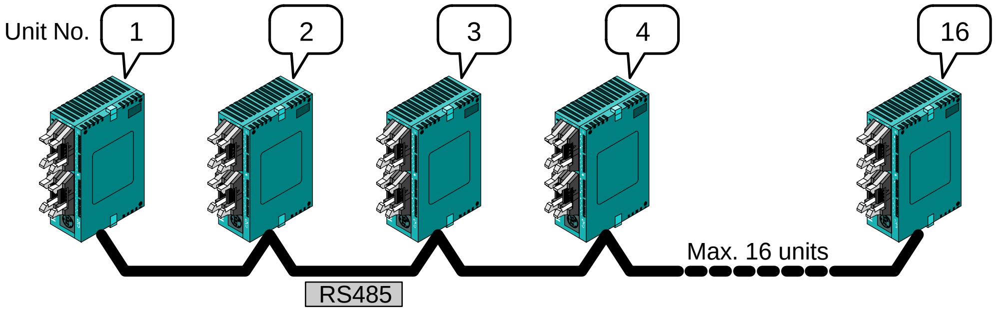


Figure 205: FPΣ Unit No. for PLC link

The unit number is a number assigned to a given PLC in order to identify that particular PLC. Unit numbers should be specified in such a way that the same number is not used for more than one PLC on the same network.

Setting method

The unit number is specified using the system registers settings in the FPWIN GR programming tool, and the unit number setting switch on the side of the main unit. Setting the unit number setting switch to “0” makes the system register settings valid.

To set unit numbers with the FPWIN GR, select “PLC Configuration” under “Option” on the menu bar, and then click on the “COM. Port” tab. There are two settings, one for the COM.1 port and one for the COM.2 port.

PLC Configuration setting dialog box

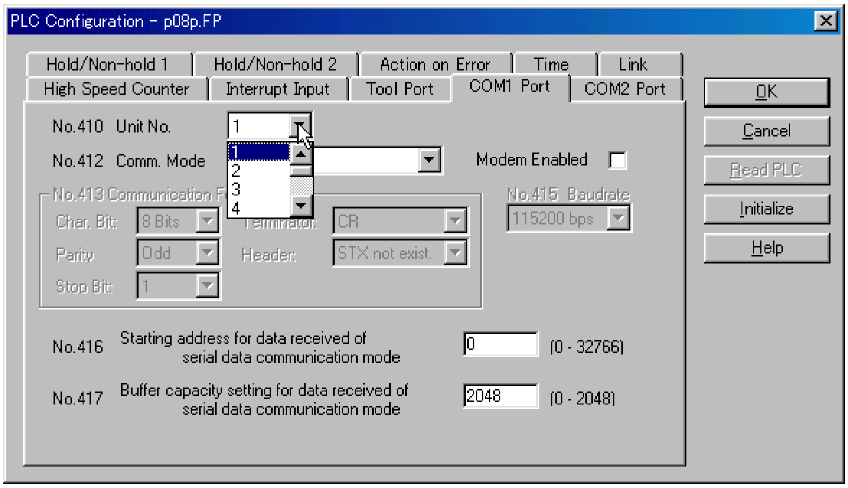


Figure 206: FPWIN GR – PLC Configuration setting dialog box

No. 410 (for COM.1 port), No. 411 (for COM.2 port) Unit No.

Click on the  button, and select a unit number from among the numbers 1 to 16 displayed on the pull–down menu.

Unit No. setting using unit No. setting switch

The unit number setting switch is located inside the cover on the left side of the FPΣ. The selector switch and the dial can be used in combination to set a unit number between 1 and 16.

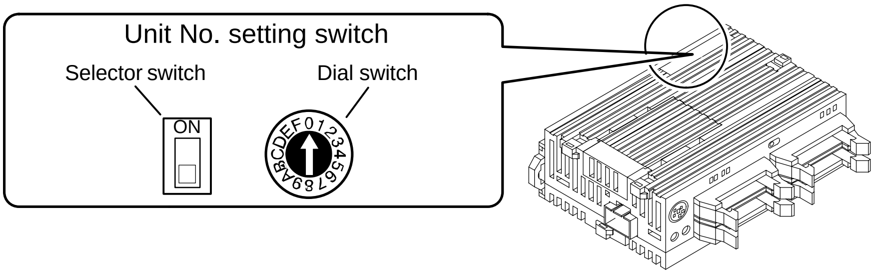


Figure 207: FPΣ Unit No. setting using switch

Relationship between unit number setting switch and unit numbers

Dial switch position	Unit No.	
	Selector switch: off	**Selector switch: on**
0	—	16
1	1	Not available
2	2	
3	3	
4	4	
5	5	
6	6	
7	7	
8	8	
9	9	
A	10	
B	11	
C	12	
D	13	
E	14	
F	15	

- The range of numbers that can be set using the unit number setting switch is from 1 to 16.
- Setting the unit number setting switch to “0” makes the system register settings valid.

To make the unit number setting in the FPWIN GR valid, set the unit number setting switch to “0”.

When using the PLC link function, set the range of unit numbers as 1 to 16.

9.2.3 Allocation of Link Relay and Link Register

Link area allocation

The PLC link function is a function that involves all of the PLCs that have been booted in the MEWNET–W0 mode.

To use the PLC link function, a link area needs to be allocated. Set the allocations for both the link relays and link registers.

Link area allocations are specified using system registers.

System registers

No.	Name	Set value
No. 40	Range of link relay used for PLC link	0 to 64 words
No. 41	Range of link register used for PLC link	0 to 128 words
No. 42	Starting no. for link relay transmission	0 to 63
No. 43	Link relay transmission size	0 to 64 words
No. 44	Starting no. for link register transmission	0 to 127
No. 45	Link register transmission size	0 to 127 words

Relation of system register set value to link area

Link relay

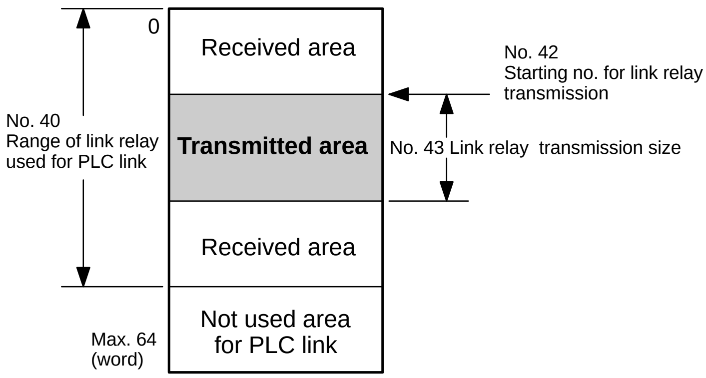


Figure 208: FPΣ Link relay allocation

Link register

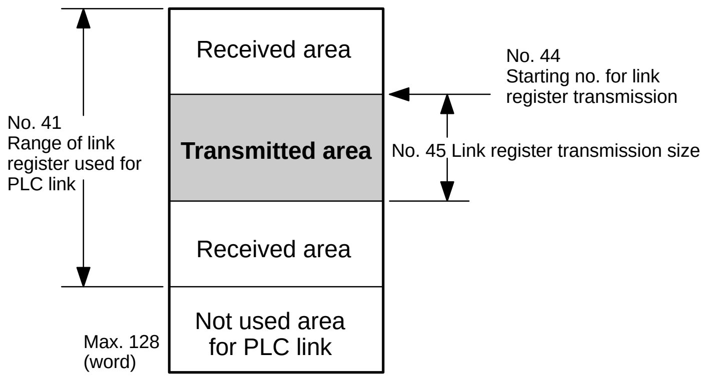


Figure 209: FPΣ Link register allocation

Tip

Link areas consist of link relays and link registers for PLC link and used with respective control units.

The link relay which can be used in an area for PLC link is maximum 1,024 points, and the link register is maximum 128 words.

Example of link area allocation

The areas for PLC link is divided into transmitted areas and received areas. The link relays and link registers are transmitted from the transmitted area to the received area of a different FPΣ. Link relays and link registers with the same numbers as those on the transmission side must exist in the received area on the receiving side.

Link relay allocation

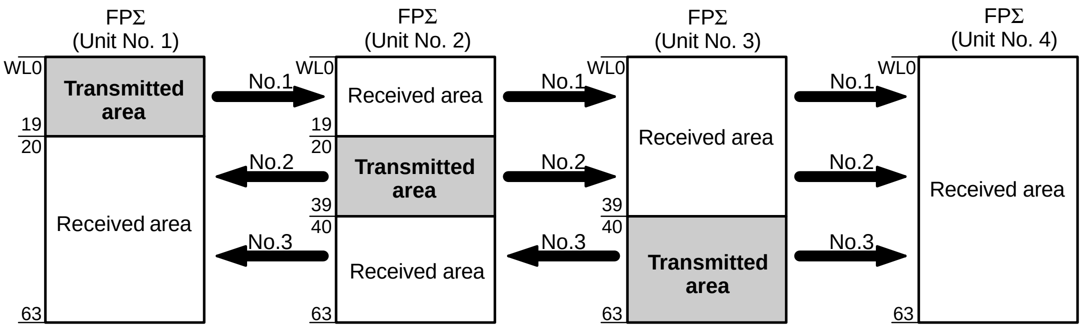


Figure 210: Example of link area allocation

System register

No.	Name	Set value of various control unit			
		No. 1	No. 2	No. 3	No. 4
No. 40	Range of link relay used for PLC link	64	64	64	64
No. 42	Starting no. for link relay transmission	0	20	40	0
No. 43	Link relay transmission size	20	20	24	0

Link register allocation

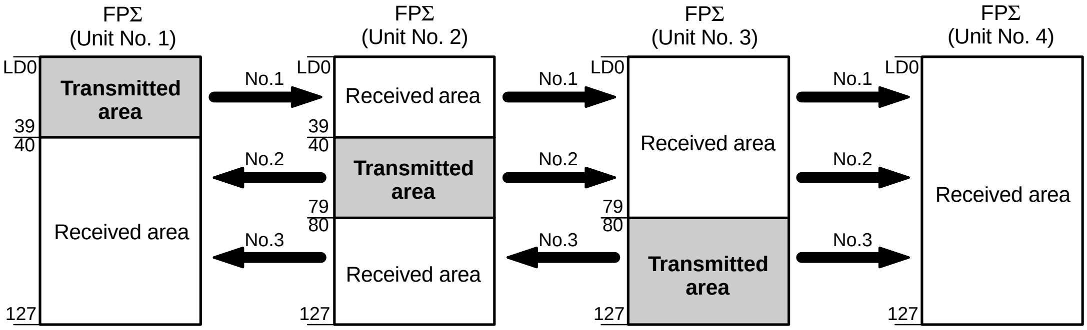


Figure 211: Example of link register allocation

System register

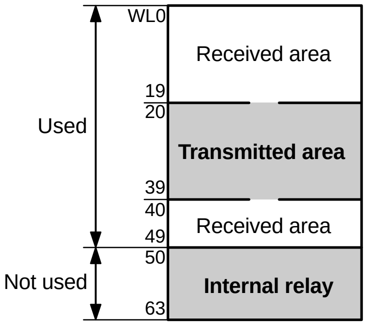
No.	Name	Set value of various control unit			
		No. 1	No. 2	No. 3	No. 4
No. 41	Range of link register used for PLC link	128	128	128	128
No. 44	Starting no. for link register transmission	0	40	80	0
No. 45	Link register transmission size	40	40	48	0

When link areas are allocated as shown above, the No. 1 transmitted area can be transmitted to the No. 2, No. 3 and No. 4 received areas. Also, the No. 1 received area can receive data from the No. 2 and No. 3 transmitted areas. No. 4 is allocated as a received area only, and can receive data from No. 1, No. 2, and No. 3, but cannot transmit it to other unit.

Using only a part of the link area

Link areas are available for PLC link, and link relay 1,024 points (64 words) and link register 128 words can be used. This does not mean, however, that it is necessary to reserve the entire area. Parts of the area which have not been reserved can be used as internal relays and internal registers.

Link relay allocation

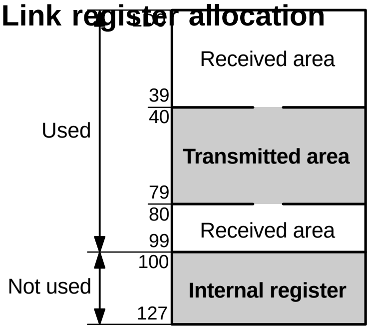


No.	Name	No. 1
No. 40	Range of link relay used for PLC link	50
No. 42	Starting no. for link relay transmission	20
No. 43	Link relay transmission size	20

With the above setting, the 14 words (224 points) consisting of WL50 to WL63 can be used as internal relays.

Figure 212: Using only a part of the link relay area

Link register allocation



No.	Name	No. 1
No. 41	Range of link register used for PLC link	100
No. 44	Starting no. for link register transmission	40
No. 45	Link register transmission size	40

With the above setting, the 28 words consisting of LD100 to LD127 can be used as internal registers.

Figure 213: Using only a part of the link register area

Precautions when allocating link areas

If a mistake is made when allocating a link area, be aware that an error will result, and communication will be disabled.

Avoid overlapping transmitted areas

When sending data from the transmitted area to the received area of another FPΣ, there must be a link relay and link register with the same number in the received area on the receiving side. In the example shown below, there is an area between No. 2 and No. 3 which is overlapped, and this will cause an error, so that communication cannot be carried out.

Link relay allocation

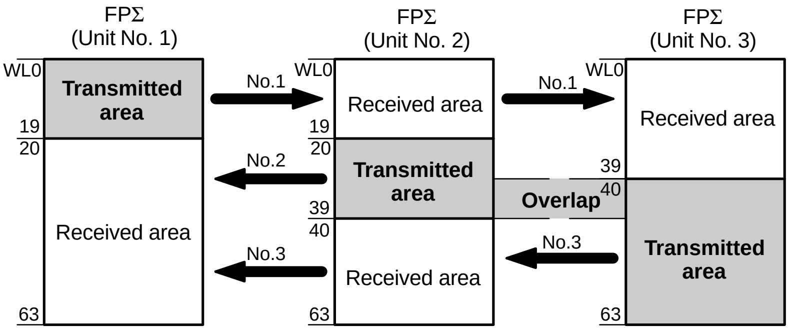


Figure 214: Precautions when allocating link relay area

System register

No.	Name	Set value of various control unit		
		No. 1	No. 2	No. 3
No. 40	Range of link relay used for PLC link	64	64	64
No. 42	Starting no. for link relay transmission	0	20	30
No. 43	Link relay transmission size	20	20	34

Unallowable allocations

Allocations such as those shown below are not possible, either for link relays or link registers.

Allocations in which the transmitted area is split

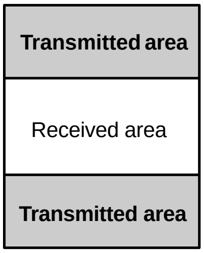


Figure 215: Unallowable allocation example 1

Allocations in which the transmitted and received areas are split into multiple segments

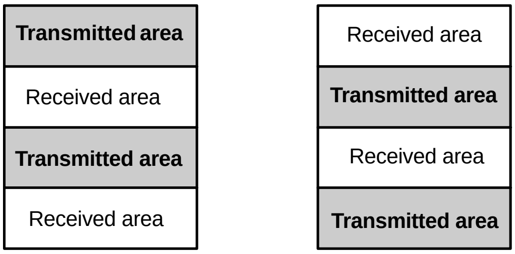


Figure 216: Unallowable allocation example 2

9.3 Connection Example of PLC Link

This section contains the connection example of PLC link.

9.3.1 Using a PLC Link with Three FPΣ Units

In the example shown here, link relays are used, and when X1 of the control unit of unit no. 1 goes on, Y10 of the control unit of unit no. 2 goes on. When X2 of the control unit of unit no. 1 goes on, Y10 of the control unit of unit no. 3 goes on.

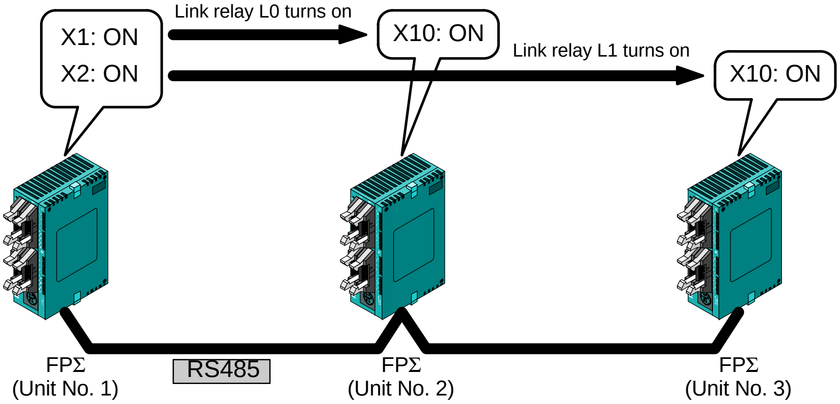


Figure 217: FPΣ Connection when using a PLC link with three FPΣ units

Communication cassettes used with the PLC link

The following types of communication cassettes can be used with the PLC link function.

Name	Description	Part No.
FPΣ Communication cassette 1–channel RS485 type	This communication cassette is a 1–channel unit with a two–wire RS485 port. It supports 1 : N computer links (C–NET), general–purpose serial communication, and a PLC link.	FPG–COM3

Setting of system register

When using a PLC link, the transmission format and baud rate are fixed as shown below.

– Communication format; Character Bit: 8 bits, Parity: Odd, Stop Bit: 1
– Baud rate: 115200 bps

Set the communication mode and the unit numbers using the system registers.

Setting of unit no. and communication mode

Setting of unit No. 1 “FPΣ control unit”

No.	Name	Set value
No. 410	Unit No. for COM.1 port	1
No. 412	Communication mode for COM.1 port	PLC link

Setting of unit No. 2 “FPΣ control unit”

No.	Name	Set value
No. 410	Unit No. for COM.1 port	2
No. 412	Communication mode for COM.1 port	PLC link

Setting of unit No. 3 “FPΣ control unit”

No.	Name	Set value
No. 410	Unit No. for COM.1 port	3
No. 412	Communication mode for COM.1 port	PLC link

Tip

Make sure the same unit number is not used for more than one of the PLCs connected through the PLC link function.

Allocation of link area

Link relay allocation

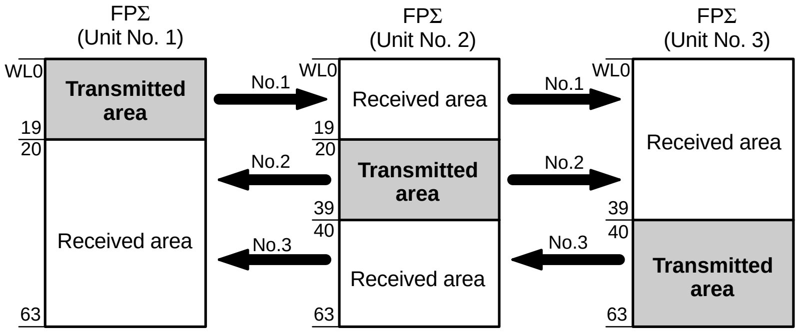


Figure 218: FPΣ Link relay allocation when using a PLC link with three FPΣ units

System register

No.	Name	Set value of various control unit		
		No. 1	No. 2	No. 3
No. 40	Range of link relay used for PLC link	64	64	64
No. 42	Starting no. for link relay transmission	0	20	40
No. 43	Link relay transmission size	20	20	24

Link register allocation

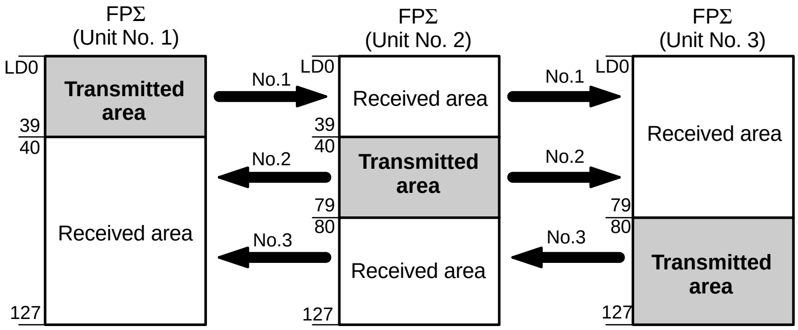


Figure 219: FPΣ Link register allocation when using a PLC link with three FPΣ units

System register

No.	Name	Set value of various control unit		
		No. 1	No. 2	No. 3
No. 41	Range of link register used for PLC link	128	128	128
No. 44	Starting no. for link register transmission	0	40	80
No. 45	Link register transmission size	40	40	48

Connection diagram

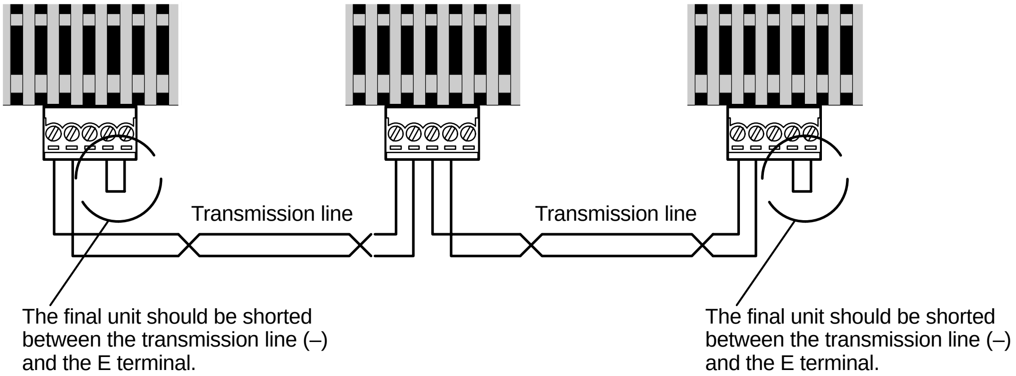


Figure 220: FPΣ Connection diagram when using a PLC link with three FPΣ units

9.3.2 Sample Programs

Program of unit No. 1 “FPΣ control unit”

When X1 is input, the L0 of the link relay goes on, and when X2 is input, the L1 of the link relay goes on.

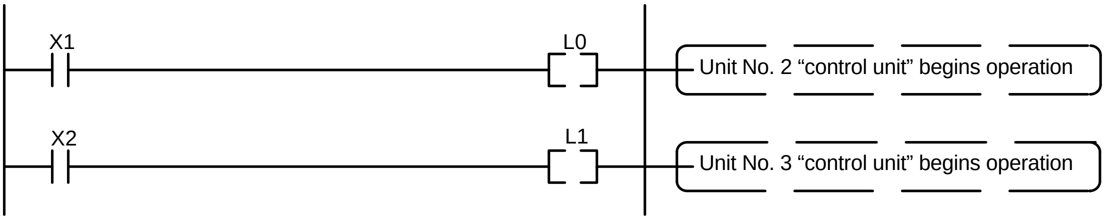


Figure 221: Sample program – unit No. 1

Program of unit No. 2 “FPΣ control unit”

When the L0 of the link relay goes on, Y10 is output.

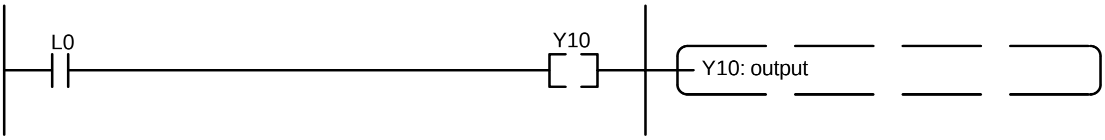


Figure 222: Sample program – unit No. 2

Program of unit No. 3 “FPΣ control unit”

When the L1 of the link relay goes on, Y10 is output.

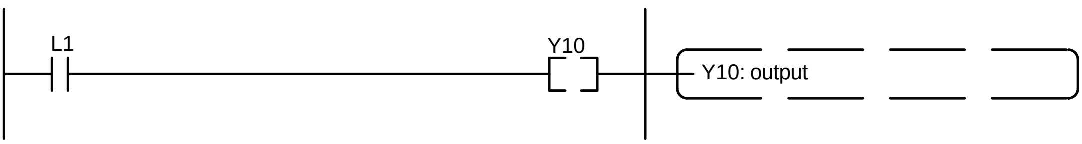


Figure 223: Sample program – unit No. 3

Chapter 10

Other Functions

10.1 Analog Potentiometer

This section contains the overview of analog potentiometer.

10.1.1 Overview of Analog Potentiometer

The FPΣ is equipped with two analog potentiometers as a standard feature. Turning the potentiometers changes the values of the special data registers DT90040 and DT90041 within a range of K0 to K1000.
Using this function makes it possible to change the internal set values in the PLC without using the programming tool, so this can be used, for example, with analog clocks, to change the set value externally by turning the potentiometer.

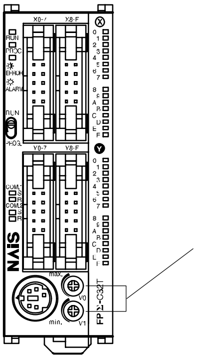


Figure 224: FPΣ Analog potentiometer

Applicable special data register

Symbol	Potentiometer No.	Special data register	Range of change
V0	Volume 0	DT90040	K0 to K1000
V1	Volume 1	DT90041	

10.1.2 Example Showing How the Analog Potentiometers are Used

The FPΣ is provided with special internal registers, in which the values in the registers change in response to the analog potentiometers being moved. If the values of these registers are sent to the clock setting value area, a clock can be created that allows the time to be set using the potentiometer.

Writing example of the clock setting value

The value of the special internal register (DT90040) that corresponds to the analog potentiometer V0 is sent to the setting value area (SV0) of TMX0 to set the time for the clock.

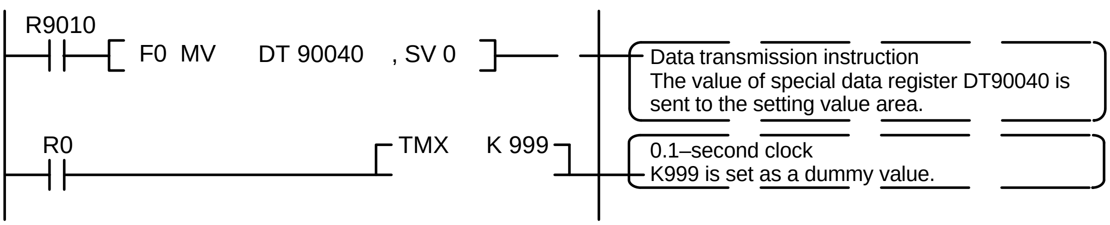


Figure 225: Program example of analog potentiometer

10.2 Clock/Calendar Function

This section contains the clock/calendar function.

10.2.1 Area for Clock/Calendar Function

If a backup battery is installed in the FPΣ, the clock/calendar function can be used. With the clock/calendar function, data indicating the hour, minute, second, day, year and other information stored in the special data registers DT90053 to DT90057 can be read using the transmission instruction and used in sequence programs.

Special data register No.	Upper byte	Lower byte	Reading	Writing
DT90053	Hour data H00 to H23	Minute data H00 to H59	Available	Not available
DT90054	Minute data H00 to H59	Second data H00 to H59	Available	Available
DT90055	Day data H01 to H31	Hour data H00 to H23	Available	Available
DT90056	Year data H00 to H99	Month data H01 to H12	Available	Available
DT90057	—	Day–of–the–week data H00 to H06	Available	Available

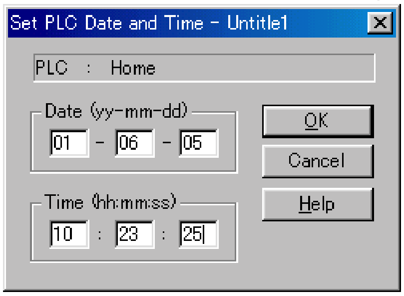
10.2.2 Setting of Clock/Calendar Function

There are two ways to set the clock/calendar function, as described below.

Setting using FPWIN GR

1. Press the **[CTRL]** and **[F2]** keys at the same time, to switch to the **[Online]** screen.
2. Select "Set PLC Date & Time" under "Tool" on the menu bar.

Set PLC Date and Time dialog box



The above steps display the "Set PLC Date and Time dialog box" shown at the left. Input the date and time, and click on the "OK" button.

Figure 226: FPWIN GR – Set PLC Date and Time dialog box

Setting and changing using program

1. The values written to the special data registers DT90054 to DT90057, which are allocated as the clock/calendar setting area, are sent.
2. A value of H8000 is written to DT90058.

Note

The value can be sent using the differential instruction "DF", or by changing H8000 to H0000.

Example showing the date and time being written

Set the time to 12:00:00 on the 5th day when the X0 turns on.

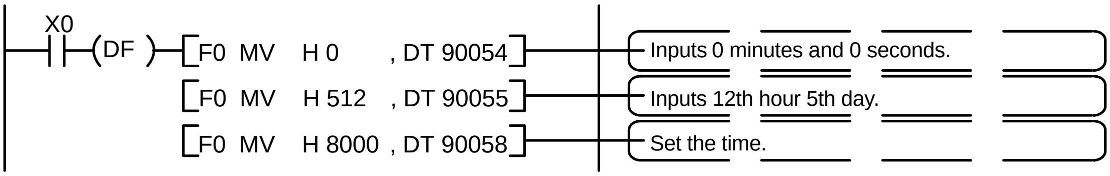


Figure 227: FPΣ Sample program of clock/calendar function

10.2.3 Precautions Concerning Backup of Clock/Calendar Data

The clock/calendar values are backed up using a battery. Please be aware that these values cannot be used unless a battery has been installed in the FPΣ.

No values have been set in the default settings, so the programming tool or another means must be used to specify the values.

10.2.4 Example Showing the Clock/Calendar being Used

Sample program for Fixed schedule and automatic start

In the example shown here, the clock/calendar function is used to output the (Y0) signal for one second, at 8:30 a.m. every day.
Here, the “Hour/minute” data stored in the special data register DT90053 is used to output the signal at the appointed time.

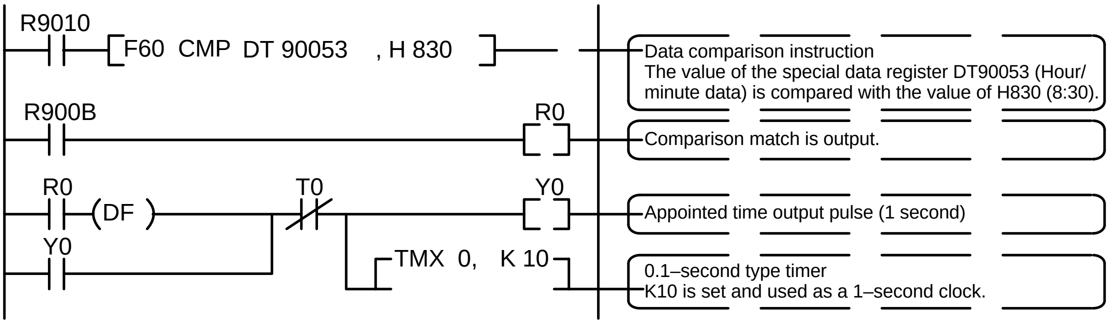


Figure 228: FPΣ Sample program of clock/calendar function

The hour data is stored in the upper 8 bits of DT90053 and the minute data in the lower 8 bits, in the BCD format. This hour and minute data is compared with the appointed time (BCD), and the R900B (=flag) special internal relay is used to detect whether or not it matches the appointed time.

Chapter 11

Self–Diagnostic and Troubleshooting

11.1 Self–Diagnostic Function

This section explains the self–diagnostic function of FPΣ.

11.1.1 LED Display for Status Condition

Status indicator LEDs on control unit

	LED status			Description	Operation status
	RUN	PROG.	ERROR/ ALARM		
Normal condition	Light (on)	Off	Off	Normal operation	Operation
	Off	Light (on)	Off	PROG. mode	Stop
	Flashes	Flashes	Off	Forcing on/off in Run mode	Operation
Abnormal condition	Off	Off	Flashes	When a self–diagnostic error occurs	Operation
	Off	Light (on)	Flashes	When a self–diagnostic error occurs	Stop
	Varies	Varies	Light (on)	System watchdog timer has been activated	Stop

The control unit has a self-diagnostic function which identifies errors and stops operation if necessary.

When an error occurs, the status of the status indicator LEDs on the control unit vary, as shown in the table above.

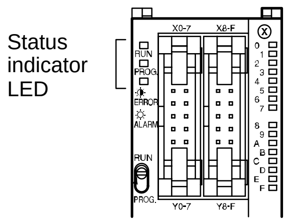


Figure 229: FPΣ Status indicator LED

11.1.2 Operation on Error

Normally, when an error occurs, the operation stops.

The user may select whether operation is to be continued or stopped when a duplicated output error or operation error occurs, by setting the system registers. You can set the error which operation is to be continued or stopped using the programming tool software as shown below.

“PLC Configuration” setting menu on programming tool software (FPWIN GR)

To specify the steps to be taken by the FPWIN GR if a PLC error occurs, select “PLC Configuration” under “Option” on the menu bar, and click on the “Action on Error” tab. The screen shown below is displayed.

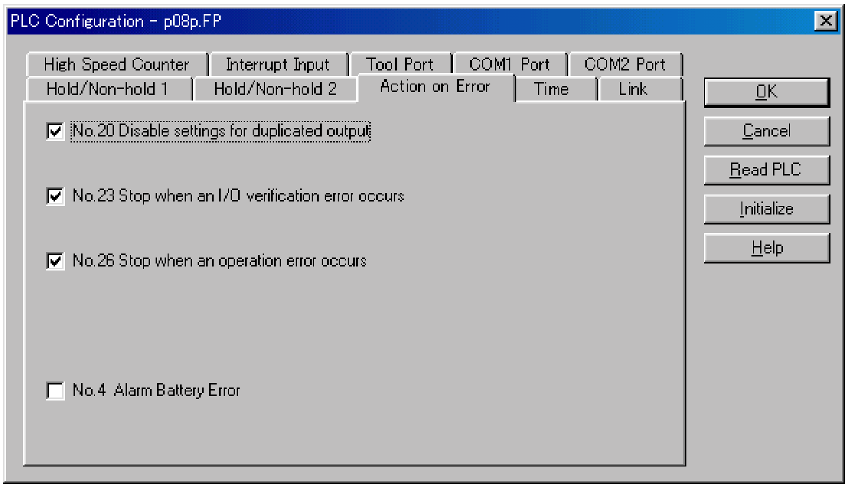


Figure 230: FPWIN GR PLC Configuration setting screen

Example 1: Allowing duplicated output

Turn off the check box for No. 20. When operation is resumed, it will not be handled as an error.

Example 2: When continuing operation even a calculation error has occured

Turn off the check box for No. 26. When operation is resumed, it will be continued, but will be handled as an error.

11.2 Troubleshooting

This section explains what to do if an error occurs.

11.2.1 If the ERROR/ALARM LED Flashes

Condition: The self-diagnostic error occurs.

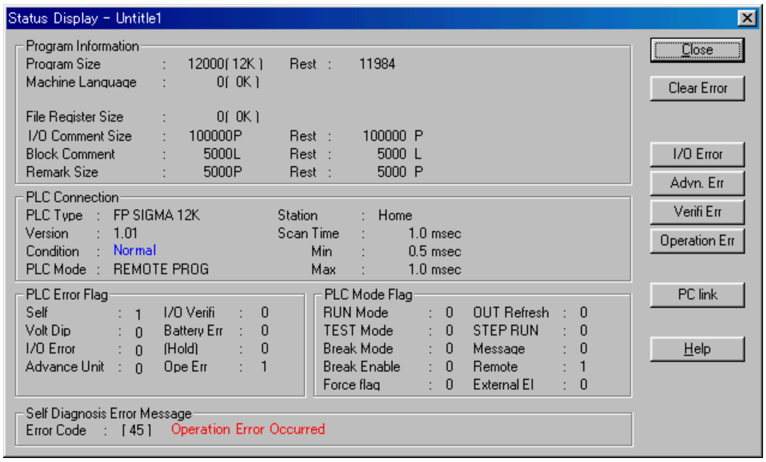
Procedure 1

Check the error contents (error code) using the programming tool “FPWIN GR”.

Using FPWIN GR

With the FPWIN GR Ver. 2, if a PLC error occurs during programming or debugging, the following status display dialog box is displayed automatically. Check the contents of the self–diagnosed error.

Status display dialog box



If the error is an operation error, the error address can be confirmed in this dialog box.
Click on the “**Clear Error**” button to clear the error.

Figure 231: FPWIN GR – Status display dialog box

Tip

To display the status display dialog box, select “Status Display” under “Online” on the menu bar.

☛ next page

Procedure 2:

For error code is 1 to 9

Condition: There is a syntax error in the program.

Operation 1

Change to PROG. mode and clear the error.

Operation 2

Execute a total–check function using FPWIN GR to determine the location of the syntax error.

For error code is 20 or higher

Condition: A self-diagnostic error other than a syntax error has occurred.

Operation

Use the programming tool "FPWIN GR" in PROG. mode to clear the error.

Using FPWIN GR

Click on the "Clear Error" button in the "Status display dialog box". Error code 43 and higher can be cleared.

In the PROG. mode, the power supply can be turned off and then on again to clear the error, but all of the contents of the operation memory except hold type data are cleared.

An error can also be cleared by executing a self-diagnostic error set instruction **F148 (ERR)**.

If the mode selector switch has been set to the "RUN" position, the error is cleared and at the same time operation is enabled. If the problem that caused the error has not been eliminated, it may look in some cases as though the error has not been cleared.

Tip

When an operation error (error code 45) occurs, the address at which the error occurred is stored in special data registers DT90017 and DT90018. If this happens, click on the "Operation Err" button in the "Status display dialog box" and confirm the address at which the error occurred before cancelling the error.

11.2.2 If the ERROR/ALARM LED Lights

Condition: The system watchdog timer has been activated and the operation of PLC has been stopped.

Procedure 1

Set the mode selector of PLC from RUN to PROG. mode and turn the power off and then on.

- If the ERROR/ALARM LED is turned on again, there is probably an abnormality in the FPΣ control unit. Please contact your dealer.
- If the ERROR/ALARM LED is flashed, go to page 11 - 5.

Procedure 2

Set the mode selector from PROG. to RUN mode.

- If the ERROR/ALARM LED is turned on, the program execution time is too long. Check the program, referring the following:
  Check if instructions such as **"Jump"** or **"LOOP"** are programmed in such a way that a scan can never finish.

  Check that interrupt instructions are executed in succession.

11.2.3 If None of the LEDs Light

Procedure 1

Check wiring of power supply.

Procedure 2

Check if the power supplied to the FPΣ control unit is in the range of the rating.

- Be sure to check the fluctuation in the power supply.

Procedure 3

Disconnect the power supply wiring to the other devices if the power supplied to the FPΣ control unit is shared with them.

- If the LED on the control unit turn on at this moment, increase the capacity of the power supply or prepare another power supply for other devices.

11.2.4 If Outputting does not Occur as Desired

Proceed from the check of the output side to the check of the input side.

Check of output condition 1: Output indicator LEDs are on

Procedure 1

Check the wiring of the loads.

Procedure 2

Check if the power is properly supplied to the loads.

– If the power is properly supplied to the load, there is probably an abnormality in the load. Check the load again.

– If the power is not supplied to the load, there is probably an abnormality in the output section. Please contact your dealer.

Check of output condition 2: Output indicator LEDs are off

Procedure 1

Monitor the output condition using a programming tool.

– If the output monitored is turned on, there is probably a duplicated output error.

Procedure 2

Forcing on the output using forcing input/output function.

– If the output indicator LED is turned on, go to input condition check.

– If the output indicator LED remains off, there is probably an abnormality in the output unit. Please contact your dealer.

Check of input condition 3: Input indicator LEDs are off

Procedure 1

Check the wiring of the input devices.

Procedure 2

Check that the power is properly supplied to the input terminals.

– If the power is properly supplied to the input terminal, there is probably an abnormality in the input unit. Please contact your dealer.

– If the power is not supplied to the input terminal, there is probably an abnormality in the input device or input power supply. Check the input device and input power supply.

Check of input condition 4: Input indicator LEDs are on

Procedure

Monitor the input condition using a programming tool.

– If the input monitored is off, there is probably an abnormality with the input unit. Please contact your dealer.

– If the input monitored is on, check the leakage current at the input devices (e.g., two-wire type sensor) and check the program again, referring the following:
  Check for the duplicated use of output and for the output using the high–level instruction.
  Check the program flow when a control instruction such as **Master control relay** or **Jump** is used.

11.2.5 If a Protect Error Message Appears

When a Password Function is Used

Procedure

Enter a password in the "Set PLC Password" menu in FPWIN GR and turn on the "Access" radio button.

Using FPWIN GR

1. Select "Set PLC Password" under "Tool" on the menu bar.

2. The PLC password setting dialog box shown below is displayed. Turn on the radio button next to "Access", enter a password, and click on the "Settings" button.

Set PLC Password dialog box

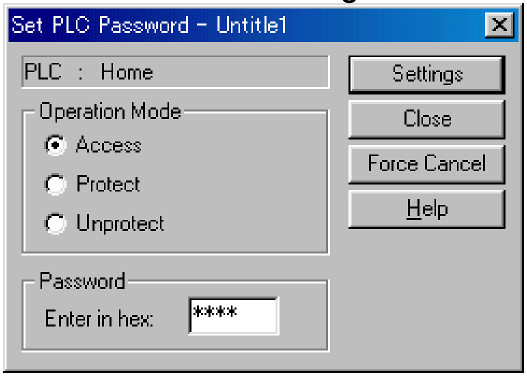


Figure 232: FPWIN GR – Set PLC Password dialog box

11.2.6 If the Program Mode does not Change to RUN

Condition: A syntax error or a self–diagnosed error that caused operation to stop has occurred.

Procedure 1

Check to see if the ERROR/ALARM LED is flashing.
If the ERROR/ALARM LED is flashing, check the contents noted on page 11 - 5.

Procedure 2

Execute a total–check function to determine the location of the syntax error.

11.2.7 If a Transmission Error has Occurred

Procedure 1

Check to make sure the transmission cables have been securely connected between the two (+) terminals and the two (–) terminals of the units, and that the final unit has been correctly connected.

Procedure 2

Check to see if the transmission cables are within the specifications range, referring to page 6 - 11.

At this point, make sure all of the cables in the link are of the same type, and that multiple types of cables are not being used.

Do not designate any unit other than those at both ends of the network as a terminal station.

Procedure 3

Check that link areas do not overlap.

Chapter 12

Specifications

12.1 Table of Specifications

12.1.1 General Specifications

Item	Description
Rated operating voltage	24 V DC
Operating voltage range	21.6 to 26.4 V DC
Allowed momentary power off time	4 ms at 21.6 V, 7 ms at 24 V, 10 ms at 26.4 V
Ambient temperature	0 to +55 °C/32 to +131 °F
Storage temperature	–20 to +70 °C/–4 to +158 °F
Ambient humidity	30 to 85 % RH (non-condensing)
Storage humidity	30 to 85 % RH (non-condensing)
Breakdown voltage	500 V AC for 1 minute between input/output terminals and power supply/ground terminal 500 V AC for 1 minute between input and output terminals
Insulation resistance	Min. 100 MΩ (measured with a 500 V AC megger) between input/output terminals and power supply/ground terminals Min. 100 MΩ (measured with a 500 V AC megger) between input and output terminals
Vibration resistance	10 to 55 Hz, 1 cycle/min: double amplitude of 0.75 mm/ 0.030 in., 10 min on 3 axes
Shock resistance	Shock of 98 m/s^2 or more, 4 times on 3 axes
Noise immunity	1,000 Vp-p with pulse widths 50 ns and 1 µs (based on in-house measurements)
Operating condition	Free from corrosive gases and excessive dust

Weight

Unit type	Part No.	Weight
Control unit	C32T	Approx. 120 g/4.24 oz
Expansion unit	E8R/E8YR	Approx. 90 g/3.17 oz
	E8X/E8YT/E8YP	Approx. 65 g/2.29 oz
	E16R	Approx. 105 g/3.70 oz
	E16T/E16P/E16X/E16YT/E16YP	Approx. 70 g/2.47 oz
	E32T/E32P	Approx. 85 g/3.00 oz

Current consumption

Unit type	Part No.	Current consumption (at 24 V DC) (*)
Control unit	C32T	90 mA or less
Expansion unit	E32T/E32P	40 mA or less
	E16T/E16P/E16YT/E16YP	25 mA or less
	E16R/E16X	20 mA or less
	E8YT/E8YP/E8R	15 mA or less
	E8X/E8YR	10 mA or less

* Current consumption by the control unit

When using expansion units, the consumption current increases by the number of expansion units. The E8R/E8YR/E16R relay–type expansion units require 50 mA (E8R) or 100 mA (E8YR, E16R) per unit, as a separate relay drive source. This current should be supplied to the each of the various units through the power supply connector for expansion unit.

12.1.2 Performance Specifications

Item			Descriptions
Programming method/Control method			Relay symbol/Cyclic operation
Controllable I/O points	**Basic unit**		Total: 32 (Input: 16/Output: 16)
	With expansion unit		Max. 128 (The number of FP0 expansion units can be expanded to a maximum of 3.)
Program memory			Built–in Flash ROM (without backup battery)
Program capacity			12,000 steps
Number of instruction	**Basic**		89
	High–level		212
Operation speed			0.4 µs/step (by basic instruction)
Operation memory points	**Relay**	**External input relay (X)**	512 points (The number of points actually available for use is determined by the hardware configuration.)
		External output relay (Y)	512 points (The number of points actually available for use is determined by the hardware configuration.)
		Internal relay (R)	1,568 points (R0 to R97F) (* Note 1)
		Timer/Counter (T/C)	1,024 points (* Note 1 and 2) (initial setting is 1,008 timer points (T0 to T1007), 16 counter points (C1008 to C1023) Timer: Can count up to (in units of 1 ms, 10 ms, 100 ms, or 1 s) x 32767. Counter: Can count up to 1 to 32767.
		Link relays (L)	1,024 points (* Note 1)
	Memory area	**Data register (DT)**	32,765 words (DT0 to DT32764) (* Note 1)
		Link data register (LD)	128 words (* Note 1)
		Index register (I)	14 words (I0 to ID)
Differential points			Unlimited of points
Master control relay points (MCR)			256 points
Number of labels (JP and LOOP)			256 labels
Number of step ladders			1,000 stages
Number of subroutines			100 subroutines
Pulse catch input			8 points (X0 to X7)
Number of interrupt programs			9 programs (external input 8 points “X0 to X7”, periodical interrupt 1 point “0.5 ms to 30s”)
Self–diagnosis function			Such as watchdog timer, program syntax check
Clock/calendar function			Available (year, month, day, hour, minute, second and day of week) (However, this can only be used when a battery has been installed.) (* Note 3)
Potentiometer (Volume) input			2 points, Resolution: 10 bits (K0 to K1000)
Battery life			220 days or more (actual usage value: approx. 840 days (25°C) (Periodic replacement interval: 1 year) (value applies when no power is supplied at all)
Comment input function			Available (128k byte) (Without backup battery)

☛ next page

Item	Descriptions
Link function	Computer link (1:1, 1:N) (* Note 4) General–purpose communication (1:1, 1:N) (* Note 4) (* Note 5) PLC link (* Note 6)
Other functions	Program edition during RUN, constant scan, forced on/off and password

Notes

1) **If no battery is used, only the fixed area is backed up (counters: C1008 to C1023, internal relays: R900 to R97F, data registers: DT32710 to DT32764). When the optional battery is used, data can be backed up. Areas to be held and not held can be specified using the system registers.**
2) **The number of points can be increased by using an auxiliary timer.**
3) **Precision of calender timer:**
   – At 0°C/32°F, less than 119 second error per month.
   – At 25°C/77°F, less than 51 seconds error per month.
   – At 55°C/131°F, less than 148 seconds error per month.
4) **An optional communication cassette (RS232C type) is required in order to use 1 : 1 communication.**
5) **An optional communication cassette (RS485 type) is required in order to use 1 : N communication.**
6) **An optional communication cassette (RS485 type) is required. If a communication cassette is installed and communication is being carried out, re–send processing is recommended.**

High–speed counter, pulse output and PWM output specifications

Item		Descriptions	
High–speed counter	Input point number	When using single–phase: Four channels maximum	When using 2–phase: Two channels maximum
	Maximum counting speed	When using single–phase: for 1 channel: 50 kHz max. (x1 ch) for 2 channels: 30 kHz max. (x2 ch) for 3 or 4 channels: 20 kHz max. (x3 to 4ch)	When using 2–phase: for 1 channel: 20 kHz max. (x1 ch) for 2 channels: 15 kHz max. (x2 ch)
	Input contact used (* Note1)	When using single–phase: X0: count input (ch0) X1: count input (ch1) X2: reset input (ch0, ch1) X3: count input (ch2) X4: count input (ch3) X5: reset input (ch2, ch3)	When using 2–phase: X0, X1: count input (ch0) X2: reset input (ch0) X3, X4: count input (ch2) X5: reset input (ch2)
Pulse output	Output point number	Two independent points (simultaneous output possible)	
	Output mode	CW and CCW mode, Pulse and Sign mode	
	Maximum output frequency	When using 1 channel: 100 kHz max. (x1 ch) When using 2 channels: 60 kHz max. (x2 ch)	
	High–speed counter used (* Note 2)	Two–phase ch0 or ch2	
	Output contact used (* Note 1)	X2 or X5: Home input Y0 or Y3: CW output or Pulse output Y1 or Y4: CCW output or Sigh output Y2 or Y5: Deviation counter reset output	
PWM output	Output point number	Two points (Y0, Y3)	
	Output frequency	1.5 to 12.5k Hz (at resolution of 1000), 15.6k to 41.7k Hz (at resolution of 100)	
	Output duty	0.0 to 99.9% (at resolution of 1000), 1 to 99% (at resolution of 100)	
	High–speed counter used (* Note 2)	Two–phase ch0 or ch 2	
	Output contact used (* Note 1)	Y0 or Y3	

Notes

1) **The contacts noted above cannot be allocated for more than one function. Also, contacts that are not assigned to the various functions can be used as general inputs/outputs. Inputs X0 to X5 are pulse catch inputs, and can also be used for interrupt input.**
2) **If using pulse output or PWM output, one channel of the two–phase high–speed counter is used for each output point, in each case. If only one pulse output point is being used, either one point of the two–phase high–speed counter or three points of the single–phase high–speed counter may be used.**

Serial communication specifications (1:1 communication) (* Note 1)

Item	Description
Communication method	Half duplex transmission
Synchronous method	Start stop synchronous system
Transmission line	RS232C
Transmission distance (total distance)	3 m/9.84 ft.
Transmission speed (baud rate)	9,600 bits/s to 115.2k bits/s (* Note 2)
Transmission code	ASCII
Transmission format	Stop bit: 1 bit/2 bits, Parity: none/even/odd, data length: 7 bits/8 bits (* Note 2)
Interface	Conforming to RS232C (connected via the terminal block)

Notes

1) **In order to use the serial communication function (1:1 communication), a communication cassette (RS232C type) is required.**
2) **The baud rate and transmission format are specified using the system registers.**

Serial communication specifications (1:N communication) (* Note 1)

Item	Description
Communication method	Two–wire, half duplex transmission
Synchronous method	Start stop synchronous system
Transmission line	Twisted–pair cable or VCTF
Transmission speed	9,600 bits/s to 115.2k bits/s (* Note 2)
Transmission code	ASCII
Transmission format	Stop bit: 1 bit/2 bits, Parity: none/even/odd, data length: 7 bits/8 bits (* Note 2)
Number of units	Maximum 32 units (* Note 3)
Interface	Conforming to RS485 (connected via the terminal block)

Notes

1) **In order to use the serial communication function (1:N communication), a communication cassette (RS485 type) is required.**
2) **The baud rate and transmission format are specified using the system registers.**
3) **Unit numbers are specified using the system registers. Up to 31 unit numbers can be set, using the switches on the control unit.**

PLC link function specification (* Note 1)

Item	Description
Communication method	Token bus
Transmission method	Floating master method
Transmission line	Twisted–pair cable
Transmission distance (total distance)	80 m/2,625 ft.
Transmission speed (baud rate)	115.2k bits/s
Number of units	Maximum 16 units (* Note 2)
PLC link capacity	Link relay: 1,024 points, Link register: 128 words
Interface	Conforming to RS485 (connected via the terminal block)

Notes

1) **A communication cassette (RS485 type) is required in order to use the PLC link function.**
2) **Unit numbers are specified using the switches on the control unit, and the system registers.**

12.2 I/O No. Allocation

FPΣ Control unit

The allocation of the FPΣ control unit is fixed.

Type of control unit		I/O No.
FPG–C32T	Input: 16 points	X0 to XF
	output: 16 points	Y0 to YF

I/O No. of FP0 expansion unit

I/O numbers do not need to be set as I/O allocation is performed automatically by the PLC when an expansion I/O unit is added.The I/O allocation of expansion unit is determined by the installation location.

Type of expansion unit		I/O No.		
		First expansion	Second expansion	Third expansion
E8X	Input: 8 points	X20 to X27	X40 to X47	X60 to X67
E8R	Input: 4 points	X20 to X23	X40 to X43	X60 to X63
	Output: 4 points	Y20 to Y23	Y40 to Y43	Y60 to Y63
E8YT/E8YR/E8YP	Output: 8 points	Y20 to Y27	Y40 to Y47	Y60 to Y67
E16X	Input: 16 points	X20 to X2F	X40 to X4F	X60 to X6F
E16R/E16T/E16P	Input: 8 points	X20 to X27	X40 to X47	X60 to X67
	Output: 8 points	Y20 to Y27	Y40 to Y47	Y60 to Y67
E16YT/E16YP	Output: 16 points	Y20 to Y2F	Y40 to Y4F	Y60 to Y6F
E32T/E32P	Input: 16 points	X20 to X2F	X40 to X4F	X60 to X6F
	Output: 16 points	Y20 to Y2F	Y40 to Y4F	Y60 to Y6F

I/O No. of FP0 analog I/O unit

The I/O allocation of FP0 analog I/O unit (FP0–A21) is determined by the installation location.

Unit		First expansion	Second expansion	Third expansion
Input	CH0: 16 points	WX2 (X20 to X2F)	WX4 (X40 to X4F)	WX6 (X60 to X6F)
	CH1: 16 points	WX3 (X30 to X3F)	WX5 (X50 to X5F)	WX7 (X70 to X7F)
Output: 16 points		WY2 (Y20 to Y2F)	WY4 (Y40 to Y4F)	WY6 (Y60 to Y6F)

I/O No. of FP0 A/D converter unit

The I/O allocation of FP0 A/D converter unit (FP0–A80) is determined by the installation location.

The data of the various channels is switched and read using a program that includes the flag for switching converted data.

Input channel of A/D converter unit	First expansion	Second expansion	Third expansion
CH0: 16 points, CH2: 16 points, CH4: 16 points and CH6: 16 points	WX2 (X20 to X2F)	WX4 (X40 to X4F)	WX6 (X60 to X6F)
CH1: 16 points, CH3: 16 points, CH5: 16 points and CH7: 16 points	WX3 (X30 to X3F)	WX5 (X50 to X5F)	WX7 (X70 to X7F)

I/O No. of FP0 I/O link unit

The I/O allocation of FP0 I/O link unit (FP0–IOL) is determined by the installation location.

Unit	First expansion	Second expansion	Third expansion
Input: 32 points	X20 to X3F	X40 to X5F	X60 to X7F
Output: 32 points	Y20 to Y3F	Y40 to Y5F	Y60 to Y7F

12.3 Relays, Memory Areas and Constants

Item			No. of memory area points and range available for use	Function
Relay	**External input relay**	**(X)**	512 points (X0 to X31F) (* Note 1)	Turn on or off based on external input.
	External output relay	**(Y)**	512 points (Y0 to Y31F) (* Note 1)	Externally outputs on or off state.
	Internal relay (* Note 2)	**(R)**	1,568 points (R0 to R97F)	Relay which turns on or off only within program.
	Link relay (* Note 2)	**(L)**	1,024 points (L0 to L63F)	This relay is a shared relay used for PLC link.
	Timer (* Note 2)	**(T)**	1,024 points (T0 to T1007/C1008 to C1023) (* Note 3)	This goes on when the timer reaches the specified time. It corresponds to the timer number.
	Counter (* Note 2)	**(C)**		This goes on when the timer increments. It corresponds to the timer number.
	Special internal relay	**(R)**	176 points (R9000 to R910F)	Relay which turns on or off based on specific conditions and is used as a flag.
Memory area	**External input relay**	**(WX)**	32 words (WX0 to WX31) (* Note 1)	Code for specifying 16 external input points as one word (16 bits) of data.
	External output relay	**(WY)**	32 words (WX0 to WY31) (* Note 1)	Code for specifying 16 external output points as one word (16 bits) of data.
	Internal relay (* Note 2)	**(WR)**	98 words (WR0 to WR97)	Code for specifying 16 internal relay points as one word (16 bits) of data.
	Link relay	**(WL)**	64 words (WL0 to WL63)	Code for specifying 16 link relay points as one word (16 bits) of data.
	Data register (* Note 2)	**(DT)**	32,765 words (DT0 to DT32764)	Data memory used in program. Data is handled in 16-bit units (one word).
	Link data register (* Note 2)	**(LD)**	128 words (LD0 to LD127)	This is a shared data memory which is used within the PLO link. Data is handled in 16-bit units (one word).
	Timer/Counter set value area (* Note 2)	**(SV)**	1,024 words (SV0 to SV1023)	Data memory for storing a target value of a timer and an initial value of a counter. Stores by timer/counter number.
	Timer/Counter set value area (* Note 2)	**(EV)**	1,024 words (EV0 to EV1023)	Data memory for storing the elapsed value during operation of a timer/counter. Stores by timer/ counter number.
	Special data register	**(DT)**	260 words (DT90000 to DT90259)	Data memory for storing specific data. Various settings and error codes are stored.
	Index register	**(I)**	14 words (I0 to ID)	Register can be used as an address of memory area and constants modifier.

Item		Range available for use
Constant	Decimal constants (integer type) (K)	K–32768 to K32767 (for 16-bit operation)
		K–2147483648 to K2147483647 (for 32-bit operation)
	Hexadecimal constants (H)	H0 to HFFFF (for 16-bit operation)
		H0 to HFFFFFFFF (for 32-bit operation)
	Decimal constants (monorefined real number) (F)	F–1.175494 $\times$ 10^{-38} to F–3.402823 $\times$ 10^{38}
		F1.175494 $\times$ 10^{-38} to F3.402823 $\times$ 10^{38}

Notes

1) **The number of points noted above is the number reserved as the calculation memory. The actual number of points available for use is determined by the hardware configuration.**
2) **If no battery is used, only the fixed area is backed up (counters: C1008 to C1023, internal relays: R900 to R97F, data registers: DT32710 to DT32764). When the optional battery is used, data can be backed up. Areas to be held and not held can be specified using the system registers.**
3) **The points for the timer and counter can be changed by the setting of system register 5. The number given in the table are the numbers when system register 5 is at its default setting.**

12.4 Table of System Registers

12.4.1 System Registers

What is the system register area

System registers are used to set values (parameters) which determine operation ranges and functions used. Set values based on the use and specifications of your program. There is no need to set system registers for functions which will not be used.

Type of system registers

Hold/non–hold type setting (System registers 5 to 8, 10, 12 and 14)
The values for the timer and counter can be specified by using system register no. 5 to specify the first number of the counter. System registers no. 6 to no. 8, no. 10, no. 12, and no. 14 are used to specify the area to be held when a battery is used.

Operation mode setting on error (System registers 4, 20,23 and 26)
Set the operation mode when errors such as battery error, duplicated use of output, I/O verification error and operation error occur.

Time settings (System registers 31 to 34)
Set time-out error detection time and the constant scan time.

MEWNET –W0 PLC link settings (System registers 40 to 45, and 47)
These settings are for using link relays and link registers for MEWNET–W0 PLC link communication.
Note that the default value setting is “no PLC link communication”

Input settings (System register 400 to 403)
When using the high–speed counter function, pulse catch function or interrupt function, set the operation mode and the input number to be used as a exclusive input.

Tool and COM. ports communication settings (System registers 410 to 419)
Set these registers when the tool port, COM.1 and COM.2 ports are to be used for computer link, general communication, PLC link and modem communication.
Note that the default value setting is “Computer link” mode.

Checking and changing the set value of system register

Using programming tool software

1. Set the control unit in the “PROG” mode.
2. Select “PLC Configuration” under “Option” on the menu bar.
3. When the function for which settings are to be entered is selected in the PLC Configuration dialog box, the value and setting status for the selected system register are displayed. To change the value and setting status, write in the new value and/or select the setting status.
4. To register these settings, click on the “OK” button.

Precautions for system register setting

Sytem register settings are effective from the time they are set.
However, MEWNET–W0 PLC link settings, input settings, tool port and COM. ports communication settings become effective when the mode is changed from PROG. to RUN. With regard to the modem connection setting, when the power is turned off and on or when the mode is changed from PROG. to RUN, the controller sends a command to the modem which enables it for reception.

When the initialized operation is performed, all set system register values (parameters) will be initialized.

12.4.2 Table of System Registers

Item	No.	Name	Default value	Descriptions
Hold/ Non–hold 1	**5**	Starting number setting for counter	1008	0 to 1024
	6	Hold type area starting number setting for timer and counter	1008	0 to 1024
	7	Hold type area starting number setting for internal relays	90	0 to 98
	8	Hold type area starting number setting for data registers	32710	0 to 32765
	14	Hold or non–hold setting for step ladder process	Non–hold	Hold/Non–hold
Hold/ Non–hold 2	**10**	Hold type area starting number for PLC link relays	64	0 to 64
	12	Hold type area starting number for PLC link registers	128	0 to 128
Action on error	**20**	Disable or enable setting for duplicated output	Disabled	Disabled/Enabled
	23	Operation setting when an I/O verification error occurs	Stop	Stop/Continuation of operation
	26	Operation setting when an operation error occurs	Stop	Stop/Continuation of operation
	4	Alarm Battery Error (Operating setting when battery error occurs)	Disabled	Disabled: When a battery error occurs, a self-diagnostic error is not issued and the ERROR/ALARM LED does not light. Enabled: When a battery error occurs, a self-diagnostic error is issued and the ERROR/ALARM LED lights.
Time setting	**31**	Wait time setting for multi-frame communication	6500.0 ms	10 to 81900 ms
	34	Constant value settings for scan time	0.0 ms	0: Normal scan 0 to 350 ms: Scans once each specified time interval.
PLC link setting	**40**	Range of link relays used for PLC link	0	0 to 64 words
	41	Range of link data registers used for PLC link	0	0 to 128 words
	42	Starting number for link relay transmission	0	0 to 63
	43	Link relay transmission size	0	0 to 64 words
	44	Starting number for link data register transmission	0	0 to 127
	45	Link data register transmission size	0	0 to 127 words
	47	Maximum unit number setting for MEWNET–W0 PLC link	16	1 to 16

Item	No.	Name	Default value	Descriptions	
High–speed count-er	**400**	High-speed counter operation mode settings (X0 to X2)	CH0: Do not set in-put X0 as high–speed counter	CH0	Do not set input X0 as high-speed counter. 2-phase input (X0, X1) 2-phase input (X0, X1), Reset input (X2) Incremental input (X0) Incremental input (X0), Reset input (X2) Decremental input (X0) Decremental input (X0), Reset input (X2) Individual input (X0, X1) Individual input (X0, X1), Reset input (X2) Direction decision (X0, X1) Direction decision (X0, X1), Reset input (X2)
			CH1: Do not set in-put X1 as high–speed counter	CH1	Do not set input X1 as high-speed counter. Incremental input (X1) Incremental input (X1), Reset input (X2) Decremental input (X1) Decremental input (X1), Reset input (X2)
	401	High-speed counter operation mode settings (X3 to X5)	CH2: Do not set in-put X3 as high–speed counter	CH2	Do not set input X3 as high-speed counter. 2-phase input (X3, X4) 2-phase input (X3, X4), Reset input (X5) Incremental input (X3) Incremental input (X3), Reset input (X5) Decremental input (X3) Decremental input (X3), Reset input (X5) Individual input (X3, X4) Individual input (X3, X4), Reset input (X5) Direction decision (X3, X4) Direction decision (X3, X4), Reset input (X5)
			CH3: Do not set in-put X4 as high–speed counter	CH3	Do not set input X4 as high-speed counter. Incremental input (X4) Incremental input (X4), Reset input (X5) Decremental input (X4) Decremental input (X4), Reset input (X5)

Item	No.	Name	Default value	Descriptions
Inter-rupt input	**402**	Pulse catch input settings	Not set	X0 X1 X2 X3 X4 X5 X6 X7 [| | | | | | |] Specify the input contacts used as pulse catch input.
	403	Interrupt input settings	Not set	X0 X1 X2 X3 X4 X5 X6 X7 [| | | | | | |] Specify the input contacts used as interrupt input. X0 X1 X2 X3 X4 X5 X6 X7 [| | | | | | |] Specify the effective interrupt edge. (When set: on → off is valid)

Notes

- **If the operation mode is set to 2–phase, individual, or direction decision, the setting for CH1 is invalid in system register 400 and the setting for CH3 is invalid in system register 401.**
- **If reset input settings overlap, the setting of CH1 takes precedence in system register 400 and the setting of CH3 takes precedence in system register 401.**
- **The settings for 402 and 403 are specified on the screen, for each contact.**
- **If system register 400 to 403 have been set simultaneously for the same input relay, the following precedence order is effective: [High–speed counter] ➧ [Pulse catch] ➧ [Interrupt input].**
  Example:
  When the high–speed counter is being used in the incremental input mode, even if input X0 is specified as an interrupt input and as pulse catch input, those settings are invalid, and input X0 functions as counter input for the high–speed counter.

Item	No.	Name	Default value	Descriptions
Tool port setting	**410**	Unit No. setting	1	1 to 99
	412	Selection of modem connection	Disabled	Enabled/Disabled
	413	Communication format setting	Character bit: 8 bits, Parity check: “with, odd” Stop bit: 1 bit	Enter the settings for the various items. Character bit: 7bits/8bits Parity chk: none/with odd/with even Stop bit: 1bit/2bits
	415	Communication speed (Baud rate) setting	9600 bps	2400 bps 4800 bps 9600 bps 19200 bps 38400 bps 57600 bps 115200 bps
COM. 1 port setting	**410**	Unit No. setting	1	0 to 99
	412	Communication mode setting	Computer link	Computer link General communication PLC link
		Selection of modem connection	Disabled	Enabled/Disabled
	413	Communication format setting	Character bit: 8 bits, Parity check: “with, odd” Stop bit: 1 bit	Enter the settings for the various items. Character bit: 7bits/8bits Parity chk: none/with odd/with even Stop bit: 1bit/2bits The following setting is valid only when the communication mode specified by system register 412 has been set to “General communication”. End code (Terminator): CR/CR+LF/None Start code (Header): STX not exist/STX exist
	415	Communication speed (Baud rate) setting	9600 bps	2400 bps 4800 bps 9600 bps 19200 bps 38400 bps 57600 bps 115200 bps
	416	Starting address for received buffer of general (serial data) communication mode	0	0 to 32764
	417	Buffer capacity setting for data received of general (serial data) communication mode	2048	0 to 2048

Note

The communication format when using the PLC link is fixed at the following settings: the data length is 8 bits, odd parity, 1 stop bit. The baud rate is fixed at 115,200 bps.

Item	No.	Name	Default value	Descriptions
COM. 2 port set-ting	**411**	Unit No. setting	1	1 to 99
	412	Communication mode setting	Computer link	Computer link General communication
		Selection of modem connection	Disabled	Enabled/Disabled
	414	Communication format setting	Character bit: 8 bits, Parity check: “with, odd” Stop bit: 1 bit	Enter the settings for the various items. Character bit: 7bits/8bits Parity chk: none/with odd/with even Stop bit: 1bit/2bits The following setting is valid only when the communication mode specified by system register 412 has been set to “General communication”. End code (Terminator): CR/CR+LF/None Start code (Header): STX not exist/STX exist
	415	Communication speed (Baud rate) setting	9600 bps	2400 bps 4800 bps 9600 bps 19200 bps 38400 bps 57600 bps 115200 bps
	418	Starting address for received buffer of general (serial data) communication mode	2048	0 to 32764
	419	Buffer capacity setting for data received of general (serial data) communication mode	2048	0 to 2048

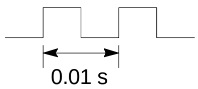
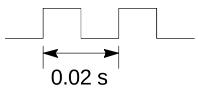
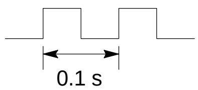
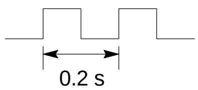
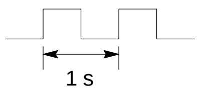
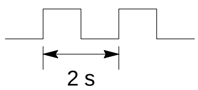
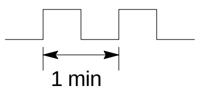
Note

The communication format when using the PLC link is fixed at the following settings: the data length is 8 bits, odd parity, 1 stop bit. The baud rate is fixed at 115,200 bps.

12.5 Table of Special Internal Relays

The special internal relays turn on and off under special conditions. The on and off states are not output externally. Writing is not possible with a programming tool or an instruction.

Relay No.	Name	Description
R9000	Self-diagnostic error flag	Turns on when a self-diagnostic error occurs. The content of self-diagnostic error is stored in DT90000.
R9001	Not used	———
R9002	Not used	———
R9003	Not used	———
R9004	I/O verification error flag	Turns on when an I/O verification error occurs.
R9005	Backup battery error flag (non-hold)	Turns on for an instant when a backup battery error occurs.
R9006	Backup battery error flag (hold)	Turns on and keeps the on state when a backup battery error occurs. Once a battery error has been detected, this is held even after recovery has been made. It goes off if the power supply is turned off, or if the system is initialized.
R9007	Operation error flag (hold)	Turns on and keeps the on state when an operation error occurs. The address where the error occurred is stored in DT90017. (indicates the first operation error which occurred).
R9008	Operation error flag (non-hold)	Turns on for an instant when an operation error occurs. The address where the operation error occurred is stored in DT90018. The contents change each time a new error occurs.
R9009	Carry flag	This is set if an overflow or underflow occurs in the calculation results, and as a result of a shift system instruction being executed.
R900A	> flag	Turns on for an instant when the compared results become larger in the comparison instructions.
R900B	= flag	Turns on for an instant, – when the compared results are equal in the comparison instructions. – when the calculated results become 0 in the arithmetic instructions.
R900C	< flag	Turns on for an instant when the compared results become smaller in the comparison instructions".
R900D	Auxiliary timer instruction flag	Turns on when the set time elapses (set value reaches 0) in the timing operation of the **F137 (STMR)/F183 (DSTM)** auxiliary timer instruction. The this flag turns off when the trigger for auxiliary timer instruction turns off.
R900E	Tool port communication error	Turns on when communication error at tool port is occurred.
R900F	Constant scan error flag	Turns on when scan time exceeds the time specified in system register 34 during constant scan execution. This goes on if 0 has been set using system register 34.

Relay No.	Name	Description
R9010	Always on relay	Always on.
R9011	Always off relay	Always off.
R9012	Scan pulse relay	Turns on and off alternately at each scan
R9013	Initial (on type) pulse relay	This goes on for only the first scan after operation (RUN) has been started, and goes off for the second and subsequent scans.
R9014	Initial (off type) pulse relay	This goes off for only the first scan after operation (RUN) has been started, and goes on for the second and subsequent scans.
R9015	Step ladder initial pulse relay (on type)	Turns on for an instant only in the first scan of the process the moment the step ladder process is opened.
R9016	Not used	
R9017	Not used	
R9018	0.01 s clock pulse relay	Repeats on/off operations in 0.01 s cycles. 
R9019	0.02 s clock pulse relay	Repeats on/off operations in 0.02 s cycles. 
R901A	0.1 s clock pulse relay	Repeats on/off operations in 0.1 s cycles. 
R901B	0.2 s clock pulse relay	Repeats on/off operations in 0.2 s cycles. 
R901C	1 s clock pulse relay	Repeats on/off operations in 1 s cycles. 
R901D	2 s clock pulse relay	Repeats on/off operations in 2 s cycles. 
R901E	1 min clock pulse relay	Repeats on/off operations in 1 min cycles. 
R901F	Not used	

Relay No.	Name	Description
R9020	RUN mode flag	Turns off while the mode selector is set to PROG. Turns on while the mode selector is set to RUN.
R9021	Not used	————
R9022	Not used	————
R9023	Not used	————
R9024	Not used	————
R9025	Not used	————
R9026	Message flag	Turns on while the **F149 (MSG)** instruction is executed.
R9027	Not used	————
R9028	Not used	————
R9029	Forcing flag	Turns on during forced on/off operation for input/output relay and timer/counter contacts.
R902A	Interrupt enable flag	Turns on while the external interrupt trigger is enabled by the **ICTL** instruction.
R902B	Interrupt error flag	Turns on when an interrupt error occurs.
R902C	Not used	————
R902D	Not used	————
R902E	Not used	————
R902F	Not used	————

Relay No.	Name		Description
R9030	Not used		—
R9031	Not used		—
R9032	COM. 1 port communication mode flag		This is on when the general–purpose communication function is being used. It goes off when the MEWTOCOL–COM or the PLC link function is being used.
R9033	Print instruction execution flag		Off: Printing is not executed. On: Execution is in progress.
R9034	Run overwrite complete flag		This is the special internal relay that goes on for only the first scan following completion of a rewrite during the RUN operation.
R9035	Not used		—
R9036	Not used		—
R9037	COM.1 port communication error flag		This goes on if a transmission error occurs during data communication. This goes off when a request is made to send data, using the **F159 (MTRN)** instruction.
R9038	COM.1 port reception done flag during general purpose communicating		Turns on when the end code is received during the general purpose communicating.
R9039	COM.1 port transmission done flag during general purpose communicating		This goes on when transmission has been completed when using general–purpose communication. It goes off when transmission is requested when using general–purpose communication.
R903A	High–speed counter control flag	ch0	Turns on while the high–speed counter instructions **F166 (HC1S)**, **F167 (HC1R)** and the pulse output instructions “**F171 (SPDH)** to **F173 (PWMH)**” are executed.
R903B	High–speed counter control flag	ch1	Turns on while the high–speed counter instructions **F166 (HC1S)**, **F167 (HC1R)** and the pulse output instructions “**F171 (SPDH)** to **F173 (PWMH)**” are executed.
R903C	High–speed counter control flag	ch2	Turns on while the high–speed counter instructions **F166 (HC1S)**, **F167 (HC1R)** and the pulse output instructions “**F171 (SPDH)** to **F173 (PWMH)**” are executed.
R903D	High–speed counter control flag	ch3	Turns on while the high–speed counter instructions **F166 (HC1S)**, **F167 (HC1R)** and the pulse output instructions “**F171 (SPDH)** to **F173 (PWMH)**” are executed.
R903E	Not used		—
R903F	Not used		—

Relay No.	Name	Description
R9040	Not used	————
R9041	COM. 1 port PLC link flag	Turns on while PLC link function is used.
R9042	COM. 2 port communication mode flag	This goes on when the general–purpose communication function is used. It goes off when MEWTOCOL is used.
R9043 to R9046	Not used	————
R9047	COM.2 port communication error flag	This goes on if a transmission error occurs during data communication. This goes off when a request is made to send data, using the F159 (MTRN) instruction.
R9048	COM.2 port reception done flag during general purpose communicating	Turns on when the end code is received during the general–purpose communication.
R9049	COM.2 port transmission done flag during general purpose communicating	This goes on when transmission has been completed when using general–purpose communication. It goes off when transmission is requested when using general–purpose communication.
R904A to R904F	Not used	————
R9050	MEWNET–W0 PLC link transmission error flag	When using MEWNET-W0 – turns on when transmission error occurs at PLC link. – turns on when there is an error in the PLC link area settings.
R9051 to R905F	Not used	————

Relay No.	Name		Description
R9060	MEWNET–W0 PLC link transmission assurance relay	Unit No. 1	Turns on when Unit No. 1 is communicating properly in the PLC link mode. Turns off when operation is stopped, when an error is occurring, or when not in the PLC link mode.
R9061		Unit No. 2	Turns on when Unit No. 2 is communicating properly in the PLC link mode. Turns off when operation is stopped, when an error is occurring, or when not in the PLC link mode.
R9062		Unit No. 3	Turns on when Unit No. 3 is communicating properly in the PLC link mode. Turns off when operation is stopped, when an error is occurring, or when not in the PLC link mode.
R9063		Unit No. 4	Turns on when Unit No. 4 is communicating properly in the PLC link mode. Turns off when operation is stopped, when an error is occurring, or when not in the PLC link mode.
R9064		Unit No. 5	Turns on when Unit No. 5 is communicating properly in the PLC link mode. Turns off when operation is stopped, when an error is occurring, or when not in the PLC link mode.
R9065		Unit No. 6	Turns on when Unit No. 6 is communicating properly in the PLC link mode. Turns off when operation is stopped, when an error is occurring, or when not in the PLC link mode.
R9066		Unit No. 7	Turns on when Unit No. 7 is communicating properly in the PLC link mode. Turns off when operation is stopped, when an error is occurring, or when not in the PLC link mode.
R9067		Unit No. 8	Turns on when Unit No. 8 is communicating properly in the PLC link mode. Turns off when operation is stopped, when an error is occurring, or when not in the PLC link mode.
R9068		Unit No. 9	Turns on when Unit No. 9 is communicating properly in the PLC link mode. Turns off when operation is stopped, when an error is occurring, or when not in the PLC link mode.
R9069		Unit No. 10	Turns on when Unit No. 10 is communicating properly in the PLC link mode. Turns off when operation is stopped, when an error is occurring, or when not in the PLC link mode.
R906A		Unit No. 11	Turns on when Unit No. 11 is communicating properly in the PLC link mode. Turns off when operation is stopped, when an error is occurring, or when not in the PLC link mode.
R906B		Unit No. 12	Turns on when Unit No. 12 is communicating properly in the PLC link mode. Turns off when operation is stopped, when an error is occurring, or when not in the PLC link mode.
R906C		Unit No. 13	Turns on when Unit No. 13 is communicating properly in the PLC link mode. Turns off when operation is stopped, when an error is occurring, or when not in the PLC link mode.
R906D		Unit No. 14	Turns on when Unit No. 14 is communicating properly in the PLC link mode. Turns off when operation is stopped, when an error is occurring, or when not in the PLC link mode.
R906E		Unit No. 15	Turns on when Unit No. 15 is communicating properly in the PLC link mode. Turns off when operation is stopped, when an error is occurring, or when not in the PLC link mode.
R906F		Unit No. 16	Turns on when Unit No. 16 is communicating properly in the PLC link mode. Turns off when operation is stopped, when an error is occurring, or when not in the PLC link mode.

Relay No.	Name		Description
R9070	MEWNET–W0 PLC link operation mode relay	Unit No. 1	Turns on when unit No. 1 is in the RUN mode. Turns off when unit No. 1 is in the PROG. mode.
R9071		Unit No. 2	Turns on when unit No. 2 is in the RUN mode. Turns off when unit No. 2 is in the PROG. mode.
R9072		Unit No. 3	Turns on when unit No. 3 is in the RUN mode. Turns off when unit No. 3 is in the PROG. mode.
R9073		Unit No. 4	Turns on when unit No. 4 is in the RUN mode. Turns off when unit No. 4 is in the PROG. mode.
R9074		Unit No. 5	Turns on when unit No. 5 is in the RUN mode. Turns off when unit No. 5 is in the PROG. mode.
R9075		Unit No. 6	Turns on when unit No. 6 is in the RUN mode. Turns off when unit No. 6 is in the PROG. mode.
R9076		Unit No. 7	Turns on when unit No. 7 is in the RUN mode. Turns off when unit No. 7 is in the PROG. mode.
R9077		Unit No. 8	Turns on when unit No. 8 is in the RUN mode. Turns off when unit No. 8 is in the PROG. mode.
R9078		Unit No. 9	Turns on when unit No. 9 is in the RUN mode. Turns off when unit No. 9 is in the PROG. mode.
R9079		Unit No. 10	Turns on when unit No. 10 is in the RUN mode. Turns off when unit No. 10 is in the PROG. mode.
R907A		Unit No. 11	Turns on when unit No. 11 is in the RUN mode. Turns off when unit No. 11 is in the PROG. mode.
R907B		Unit No. 12	Turns on when unit No. 12 is in the RUN mode. Turns off when unit No. 12 is in the PROG. mode.
R907C		Unit No. 13	Turns on when unit No. 13 is in the RUN mode. Turns off when unit No. 13 is in the PROG. mode.
R907D		Unit No. 14	Turns on when unit No. 14 is in the RUN mode. Turns off when unit No. 14 is in the PROG. mode.
R907E		Unit No. 15	Turns on when unit No. 15 is in the RUN mode. Turns off when unit No. 15 is in the PROG. mode.
R907F		Unit No. 16	Turns on when unit No. 16 is in the RUN mode. Turns off when unit No. 16 is in the PROG. mode.

12.6 Table of Special Data Registers

The special data registers are one word (16-bit) memory areas which store specific information.

(A: Available, N/A: Not available)

Address	Name	Description	Reading	Writing
DT90000	Self–diagnostic error code	The self-diagnostic error code is stored here when a self-diagnostic error occurs.	A	N/A
DT90001 to DT90003	Not used	———	N/A	N/A
DT90004	I/O verify error flag	Turns on when I/O verification error occurs.	A	N/A
DT90005 to DT90013	Not used	———	N/A	N/A
DT90014	Operation auxiliary register for data shift instruction	One shift-out hexadecimal digit is stored in bit positions 0 to 3 when the data shift instruction, **F105 (BSR)** or **F106 (BSL)** is executed.	A	N/A
DT90015	Operation auxiliary register for division instruction	The divided remainder (16-bit) is stored in DT90015 when the division instruction **F32 (%)** or **F52 (B%)** instruction is executed. The divided remainder (32-bit) is stored in DT90015 and DT90016 when the division instruction **F33 (D%)** or **F53 (DB%)** is executed. The value can be read and written by executing F0 (MV) instruction.	A	N/A
DT90016				
DT90017	Operation error address (hold type)	After commencing operation, the address where the first operation error occurred is stored. Monitor the address using decimal display.	A	N/A
DT90018	Operation error address (non-hold type)	The address where a operation error occurred is stored. Each time an error occurs, the new address overwrites the previous address. At the beginning of scan, the address is 0. Monitor the address using decimal display.	A	N/A
DT90019	2.5ms ring counter	The data stored here is increased by one every 2.5ms. (H0 to HFFFF) Difference between the values of the two points (absolute value) × 2.5ms = Elapsed time between the two points.	A	N/A
DT90020	Not used	———	N/A	N/A
DT90021	Not used	———		
DT90022	Scan time (current value) (* Note)	The current scan time is stored here. Scan time is calculated using the formula: Scan time (ms) = stored data (decimal) × 0.1ms Example: K50 indicates 5ms.	A	N/A

(A: Available, N/A: Not available)

Address	Name	Description	Reading	Writing
DT90023	Scan time (minimum value) (* Note)	The minimum scan time is stored here. Scan time is calculated using the formula: Scan time (ms) = stored data (decimal) × 0.1ms Example: K50 indicates 5ms.	A	N/A
DT90024	Scan time (maximum value) (* Note)	The maximum scan time is stored here. Scan time is calculated using the formula: Scan time (ms) = stored data (decimal) × 0.1ms Example: K125 indicates 12.5ms.	A	N/A

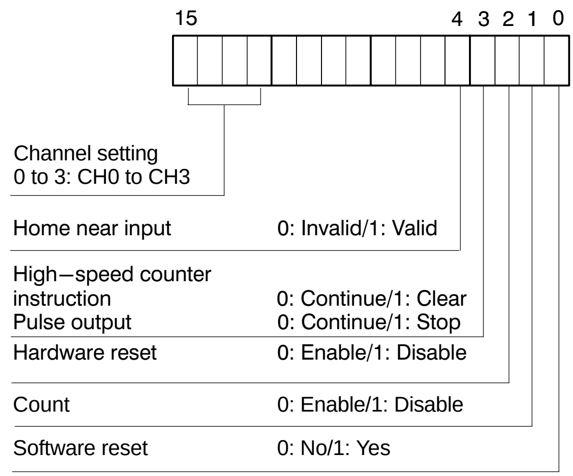
Note

Scan time display is only possible in RUN mode, and shows the operation cycle time. (In the PROG. mode, the scan time for the operation is not displayed.) The maximum and minimum values are cleared when each the mode is switched between RUN mode and PROG. mode.

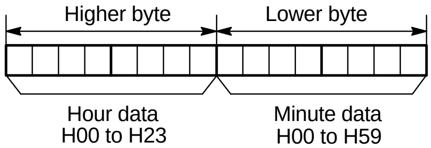
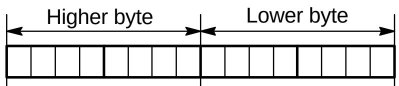
(A: Available, N/A: Not available)

Address	Name	Description	Reading	Writing
DT90025	Mask condition monitoring register for interrupts (INT 0 to 7)	The mask conditions of interrupts using **ICTL** instruction can be stored here. Monitor using binary display. 15 11 7 3 0 (Bit No.) 23 19 16 (INT No.) 0: interrupt disabled (masked) 1: interrupt enabled (unmasked)	A	N/A
DT90026	Not used	————————	N/A	N/A
DT90027	Periodical interrupt interval (INT 24)	The value set by **ICTL** instruction is stored. – K0: periodical interrupt is not used – K1 to K3000: 0.5ms to 1.5s or 10ms to 30s	A	N/A
DT90028	Not used	————————	N/A	N/A
DT90029	Not used	————————		
DT90030	Message 0	The contents of the specified message are stored in these special data registers when **F149 (MSG)** instruction is executed.	A	N/A
DT90031	Message 1			
DT90032	Message 2			
DT90033	Message 3			
DT90034	Message 4			
DT90035	Message 5			
DT90036	Not used	————————	N/A	N/A
DT90037	Operation auxiliary register for search instruction “F96 (SRC)”	The number of data that match the searched data is stored here when **F96 (SRC)** instruction is executed.	A	N/A
DT90038	Operation auxiliary register for instruction “F96 (SRC)”	The position of the first matching data is stored here when an **F96 (SRC)** instruction is executed.	A	N/A
DT90039	Not used	————————	N/A	N/A
DT90040	Potentiometer (volume) input V0	The potentiometer value (K0 to K1000) is stored here. This value can be used in analog timers and other applications by using the program to read this value to a data register. V0→DT90040 V1→DT90041	A	N/A
DT90041	Potentiometer (volume) input V1			
DT90042	————————	Used by the system.	N/A	N/A
DT90043	————————	Used by the system.	N/A	N/A

(A: Available, N/A: Not available)

Address	Name		Description	Reading	Writing
DT90044 **DT90045**	High-speed counter elapsed value	For ch0	The elapsed value (32–bit data) for the high–speed counter is stored here. The value can be read and written by executing **F1 (DMV)** instruction.	A	A
DT90046 **DT90047**	High-speed counter target value	For ch0	The target value (32–bit data) of the high–speed counter specified by the high–speed counter instruction is stored here. Target values have been preset for the various instructions, to be used when the high–speed counter related instruction **F166,F167,and F171 to F173** is executed.The value can be read by executing F1 (DMV) instruction.	A	N/A
DT90048 **DT90049**	High-speed counter elapsed value area	For ch1	The elapsed value (32–bit data) for the high–speed counter is stored here.The value can be read and written by executing **F1 (DMV)**instruction.	A	A
DT90050 **DT90051**	High-speed counter target value area	For ch1	The target value (32–bit data) of the high–speed counter specified by the high–speed counter instruction is stored here. Target values have been preset for the various instructions, to be used when the high–speed counter related instruction **F166,F167,and F171 to F173** is executed.The value can be read by executing F1 (DMV) instruction.	A	N/A
DT90052	High–speed counter and pulse output control flag		A value can be written with **F0 (MV)** instruction to reset the high-speed counter, disable counting, continue or clear high-speed counter instruction. Control code setting 	N/A	A

(A: Available, N/A: Not available)

Address	Name	Description	Reading	Writing
DT90053	Clock/calendar monitor (hour/minute)	Hour and minute data of the clock/calendar are stored here. This data is read-only data; it cannot be overwritten. 	A	N/A
DT90054	Clock/calendar setting (minute/second)	The year, month, day, hour, minute, second, and day-of-the-week data for the calendar timer is stored. The built-in calendar timer will operate correctly through the year 2099 and supports leap years. The calendar timer can be set (the time set) by writing a value using a programming tool software or a program that uses the **F0 (MV)** instruction. 	A	A
DT90055	Clock/calendar setting (day/hour)			
DT90056	Clock/calendar setting (year/month)			
DT90057	Clock/calendar setting (day-of-the-week)			

	Higher byte	Lower byte
DT90054	Minute data H00 to H59	Second data H00 to H59
DT90055	Day data H01 to H31	Hour data H00 to H23
DT90056	Year data H00 to H99	Month data H01 to H12
DT90057	———	Day-of-the-week data H00 to H06

(A: Available, N/A: Not available)

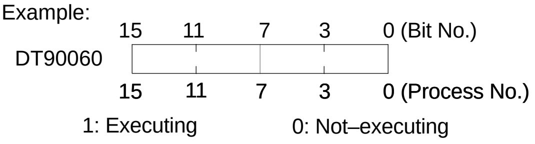
Address	Name	Description	Reading	Writing
DT90058	Clock/calendar time setting and 30 seconds correction register	The clock/calendar is adjusted as follows. **When setting the clock/calendar by program** By setting the the highest bit of DT90058 to 1, the time becomes that written to DT90054 to DT90057 by **F0 (MV)** instruction. After the time is set, DT90058 is cleared to 0. (Cannot be performed with any instruction other than **F0 (MV)** instruction.) Example: Set the time to 12:00:00 on the 5th day when the X0 turns on. X0 (DF) [F0 MV, H 0, DT90054] — Inputs 0 minutes and 0 seconds [F0 MV, H 512, DT90055] — Inputs 12th hour 5th day [F0 MV, H8000, DT90058] — Sets the time If you changed the values of DT90054 to DT90057 with the programming tool software, the time will be set when the new values are written. Therefore, it is unnecessary to write to DT90058. When the correcting times less than 30 seconds By setting the lowest bit of DT90058 to 1, the value will be moved up or down and become exactly 0 seconds. After the correction is completed, DT90058 is cleared to 0. Example: Correct to 0 seconds with X0 turns on X0 (DF) [F0 MV, H 1, DT90058] — Correct to 0 second At the time of correction, if between 0 and 29 seconds, it will be moved down, and if the between 30 and 59 seconds, it will be moved up. In the example above, if the time was 5 minutes 29 seconds, it will become 5 minutes 0 second; and, if the time was 5 minutes 35 seconds, it will become 6 minutes 0 second.	A	A

(A: Available, N/A: Not available)

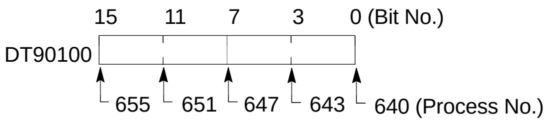
<table>
<tr><th>Address</th><th>Name</th><th>Description</th><th>Reading</th><th>Writing</th></tr>
<tr><td>DT90059</td><td>Serial communication error code</td><td>Error code is stored here when a communication error occurs.</td><td>N/A</td><td>N/A</td></tr>
<tr><td>DT90060</td><td>Step ladder process (0 to 15)</td><td rowspan="17">Indicates the startup condition of the step ladder process. When the proccess starts up, the bit corresponding to the process number turns on “1”.
Monitor using binary display.
Example:
15 11 7 3 0 (Bit No.)
DT90060
15 11 7 3 0 (Process No.)
1: Executing 0: Not–executing

A programming tool software can be used to write data.</td><td rowspan="17">A</td><td rowspan="17">A</td></tr>
<tr><td>DT90061</td><td>Step ladder process (16 to 31)</td></tr>
<tr><td>DT90062</td><td>Step ladder process (32 to 47)</td></tr>
<tr><td>DT90063</td><td>Step ladder process (48 to 63)</td></tr>
<tr><td>DT90064</td><td>Step ladder process (64 to 79)</td></tr>
<tr><td>DT90065</td><td>Step ladder process (80 to 95)</td></tr>
<tr><td>DT90066</td><td>Step ladder process (96 to 111)</td></tr>
<tr><td>DT90067</td><td>Step ladder process (112 to 127)</td></tr>
<tr><td>DT90068</td><td>Step ladder process (128 to 143)</td></tr>
<tr><td>DT90069</td><td>Step ladder process (144 to 159)</td></tr>
<tr><td>DT90070</td><td>Step ladder process (160 to 175)</td></tr>
<tr><td>DT90071</td><td>Step ladder process (176 to 191)</td></tr>
<tr><td>DT90072</td><td>Step ladder process (192 to 207)</td></tr>
<tr><td>DT90073</td><td>Step ladder process (208 to 223)</td></tr>
<tr><td>DT90074</td><td>Step ladder process (224 to 239)</td></tr>
<tr><td>DT90075</td><td>Step ladder process (240 to 255)</td></tr>
<tr><td>DT90076</td><td>Step ladder process (256 to 271)</td></tr>
</table>

(A: Available, N/A: Not available)

Address	Name	Description	Reading	Writing
DT90077	Step ladder process (272 to 287)	Indicates the startup condition of the step ladder process. When the proccess starts up, the bit corresponding to the process number turns on "1". Monitor using binary display. Example:  A programming tool software can be used to write data.	A	A
DT90078	Step ladder process (288 to 303)			
DT90079	Step ladder process (304 to 319)			
DT90080	Step ladder process (320 to 335)			
DT90081	Step ladder process (336 to 351)			
DT90082	Step ladder process (352 to 367)			
DT90083	Step ladder process (368 to 383)			
DT90084	Step ladder process (384 to 399)			
DT90085	Step ladder process (400 to 415)			
DT90086	Step ladder process (416 to 431)			
DT90087	Step ladder process (432 to 447)			
DT90088	Step ladder process (448 to 463)			
DT90089	Step ladder process (464 to 479)			
DT90090	Step ladder process (480 to 495)			
DT90091	Step ladder process (496 to 511)			
DT90092	Step ladder process (512 to 527)			
DT90093	Step ladder process (528 to 543)			
DT90094	Step ladder process (544 to 559)			
DT90095	Step ladder process (560 to 575)			
DT90096	Step ladder process (576 to 591)			
DT90097	Step ladder process (592 to 607)			

(A: Available, N/A: Not available)

<table>
<tr><th>Address</th><th>Name</th><th>Description</th><th>Reading</th><th>Writing</th></tr>
<tr><td>DT90098</td><td>Step ladder process (608 to 623)</td><td rowspan="25">Indicates the startup condition of the step ladder process. When the proccess starts up, the bit corresponding to the process number turns on “1”.
Monitor using binary display.
Example:

1: Executing 0: Not–executing
A programming tool software can be used to write data.</td><td rowspan="25">A</td><td rowspan="25">A</td></tr>
<tr><td>DT90099</td><td>Step ladder process (624 to 639)</td></tr>
<tr><td>DT90100</td><td>Step ladder process (640 to 655)</td></tr>
<tr><td>DT90101</td><td>Step ladder process (656 to 671)</td></tr>
<tr><td>DT90102</td><td>Step ladder process (672 to 687)</td></tr>
<tr><td>DT90103</td><td>Step ladder process (688 to 703)</td></tr>
<tr><td>DT90104</td><td>Step ladder process (704 to 719)</td></tr>
<tr><td>DT90105</td><td>Step ladder process (720 to 735)</td></tr>
<tr><td>DT90106</td><td>Step ladder process (736 to 751)</td></tr>
<tr><td>DT90107</td><td>Step ladder process (752 to 767)</td></tr>
<tr><td>DT90108</td><td>Step ladder process (768 to 783)</td></tr>
<tr><td>DT90109</td><td>Step ladder process (784 to 799)</td></tr>
<tr><td>DT90110</td><td>Step ladder process (800 to 815)</td></tr>
<tr><td>DT90111</td><td>Step ladder process (816 to 831)</td></tr>
<tr><td>DT90112</td><td>Step ladder process (832 to 847)</td></tr>
<tr><td>DT90113</td><td>Step ladder process (848 to 863)</td></tr>
<tr><td>DT90114</td><td>Step ladder process (864 to 879)</td></tr>
<tr><td>DT90115</td><td>Step ladder process (880 to 895)</td></tr>
<tr><td>DT90116</td><td>Step ladder process (896 to 911)</td></tr>
<tr><td>DT90117</td><td>Step ladder process (912 to 927)</td></tr>
<tr><td>DT90118</td><td>Step ladder process (928 to 943)</td></tr>
<tr><td>DT90119</td><td>Step ladder process (944 to 959)</td></tr>
<tr><td>DT90120</td><td>Step ladder process (960 to 975)</td></tr>
<tr><td>DT90121</td><td>Step ladder process (976 to 991)</td></tr>
<tr><td>DT90122</td><td>Step ladder process (992 to 999)
(Higher byte: not used)</td></tr>
</table>

(A: Available, N/A: Not available)

Address	Name	Description	Reading	Writing
DT90123 to DT90125	Not used	————	N/A	N/A
DT90126	Forced on/off operating unit No. display	Used by the system.		
DT90127 to DT90139	Not used	————		
DT90140	MEWNET–W0 PLC link status	The number of times the receiving operation is performed.	A	N/A
DT90141		The current interval between two receiving operations: value in the register × 2.5ms		
DT90142		The minimum interval between two receiving operations: value in the register × 2.5ms		
DT90143		The maximum interval between two receiving operations: value in the register × 2.5ms		
DT90144		The number of times the sending operation is performed.		
DT90145		The current interval between two sending operations: value in the register × 2.5ms		
DT90146		The minimum interval between two sending operations: value in the register × 2.5ms		
DT90147		The maximum interval between two sending operations: value in the register × 2.5ms		
DT90148 to DT90155	Not used	————	N/A	N/A
DT90156	MEWNET–W0 PLC link status	Area used for measurement of receiving interval.	A	N/A
DT90157		Area used for measurement of sending interval.		
DT90158	Not used	————	N/A	N/A
DT90159				
DT90160	MEWNET–W0 PLC link unit No.	Stores the unit No. of PLC link	A	N/A
DT90161	MEWNET–W0 PLC link error flag	Stores the error contents of PLC link	A	N/A
DT90162 to DT90169	Not used	————	N/A	N/A

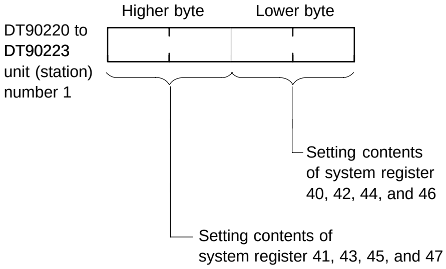
(A: Available, N/A: Not available)

Address	Name		Description	Reading	Writing
DT90170	MEWNET–W0 PLC link status		Duplicated destination for PLC inter–link address	A	N/A
DT90171			Counts how many times a token is lost.		
DT90172			Counts how many times two or more tokens are detected.		
DT90173			Counts how many times a signal is lost.		
DT90174			No. of times undefined commands have been received		
DT90175			No. of times sum check errors have occurred during reception		
DT90176			No. of times format errors have occurred in received data		
DT90177			No. of times transmission errors have occurred		
DT90178			No. of times procedural errors have occurred		
DT90179			No. of times overlapping parent units have occurred		
DT90180 to DT90189	Not used		———	N/A	N/A
DT90190	High–speed counter control flag monitor for ch0		This monitors the data specified in DT90052. Bits 4 3 2 1 0: Home near input 0: Invalid/1: Valid High–speed counter instruction 0: Continue/1: Clear Pulse output 0: Continue/1: Stop Hardware reset 0: Enable/1: Disable Count 0: Enable/1: Disable Software reset 0: No/1: Yes	A	N/A
DT90191	High–speed counter control flag monitor for ch1				
DT90192	High–speed counter control flag monitor for ch2				
DT90193	High–speed counter control flag monitor for ch3				
DT90194 to DT90199	Not used		———	N/A	N/A
DT90200	High–speed counter elapsed value	For ch2	The elapsed value (32–bit data) for the high–speed counter is stored here. The value can be read and written by executing **F1 (DMV)** instruction.	A	A
DT90201					
DT90202	High–speed counter target value	For ch2	The target value (32–bit data) of the high–speed counter specified by the high–speed counter instruction is stored here. Target values have been preset for the various instructions, to be used when the high–speed counter related instruction **F166, F167, and F171 to F173** is executed. The value can be read by executing **F1 (DMV)** instruction.	A	N/A
DT90203					
DT90204	High–speed counter elapsed value	For ch3	The elapsed value (32–bit data) for the high–speed counter is stored here.The value can be read and written by executing **F1 (DMV)**instruction.	A	A
DT90205					

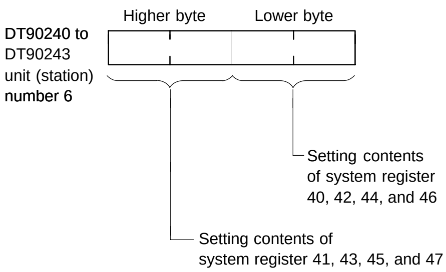
(A: Available, N/A: Not available)

Address	Name		Description	Reading	Writing
DT90206 **DT90207**	High–speed counter target value	For ch3	The target value (32–bit data) of the high–speed counter specified by the high–speed counter instruction is stored here. Target values have been preset for the various instructions, to be used when the high–speed counter related instruction **F166, F167, and F171 to F173** is executed. The value can be read by executing **F1 (DMV)** instruction.	A	N/A
DT90208 to DT90218	Not used		———	N/A	N/A

(A: Available, N/A: Not available)

<table>
<tr><th>Address</th><th colspan="2">Name</th><th>Description</th><th>Reading</th><th>Writing</th></tr>
<tr><td>DT90219</td><td colspan="2">Unit (station) No. selection for DT90220 to DT90251</td><td>0: Unit (station) number 1 to 8, 1: Unit (station) number 9 to 16</td><td>A</td><td>N/A</td></tr>
<tr><td>DT90220</td><td rowspan="4">PLC link unit (station) No.1 or 9</td><td>System register 40 and 41</td><td rowspan="20">The contents of the system register settings pertaining to the PLC inter–link function for the various unit numbers are stored as shown below.
Example:
When DT90219 is 0

</td><td rowspan="20">A</td><td rowspan="20">N/A</td></tr>
<tr><td>DT90221</td><td>System register 42 and 43</td></tr>
<tr><td>DT90222</td><td>System register 44 and 45</td></tr>
<tr><td>DT90223</td><td>System register 46 and 47</td></tr>
<tr><td>DT90224</td><td rowspan="4">PLC link unit (station) No.2 or 10</td><td>System register 40 and 41</td></tr>
<tr><td>DT90225</td><td>System register 42 and 43</td></tr>
<tr><td>DT90226</td><td>System register 44 and 45</td></tr>
<tr><td>DT90227</td><td>System register 46 and 47</td></tr>
<tr><td>DT90228</td><td rowspan="4">PLC link unit (station) No.3 or 11</td><td>System register 40 and 41</td></tr>
<tr><td>DT90229</td><td>System register 42 and 43</td></tr>
<tr><td>DT90230</td><td>System register 44 and 45</td></tr>
<tr><td>DT90231</td><td>System register 46 and 47</td></tr>
<tr><td>DT90232</td><td rowspan="4">PLC link unit (station) No.4 or 12</td><td>System register 40 and 41</td></tr>
<tr><td>DT90233</td><td>System register 42 and 43</td></tr>
<tr><td>DT90234</td><td>System register 44 and 45</td></tr>
<tr><td>DT90235</td><td>System register 46 and 47</td></tr>
<tr><td>DT90236</td><td rowspan="4">PLC link unit (station) No.5 or 13</td><td>System register 40 and 41</td></tr>
<tr><td>DT90237</td><td>System register 42 and 43</td></tr>
<tr><td>DT90238</td><td>System register 44 and 45</td></tr>
<tr><td>DT90239</td><td>System register 46 and 47</td></tr>
</table>

(A: Available, N/A: Not available)

<table>
<tr><th>Address</th><th>Name</th><th>Name</th><th>Description</th><th>Reading</th><th>Writing</th></tr>
<tr><td>DT90240</td><td rowspan="4">PLC link unit (station) No.6 or 14</td><td>System register 40 and 41</td><td rowspan="12">The contents of the system register settings pertaining to the PLC inter–link function for the various unit numbers are stored as shown below.
Example:
When DT90219 is 0

</td><td rowspan="4">A</td><td rowspan="4">N/A</td></tr>
<tr><td>DT90241</td><td>System register 42 and 43</td></tr>
<tr><td>DT90242</td><td>System register 44 and 45</td></tr>
<tr><td>DT90243</td><td>System register 46 and 47</td></tr>
<tr><td>DT90244</td><td rowspan="4">PLC link unit (station) No.7 or 15</td><td>System register 40 and 41</td><td rowspan="8">A</td><td rowspan="8">N/A</td></tr>
<tr><td>DT90245</td><td>System register 42 and 43</td></tr>
<tr><td>DT90246</td><td>System register 44 and 45</td></tr>
<tr><td>DT90247</td><td>System register 46 and 47</td></tr>
<tr><td>DT90248</td><td rowspan="4">PLC link unit (station) No.8 or 16</td><td>System register 40 and 41</td></tr>
<tr><td>DT90249</td><td>System register 42 and 43</td></tr>
<tr><td>DT90250</td><td>System register 44 and 45</td></tr>
<tr><td>DT90251</td><td>System register 46 and 47</td></tr>
<tr><td>DT90252 to DT90255</td><td colspan="2">Not used</td><td>———</td><td>N/A</td><td>N/A</td></tr>
<tr><td>DT90256</td><td colspan="2">Unit (station) No. switch monitor for COM port</td><td>Used by the system.</td><td>N/A</td><td>N/A</td></tr>
</table>

12.7 Table of Error Cords

12.7.1 Table of Syntax Check Error

Error code	Name	Operation status	Description and steps to take
E1	Syntax error	Stops	A program with a syntax error has been written. **Change to PROG. mode and correct the error.**
E2	Duplicated output error	Stops	Two or more **OT(Out)** instructions and **KP(Keep)** instructions are programmed using the same relay. (This also occurs if the same timer/counter number is being used.) **Change to PROG. mode and correct the program so that one relay is not used for two or more OT instructions and KP instructions. Or, set the duplicated output to enable in system register 20.**
E3	Not paired error	Stops	For instructions which must be used in a pair such as jump (**JP** and **LBL**), one instruction is either missing or in an incorrect position. **Change to PROG. mode and enter the two instructions which must be used in a pair in the correct positions.**
E4	Parameter mismatch error	Stops	An instruction has been written which does not agree with system register settings. For example, the number setting in a program does not agree with the timer/counter range setting. **Change to PROG. mode, check the system register settings, and change so that the settings and the instruction agree.**
E5	Program area error	Stops	An instruction which must be written to a specific area (main program area or subprogram area) has been written to a different area (for example, a subroutine **SUB** to **RET** is placed before an **ED** instruction). **Change to PROG. mode and enter the instruction into the correct area.**
E8	High-level instruction operand combination error	Stops	There is an incorrect operand in an instruction which requires a specific combination operands (for example, the operands must all be of a certain type). **Enter the correct combination of operands.**

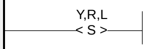
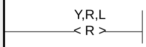
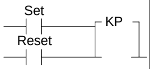
12.7.2 Table of Self–Diagnostic Error

Error code	Name		Operation status	Description and steps to take
E31	Interrupt error 1		Stops	An interrupt occurred without an interrupt request. A hardware problem or error due to noise is possible. **Turn off the power and check the noise conditions.**
E32	Interrupt error 2		Stops	An interrupt occurred without an interrupt request. A hardware problem or error due to noise is possible. **Turn off the power and check the noise conditions.**
				There is no interrupt program for an interrupt which occurred. **Check the number of the interrupt program and change it to agree with the interrupt request.**
E45	Operation error		Selectable	Operation became impossible when a high-level instruction was executed. The causes of calculation errors vary depending on the instruction. **Set the operation status using system register 26 to continue operation.**
E100 to E299	Self–diagnostic error set by F148 (ERR) instruction	E100 to E199	Stops	The self-diagnostic error specified by the **F148 (ERR)** instruction is occurred. **Take steps to clear the error condition according to the specification you chose.**
		E200 to E299	Continues	

12.8 Table of Instructions

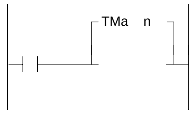
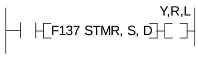
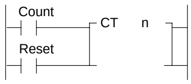
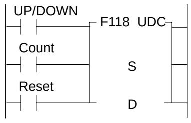
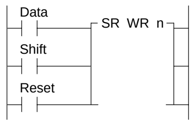
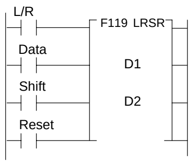
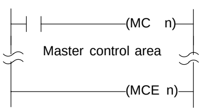
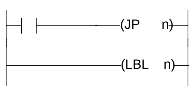
Table of Basic Instructions

Name	Boolean	Symbol	Description	Steps (* Note)
Sequence basic instructions				
Start	**ST**	X,Y,R,L,T,C	Begins a logic operation with a Form A (normally open) contact.	1 (2)
Start Not	**ST/**	X,Y,R,L,T,C	Begins a logic operation with a Form B (normally closed) contact.	1 (2)
Out	**OT**	Y,R,L	Outputs the operated result to the specified output.	1 (2)
Not	**/**	/	Inverts the operated result up to this instruction.	1
AND	**AN**	X,Y,R,L,T,C	Connects a Form A (normally open) contact serially.	1 (2)
AND Not	**AN/**	X,Y,R,L,T,C	Connects a Form B (normally closed) contact serially.	1 (2)
OR	**OR**	X,Y,R,L,T,C	Connects a Form A (normally open) contact in parallel.	1 (2)
OR Not	**OR/**	X,Y,R,L,T,C	Connects a Form B (normally closed) contact in parallel.	1 (2)
Alternative out	**ALT**	Y,R,L A	Inverts the output condition (on/off) each time the leading edge of the trigger is detected.	3
AND stack	**ANS**		Connects the multiple instruction blocks serially.	1
OR stack	**ORS**		Connects the multiple instruction blocks in parallel.	1
Push stack	**PSHS**		Stores the operated result up to this instruction.	1
Read stack	**RDS**		Reads the operated result stored by the **PSHS** instruction.	1
Pop stack	**POPS**		Reads and clears the operated result stored by the **PSHS** instruction.	1
Leading edge differential	**DF**	(DF)	Turns on the contact for only one scan when the leading edge of the trigger is detected.	1
Trailing edge differential	**DF/**	(DF/)	Turns on the contact for only one scan when the trailing edge of the trigger is detected.	1

Name	Boolean	Symbol	Description	Steps (* Note)
Leading edge differential (initial execution type)	**DFI**		Turns on the contact for only one scan when the leading edge of the trigger is detected. The leading edge detection is possible on the first scan.	1
Set	**SET**		Output is set to and held at on.	3
Reset	**RST**		Output is set to and held at off.	3
Keep	**KP**		Outputs at set trigger and holds until reset trigger turns on.	1
No operation	**NOP**		No operation.	1

Note

When relay R1120 or higher, or timer T256 or higher, or counter C256 or higher is used, the number of steps is the number in parentheses.

Name	Boolean	Symbol	Description	Steps (* Note)
Basic function instructions				
On-delay timer	**TML**		After set value “n” × 0.001 seconds, timer contact “a” is set to on.	3 (4)
	TMR		After set value “n” × 0.01 seconds, timer contact “a” is set to on.	3 (4)
	TMX		After set value “n” × 0.1 seconds, timer contact “a” is set to on.	3 (4)
	TMY		After set value “n” × 1 second, timer contact “a” is set to on.	4 (5)
Auxiliary timer (16–bit)	**F137 (STMR)**		After set value “S” × 0.01 seconds, the specified output and R900D are set to on.	5
Auxiliary timer (32–bit)	**F183 (DSTM)**		After set value “S” × 0.01 seconds, the specified output and R900D are set to on.	7
Counter	**CT**		Decrements from the preset value “n”.	3 (4)
UP/DOWN counter	**F118 (UDC)**		Increments or decrements from the preset value “S” based on up/down input.	5
Shift register	**SR**		Shifts one bit of 16-bit [word internal relay (WR)] data to the left.	1
Left/right shift register	**F119 (LRSR)**		Shifts one bit of 16-bit data range specified by “D1” and “D2” to the left or to the right.	5
Control instructions				
Master control relay	**MC**		Starts the master control program.	2
Master control relay end	**MCE**		Ends the master control program.	2
Jump **Label**	**JP** **LBL**		The program jumps to the label instruction and continues from there.	2 1

Name	Boolean	Symbol	Description	Steps (* Note)
Loop	**LOOP**	(LBL n)	The program jumps to the label instruction and continues from there (the number of jumps is set in “S”).	4
Label	**LBL**	[LOOP n, S]		1
End	**ED**	(ED)	The operation of program is ended. Indicates the end of a main program.	1
Conditional end	**CNDE**	(CNDE)	The operation of program is ended when the trigger turns on.	1

Note

When relay R1120 or higher, or timer T256 or higher, or counter C256 or higher is used, the number of steps is the number in parentheses.

Name	Boolean	Symbol	Description	Steps
Step ladder instructions				
Start step	**SSTP**	(SSTP n)	The start of program “n” for process control	3
Next step	**NSTL**	(NSTL n)	Start the specified process “n” and clear the process currently operated. (Scan execution type)	3
	NSTP	(NSTP n)	Start the specified process “n” and clear the process currently operated. (Pulse execution type)	3
Clear step	**CSTP**	(CSTP n)	Resets the currently operated process “n”.	3
Step end	**STPE**	(STPE)	End of step ladder area	1
Clear multiple steps	**SCLR**	[SCLR n1, n2]	Resets the currently operated processes “n1” to “n2”.	5
Subroutine instructions				
Subroutine call	**CALL**	(CALL n)	Executes the specified subroutine. When returning to the main program, outputs in the subroutine program are maintained.	2
Subroutine entry	**SUB**	(SUB n)	Indicates the start of the subroutine program “n”.	1
Subroutine return	**RET**	(RET)	Ends the subroutine program.	1
Interrupt instructions				
Interrupt	**INT**	(INT n)	Indicates the start of the interrupt program “n”.	1
Interrupt return	**IRET**	(IRET)	Ends the interrupt program.	1
Interrupt control	**ICTL**	(DF)–[ICTL S1, S2]	Select interrupt enable/disable or clear in “S1” and “S2” and execute.	5
Data comparison instructions				
16-bit data comparison (Start)	**ST=**	[= S1, S2]	Begins a logic operation by comparing two 16-bit data in the comparative condition “S1=S2”.	5
	ST<>	[< > S1, S2]	Begins a logic operation by comparing two 16-bit data in the comparative condition “S1≠S2”.	5
	ST>	[> S1, S2]	Begins a logic operation by comparing two 16-bit data in the comparative condition “S1>S2”.	5
	ST>=	[> = S1, S2]	Begins a logic operation by comparing two 16-bit data in the comparative condition “S1≧S2”.	5
	ST<	[< S1, S2]	Begins a logic operation by comparing two 16-bit data in the comparative condition “S1<S2”.	5
	ST<=	[< = S1, S2]	Begins a logic operation by comparing two 16-bit data in the comparative condition “S1≦S2”.	5

Name	Boolean	Symbol	Description	Steps
16-bit data comparison (AND)	**AN=**	= S1, S2	Connects a contact serially by comparing two 16-bit data in the comparative condition “S1=S2”.	5
	AN<>	< > S1, S2	Connects a contact serially by comparing two 16-bit data in the comparative condition “S1≠ S2”.	5
	AN>	> S1, S2	Connects a contact serially by comparing two 16-bit data in the comparative condition “S1>S2”.	5
	AN>=	> = S1, S2	Connects a contact serially by comparing two 16-bit data in the comparative condition “S1≧ S2”.	5
	AN<	< S1, S2	Connects a contact serially by comparing two 16-bit data in the comparative condition “S1<S2”.	5
	AN<=	< = S1, S2	Connects a contact serially by comparing two 16-bit data in the comparative condition “S1≦ S2”.	5
16-bit data comparison (OR)	**OR=**	= S1, S2	Connects a contact in parallel by comparing two 16-bit data in the comparative condition “S1=S2”.	5
	OR<>	< > S1, S2	Connects a contact in parallel by comparing two 16-bit data in the comparative condition “S1≠ S2”.	5
	OR>	> S1, S2	Connects a contact in parallel by comparing two 16-bit data in the comparative condition “S1>S2”.	5
	OR>=	> = S1, S2	Connects a contact in parallel by comparing two 16-bit data in the comparative condition “S1≧ S2”.	5
	OR<	< S1, S2	Connects a contact in parallel by comparing two 16-bit data in the comparative condition “S1<S2”.	5
	OR<=	< = S1, S2	Connects a contact in parallel by comparing two 16-bit data in the comparative condition “S1≦ S2”.	5
32-bit data comparison (Start)	**STD=**	D= S1, S2	Begins a logic operation by comparing two 32-bit data in the comparative condition “(S1+1, S1) = (S2+1, S2)”.	9
	STD<>	D< > S1, S2	Begins a logic operation by comparing two 32-bit data in the comparative condition “(S1+1, S1) ≠ (S2+1, S2)”.	9
	STD>	D> S1, S2	Begins a logic operation by comparing two 32-bit data in the comparative condition “(S1+1, S1) > (S2+1, S2)”.	9
	STD>=	D> = S1, S2	Begins a logic operation by comparing two 32-bit data in the comparative condition “(S1+1, S1) ≧ (S2+1, S2)”.	9
	STD<	D< S1, S2	Begins a logic operation by comparing two 32-bit data in the comparative condition “(S1+1, S1) < (S2+1, S2)”.	9
	STD<=	D< = S1, S2	Begins a logic operation by comparing two 32-bit data in the comparative condition “(S1+1, S1) ≦ (S2+1, S2)”.	9

Name	Boolean	Symbol	Description	Steps
32-bit data comparison (AND)	**AND=**	D= S1, S2	Connects a contact serially by comparing two 32-bit data in the comparative condition “(S1+1, S1)=(S2+1, S2)”.	9
	AND<>	D< > S1, S2	Connects a contact serially by comparing two 32-bit data in the comparative condition “(S1+1, S1) ≠ (S2+1, S2)”.	9
	AND>	D> S1, S2	Connects a contact serially by comparing two 32-bit data in the comparative condition “(S1+1, S1)>(S2+1, S2)”.	9
	AND>=	D> = S1, S2	Connects a contact serially by comparing two 32-bit data in the comparative condition “(S1+1, S1) ≧ (S2+1, S2)”.	9
	AND<	D< S1, S2	Connects a contact serially by comparing two 32-bit data in the comparative condition “(S1+1, S1)<(S2+1, S2)”.	9
	AND<=	D< = S1, S2	Connects a contact serially by comparing two 32-bit data in the comparative condition “(S1+1, S1) ≦ (S2+1, S2)”.	9
32-bit data comparison (OR)	**ORD=**	D= S1, S2	Connects a contact in parallel by comparing two 32-bit data in the comparative condition “(S1+1, S1)=(S2+1, S2)”.	9
	ORD<>	D< > S1, S2	Connects a contact in parallel by comparing two 32-bit data in the comparative condition “(S1+1, S1) ≠ (S2+1, S2)”.	9
	ORD>	D> S1, S2	Connects a contact in parallel by comparing two 32-bit data in the comparative condition “(S1+1, S1)>(S2+1, S2)”.	9
	ORD>=	D> = S1, S2	Connects a contact in parallel by comparing two 32-bit data in the comparative condition “(S1+1, S1) ≧ (S2+1, S2)”.	9
	ORD<	D< S1, S2	Connects a contact in parallel by comparing two 32-bit data in the comparative condition “(S1+1, S1)<(S2+1, S2)”.	9
	ORD<=	D< = S1, S2	Connects a contact in parallel by comparing two 32-bit data in the comparative condition “(S1+1, S1) ≦ (S2+1, S2)”.	9

Table of High–level Instructions

No.	Name	Boolean	Operand	Description	Steps
Data transfer instructions					
F0	**16-bit data move**	**MV**	S, D	(S) → (D)	5
F1	**32-bit data move**	**DMV**	S, D	(S+1, S) → (D+1, D)	7
F2	**16-bit data invert and move**	**MV/**	S, D	$(\overline{S}) \rightarrow (D)$	5
F3	**32-bit data invert and move**	**DMV/**	S, D	$(\overline{S+1, S}) \rightarrow (D+1, D)$	7
F5	**Bit data move**	**BTM**	S, n, D	The specified one bit in “S” is transferred to the specified one bit in “D”. The bit is specified by “n”.	7
F6	**Hexadecimal digit (4-bit) data move**	**DGT**	S, n, D	The specified one digit in “S” is transferred to the specified one digit in “D”. The digit is specified by “n”.	7
F7	**Two 16-bit data move**	**MV2**	S1, S2, D	(S1) → (D), (S2) → (D+1)	7
F8	**Two 32-bit data move**	**DMV2**	S1, S2, D	(S1+1, S1) → (D+1, D), (S2+1, S2) → (D+3, D+2)	11
F10	**Block move**	**BKMV**	S1, S2, D	The data between “S1” and “S2” is transferred to the area starting at “D”.	7
F11	**Block copy**	**COPY**	S, D1, D2	The data of “S” is transferred to the all area between “D1” and “D2”.	7
F12	**Data read from EEP–ROM/ F–ROM**	**ICRD**	S1, S2, D	The data stored in the EEPROM/F–ROM specified by “S1” and “S2” are transferred to the area starting at “D”.	11
P13	**Data write to EEP–ROM/ F–ROM**	**PICWT**	S1, S2, D	The data specified by “S1” and “S2” are transferred to the EEPROM/F–ROM starting at “D”.	11
F15	**16-bit data exchange**	**XCH**	D1, D2	(D1) → (D2), (D2) → (D1)	5
F16	**32-bit data exchange**	**DXCH**	D1, D2	(D1+1, D1) → (D2+1, D2) (D2+1, D2) → (D1+1, D1)	5
F17	**Higher/ lower byte in 16-bit data exchange**	**SWAP**	D	The higher byte and lower byte of “D” are exchanged.	3
F18	**16-bit data block exchange**	**BXCH**	D1, D2, D3	Exchange the data between “D1” and “D2” with the data specified by “D3”.	7

No.	Name	Boolean	Operand	Description	Steps
Binary arithmetic instructions					
F20	**16-bit data addition**	**+**	S, D	(D) + (S) → (D)	5
F21	**32-bit data addition**	**D+**	S, D	(D +1, D) + (S+1, S) → (D+1, D)	7
F22	**16-bit data addition**	**+**	S1, S2, D	(S1) + (S2) → (D)	7
F23	**32-bit data addition**	**D+**	S1, S2, D	(S1+1, S1) + (S2+1, S2) → (D+1, D)	11
F25	**16-bit data subtraction**	**–**	S, D	(D) – (S) → (D)	5
F26	**32-bit data subtraction**	**D–**	S, D	(D+1, D) – (S+1, S) → (D+1, D)	7
F27	**16-bit data subtraction**	**–**	S1, S2, D	(S1) – (S2) → (D)	7
F28	**32-bit data subtraction**	**D–**	S1, S2, D	(S1+1, S1) – (S2+1, S2) → (D+1, D)	11
F30	**16-bit data multiplication**	*****	S1, S2, D	(S1) × (S2) → (D+1, D)	7
F31	**32-bit data multiplication**	**D***	S1, S2, D	(S1+1, S1) × (S2+1, S2) → (D+3, D+2, D+1, D)	11
F32	**16-bit data division**	**%**	S1, S2, D	(S1) ÷ (S2) → quotient (D) remainder (DT90015)	7
F33	**32-bit data division**	**D%**	S1, S2, D	(S1+1, S1) ÷ (S2+1, S2) → quotient (D+1, D) remainder (DT90016, DT90015)	11
F34	**16-bit data multiplication (result in one word)**	***W**	S1, S2, D	(S1) × (S2) → (D)	7
F35	**16-bit data increment**	**+1**	D	(D) + 1 → (D)	3
F36	**32-bit data increment**	**D+1**	D	(D+1, D) + 1 → (D+1, D)	3
F37	**16-bit data decrement**	**–1**	D	(D) – 1 → (D)	3
F38	**32-bit data decrement**	**D–1**	D	(D+1, D) – 1 → (D+1, D)	3
F39	**32-bit data multiplication (result in two words)**	**D*D**	S1, S2, D	(S1+1, S1) × (S2+1, S2) → (D+1, D)	11

No.	Name	Boolean	Operand	Description	Steps
BCD arithmetic instructions					
F40	**4-digit BCD data addition**	**B+**	S, D	(D) + (S) → (D)	5
F41	**8-digit BCD data addition**	**DB+**	S, D	(D+1, D) + (S+1, S) → (D+1, D)	7
F42	**4-digit BCD data addition**	**B+**	S1, S2, D	(S1) + (S2) → (D)	7
F43	**8-digit BCD data addition**	**DB+**	S1, S2, D	(S1+1, S1) + (S2+1, S2) → (D+1, D)	11
F45	**4-digit BCD data subtraction**	**B–**	S, D	(D) – (S) → (D)	5
F46	**8-digit BCD data subtraction**	**DB–**	S, D	(D+1, D) – (S+1, S) → (D+1, D)	7
F47	**4-digit BCD data subtraction**	**B–**	S1, S2, D	(S1) – (S2) → (D)	7
F48	**8-digit BCD data subtraction**	**DB–**	S1, S2, D	(S1+1, S1) – (S2+1, S2) → (D+1, D)	11
F50	**4-digit BCD data multiplication**	**B***	S1, S2, D	(S1) × (S2) → (D+1, D)	7
F51	**8-digit BCD data multiplication**	**DB***	S1, S2, D	(S1+1, S1) × (S2+1, S2) → (D+3, D+2, D+1, D)	11
F52	**4-digit BCD data division**	**B%**	S1, S2, D	(S1) ÷ (S2) → quotient (D) remainder (DT90015)	7
F53	**8-digit BCD data division**	**DB%**	S1, S2, D	(S1+1, S1) ÷ (S2+1, S2) → quotient (D+1, D) remainder (DT90016, DT90015)	11
F55	**4-digit BCD data increment**	**B+1**	D	(D) + 1 → (D)	3
F56	**8-digit BCD data increment**	**DB+1**	D	(D+1, D) + 1 → (D+1, D)	3
F57	**4-digit BCD data decrement**	**B–1**	D	(D) – 1 → (D)	3
F58	**8-digit BCD data decrement**	**DB–1**	D	(D+1, D) – 1 → (D+1, D)	3
Data comparison instructions					
F60	**16-bit data comparison**	**CMP**	S1, S2	(S1) > (S2) → R900A: on (S1) = (S2) → R900B: on (S1) < (S2) → R900C: on	5
F61	**32-bit data comparison**	**DCMP**	S1, S2	(S1+1, S1) > (S2+1, S2) → R900A: on (S1+1, S1) = (S2+1, S2) → R900B: on (S1+1, S1) < (S2+1, S2) → R900C: on	9
F62	**16-bit data band comparison**	**WIN**	S1, S2, S3	(S1) > (S3) → R900A: on (S2) ≦ (S1) ≦ (S3) → R900B: on (S1) < (S2) → R900C: on	7
F63	**32-bit data band comparison**	**DWIN**	S1, S2, S3	(S1+1, S1) > (S3+1, S3) → R900A: on (S2+1, S2) ≦ (S1+1, S1) ≦ (S3+1, S3) → R900B: on (S1+1, S1) < (S2+1, S2) → R900C: on	13
F64	**Block data comparison**	**BCMP**	S1, S2, S3	Compares the two blocks beginning with “S2” and “S3” to see if they are equal.	7

No.	Name	Boolean	Operand	Description	Steps
Logic operation instructions					
F65	**16-bit data AND**	**WAN**	S1, S2, D	(S1) ∧ (S2) → (D)	7
F66	**16-bit data OR**	**WOR**	S1, S2, D	(S1) ∨ (S2) → (D)	7
F67	**16-bit data exclusive OR**	**XOR**	S1, S2, D	{(S1) ∧ ($\overline{S2}$)} ∨ {($\overline{S1}$) ∧ (S2)} → (D)	7
F68	**16-bit data exclusive NOR**	**XNR**	S1, S2, D	{(S1) ∧ (S2)} ∨ {($\overline{S1}$) ∧ ($\overline{S2}$)} → (D)	7
F69	**16-bit data unite**	**WUNI**	S1, S2, S3, D	([S1] ∧ [S3]) ∨ ([S2] ∧ [$\overline{S3}$]) → (D) When (S3) is H0, (S2) → (D) When (S3) is HFFFF, (S1) → (D)	9
Data conversion instructions					
F70	**Block check code calculation**	**BCC**	S1, S2, S3, D	Creates the code for checking the data specified by “S2” and “S3” and stores it in “D”. The calculation method is specified by “S1”.	9
F71	**Hexadecimal data → ASCII code**	**HEXA**	S1, S2, D	Converts the hexadecimal data specified by “S1” and “S2” to ASCII code and stores it in “D”. Example: HABCD → H 42 41 44 43 B A D C	7
F72	**ASCII code → Hexadecimal data**	**AHEX**	S1, S2, D	Converts the ASCII code specified by “S1” and “S2” to hexadecimal data and stores it in “D”. Example: H 44 43 42 41 → HCDAB D C B A	7
F73	**4-digit BCD data → ASCII code**	**BCDA**	S1, S2, D	Converts the four digits of BCD data specified by “S1” and “S2” to ASCII code and stores it in “D”. Example: H1234 → H 32 31 34 33 2 1 4 3	7
F74	**ASCII code → 4-digit BCD data**	**ABCD**	S1, S2, D	Converts the ASCII code specified by “S1” and “S2” to four digits of BCD data and stores it in “D”. Example: H 34 33 32 31 → H3412 4 3 2 1	9
F75	**16-bit binary data → ASCII code**	**BINA**	S1, S2, D	Converts the 16 bits of binary data specified by “S1” to ASCII code and stores it in “D” (area of “S2” bytes). Example: K–100 → H 30 30 31 2D 20 20 0 0 1 –	7
F76	**ASCII code → 16-bit binary data**	**ABIN**	S1, S2, D	Converts the ASCII code specified by “S1” and “S2” to 16 bits of binary data and stores it in “D”. Example: H 30 30 31 2D 20 20 → K–100 0 0 1 –	7
F77	**32-bit binary data → ASCII code**	**DBIA**	S1, S2, D	Converts the 32 bits of binary data (S1+1, S1) to ASCII code and stores it in (D+1, D).	11
F78	**ASCII code → 32-bit binary data**	**DABI**	S1, S2, D	Converts the ASCII code specified by “S1” and “S2” to 32 bits of binary data and stores it in (D+1, D).	11
F80	**16-bit binary data → 4-digit BCD data**	**BCD**	S, D	Converts the 16 bits of binary data specified by “S” to four digits of BCD data and stores it in “D”. Example: K100 → H100	5

No.	Name	Boolean	Operand	Description	Steps
F81	**4-digit BCD data → 16-bit binary data**	**BIN**	S, D	Converts the four digits of BCD data specified by “S” to 16 bits of binary data and stores it in “D”. Example: H100 → K100	5
F82	**32-bit binary data → 8-digit BCD data**	**DBCD**	S, D	Converts the 32 bits of binary data specified by (S+1, S) to eight digits of BCD data and stores it in (D+1, D).	7
F83	**8-digit BCD data → 32-bit binary data**	**DBIN**	S, D	Converts the eight digits of BCD data specified by (S+1, S) to 32 bits of binary data and stores it in (D+1, D).	7
F84	**16-bit data invert (complement of 1)**	**INV**	D	Inverts each bit of data of “D”.	3
F85	**16-bit data complement of 2**	**NEG**	D	Inverts each bit of data of “D” and adds 1 (inverts the sign).	3
F86	**32-bit data complement of 2**	**DNEG**	D	Inverts each bit of data of (D+1, D) and adds 1 (inverts the sign).	3
F87	**16-bit data absolute**	**ABS**	D	Gives the absolute value of the data of “D”.	3
F88	**32-bit data absolute**	**DABS**	D	Gives the absolute value of the data of (D+1, D).	3
F89	**16-bit data sign extension**	**EXT**	D	Extends the 16 bits of data in “D” to 32 bits in (D+1, D).	3
F90	**Decode**	**DECO**	S, n, D	Decodes part of the data of “S” and stores it in “D”. The part is specified by “n”.	7
F91	**7-segment decode**	**SEGT**	S, D	Converts the data of “S” for use in a 7-segment display and stores it in (D+1, D).	5
F92	**Encode**	**ENCO**	S, n, D	Encodes part of the data of “S” and stores it in “D”. The part is specified by “n”.	7
F93	**16-bit data digit combine**	**UNIT**	S, n, D	The least significant digit of each of the “n” words of data beginning at “S” are stored (united) in order in “D”.	7
F94	**16-bit data digit distribute**	**DIST**	S, n, D	Each of the digits of the data of “S” are stored in (distributed to) the least significant digits of the areas beginning at “D”.	7
Character strings instruction					
F95	**ASCII code conversion**	**ASC**	S, D	Twelve characters of the character constants of “S” are converted to ASCII code and stored in “D” to “D+5”.	15
Data conversion instructions					
F96	**16-bit table data search**	**SRC**	S1, S2, S3	The data of “S1” is searched for in the areas in the range “S2” to “S3” and the result is stored in DT90037 and DT90038.	7
F97	**32-bit table data search**	**DSRC**	S1, S2, S3	The data of (S1+1, S1) is searched for in the 32-bit data designated by “S3”, beginning from “S2”, and the result is stored in DT90037 and DT90038.	11

No.	Name	Boolean	Operand	Description	Steps
Data buffer instructions					
F98	**Data table shift-out and compress**	**CMPR**	D1, D2, D3	Transfer “D2” to “D3”. Any parts of the data between “D1” and “D2” that are 0 are compressed, and shifted in order toward “D2”.	7
F99	**Data table shift-in and compress**	**CMPW**	S, D1, D2	Transfer “S” to “D1”. Any parts of the data between “D1” and “D2” that are 0 are compressed, and shifted in order toward “D2”.	7
Data shift instructions					
F100	**Right shift of n bits in a 16-bit data**	**SHR**	D, n	Shifts the “n” bits of “D” to the right.	5
F101	**Left shift of n bits in a 16-bit data**	**SHL**	D, n	Shifts the “n” bits of “D” to the left.	5
F102	**Right shift of n bits in a 32-bit data**	**DSHR**	D, n	Shifts the “n” bits of the 32-bit data area specified by (D+1, D) to the right.	5
F103	**Left shift of n bits in a 32-bit data**	**DSHL**	D, n	Shifts the “n” bits of the 32-bit data area specified by (D+1, D) to the left.	5
F105	**Right shift of one hexadecimal digit (4-bit)**	**BSR**	D	Shifts the one digit of data of “D” to the right.	3
F106	**Left shift of one hexadecimal digit (4-bit)**	**BSL**	D	Shifts the one digit of data of “D” to the left.	3
F108	**Right shift of multiple bits (n bits)**	**BITR**	D1, D2, n	Shifts the “n” bits of data range by “D1” and “D2” to the right.	7
F109	**Left shift of multiple bits (n bits)**	**BITL**	D1, D2, n	Shifts the “n” bits of data range by “D1” and “D2” to the left.	7
F110	**Right shift of one word (16-bit)**	**WSHR**	D1, D2	Shifts the one word of the areas by “D1” and “D2” to the right.	5
F111	**Left shift of one word (16-bit)**	**WSHL**	D1, D2	Shifts the one word of the areas by “D1” and “D2” to the left.	5
F112	**Right shift of one hexadecimal digit (4-bit)**	**WBSR**	D1, D2	Shifts the one digit of the areas by “D1” and “D2” to the right.	5
F113	**Left shift of one hexadecimal digit (4-bit)**	**WBSL**	D1, D2	Shifts the one digit of the areas by “D1” and “D2” to the left.	5
Data buffer instructions					
F115	**FIFO buffer define**	**FIFT**	n, D	The “n” words beginning from “D” are defined in the buffer.	5
F116	**Data read from FIFO buffer**	**FIFR**	S, D	The oldest data beginning from “S” that was written to the buffer is read and stored in “D”.	5
F117	**Data write into FIFO buffer**	**FIFW**	S, D	The data of “S” is written to the buffer starting from “D”.	5

No.	Name	Boolean	Operand	Description	Steps
Basic function instructions					
F118	**UP/DOWN counter**	**UDC**	S, D	Counts up or down from the value preset in “S” and stores the elapsed value in “D”.	5
F119	**Left/right shift register**	**LRSR**	D1, D2	Shifts one bit to the left or right with the area between “D1” and “D2” as the register.	5
Data rotation instructions					
F120	**16-bit data right rotation**	**ROR**	D, n	Rotate the “n” bits in data of “D” to the right.	5
F121	**16-bit data left rotation**	**ROL**	D, n	Rotate the “n” bits in data of “D” to the left.	5
F122	**16-bit data right rotation with carry flag data**	**RCR**	D, n	Rotate the “n” bits in 17-bit area consisting of “D” plus the carry flag (R9009) data to the right.	5
F123	**16-bit data left rotation with carry flag data**	**RCL**	D, n	Rotate the “n” bits in 17-bit area consisting of “D” plus the carry flag (R9009) data to the left.	5
F125	**32-bit data right rotation**	**DROR**	D, n	Rotate the number of bits specified by “n” of the double words data (32 bits) specified by (D+1, D) to the right.	5
F126	**32-bit data left rotation**	**DROL**	D, n	Rotate the number of bits specified by “n” of the double words data (32 bits) specified by (D+1, D) to the left.	5
F127	**32-bit data right rotation with carry flag data**	**DRCR**	D, n	Rotate the number of bits specified by “n” of the double words data (32 bits) specified by (D+1, D) to the right together with carry flag (R9009) data.	5
F128	**32-bit data left rotation with carry flag data**	**DRCL**	D, n	Rotate the number of bits specified by “n” of the double words data (32 bits) specified by (D+1, D) to the left together with carry flag (R9009) data.	5
Bit manipulation instructions					
F130	**16-bit data bit set**	**BTS**	D, n	Set the value of bit position “n” of the data of “D” to 1.	5
F131	**16-bit data bit reset**	**BTR**	D, n	Set the value of bit position “n” of the data of “D” to 0.	5
F132	**16-bit data bit invert**	**BTI**	D, n	Invert the value of bit position “n” of the data of “D”.	5
F133	**16-bit data bit test**	**BTT**	D, n	Test the value of bit position “n” of the data of “D” and output the result to R900B.	5
F135	**Number of on (1) bits in 16-bit data**	**BCU**	S, D	Store the number of on (1) bits in the data of “S” in “D”.	5
F136	**Number of on (1) bits in 32-bit data**	**DBCU**	S, D	Store the number of on (1) bits in the data of (S+1, S) in “D”.	7
Basic function instruction					
F137	**Auxiliary timer (16–bit)**	**STMR**	S, D	Turn on the specified output and R900D after set value “S” × 0.01 sec..	5

No.	Name	Boolean	Operand	Description	Steps
Special instructions					
F138	**Hours, minutes and seconds data to seconds data**	**HMSS**	S, D	Converts the hour, minute and second data of (S+1, S) to seconds data, and the converted data is stored in (D+1, D).	5
F139	**Seconds data to hours, minutes and seconds data**	**SHMS**	S, D	Converts the seconds data of (S+1, S) to hour, minute and second data, and the converted data is stored in (D+1, D).	5
F140	**Carry flag set**	**STC**	——	Turns on the carry flag (R9009).	1
F141	**Carry flag reset**	**CLC**	——	Turns off the carry flag (R9009).	1
F143	**Partial I/O update**	**IORF**	D1, D2	Updates the I/O from the number specified by “D1” to the number specified by “D2”. Only possible for I/O numbers in a range of X0 to XF and Y0 to YF.	5
F147	**Printout**	**PR**	S, D	Converts the ASCII code data in the area starting with “S” for printing, and outputs it to the word external output relay WY specified by “D”.	5
F148	**Self-diagnostic error set**	**ERR**	n (n: K100 to K299)	Stores the self-diagnostic error number “n” in DT90000 turns R9000 on, and turns on the ERROR/ALARM LED.	3
F149	**Message display**	**MSG**	S	Displays the character constant of “S” in the connected programming tool.	13
F157	**Time addition**	**CADD**	S1, S2, D	The time after (S2+1, S2) elapses from the time of (S1+2, S1+1, S1) is stored in (D+2, D+1, D).	9
F158	**Time substruction**	**CSUB**	S1, S2, D	The time that results from subtracting (S2+1, S2) from the time (S1+2, S1+1, S1) is stored in (D+2, D+1, D).	9
F159	**Serial data communication**	**MTRN**	S, n, D	This is used to send data to or receive data from an external device through the specified RS232C port.	7
BIN arithmetic instruction					
F160	**Double word (32-bit) data square root**	**DSQR**	S, D	$\sqrt{(S)} \rightarrow (D)$	7
High–speed counter and pulse output control instructions					
F0	**High–speed counter and pulse output control**	**MV**	S, DT90052	Performs high–speed counter control according to the control code specified by “S”.	5
F1	**Change and read of the elapsed value of high–speed counter**	**DMV**	S, DT90044	Transfers (S+1, S) to high–speed counter elapsed value area (* Note) (DT90045, DT90044).	7
			DT90044, D	Transfers value in high–speed counter elapsed value area (* Note) (DT90045, DT90044) to (D+1, D).	7
F166	**Target value much on instruction (with channel specification)**	**HC1S**	n, S, D	Turns output Yn on when the elapsed value of the built–in high–speed counter reaches the target value of (S+1,S).	11
F167	**Target value much off instruction (with channel specification)**	**HC1R**	n, S, D	Turns output Yn off when the elapsed value of the built–in high–speed counter reaches the target value of (S+1,S).	11

No.	Name	Boolean	Operand	Description	Steps
F171	**Pulse output instruction (with channel specification)** **(Table shaped control and home return)**	**SPDH**	S, n	Positioning pulses are output from the specified output, in accordance with the contents of the data table that starts with S.	5
F172	**Pulse output instruction (with channel specification)** **(JOG operation)**	**PLSH**	S, n	Pulse strings are output from the specified output, in accordance with the contents of the data table that starts with S.	5
F173	**Pulse output instruction (with channel specification)** **(PWM output)**	**PWMH**	S, n	PWM output is output from the specified output, in accordance with the contents of the data table that starts with S.	5
Basic function instruction					
F183	**Auxiliary timer (32-bit)**	**DSTM**	S, D	Turn on the specified output and R900D after set value “S” × 0.01 sec..	7
Data transfer instructions					
F190	**Three 16-bit data move**	**MV3**	S1, S2, S3, D	(S1) → (D), (S2) → (D+1), (S3) → (D+2)	10
F191	**Three 32-bit data move**	**DMV3**	S1, S2, S3, D	(S1+1, S1) → (D+1, D), (S2+1, S2) → (D+3, D+2), (S3+1, S3) → (D+5, D+4)	16
Logic operation instructions					
F215	**32-bit data AND**	**DAND**	S1, S2, D	(S1+1, S1) ∧ (S2+1, S2) → (D+1, D)	12
F216	**32-bit data OR**	**DOR**	S1, S2, D	(S1+1, S1) ∨ (S2+1, S2) → (D+1, D)	12
F217	**32-bit data XOR**	**DXOR**	S1, S2, D	$\{(S1+1, S1) \wedge \overline{(S2+1, S2)}\} \vee \{\overline{(S1+1, S1)} \wedge (S2+1, S2)\} \rightarrow (D+1, D)$	12
F218	**32-bit data XNR**	**DXNR**	S1, S2, D	$\{(S1+1, S1) \wedge (S2+1, S2)\} \vee \{\overline{(S1+1, S1)} \wedge \overline{(S2+1, S2)}\} \rightarrow (D+1, D)$	12
F219	**Double word (32-bit) data unites**	**DUNI**	S1, S2, S3, D	$\{(S1+1, S1) \wedge (S3+1, S3)\} \vee \{(S2+1, S2) \wedge \overline{(S3+1, S3)}\} \rightarrow (D+1, D)$	16

Note

The elapsed value area varies depending on the channel being used.

No.	Name	Boolean	Operand	Description	Steps
Data conversion instructions					
F235	**16–bit binary data → Gray code conversion**	**GRY**	S, D	Converts the 16-bit binary data of “S” to gray codes, and the converted result is stored in the “D”.	6
F236	**32–bit binary data → Gray code conversion**	**DGRY**	S, D	Converts the 32-bit binary data of (S+1, S) to gray code, and the converted result is stored in the (D+1, D).	8
F237	**16–bit gray code → binary data conversion**	**GBIN**	S, D	Converts the gray codes of “S” to binary data, and the converted result is stored in the “D”.	6
F238	**32–bit gray code → binary data conversion**	**DGBIN**	S, D	Converts the gray code of (S+1, S) to binary data,and the converted result is stored in the (D+1, D).	8
F240	**Bit line to bit column conversion**	**COLM**	S, n, D	The values of bits line 0 to 15 of “S” are stored in bit column “n” of (D to D+15).	8
F241	**Bit column to bit line conversion**	**LINE**	S, n, D	The values of bit column “n” of (S to S+15) are stored in bits line 0 to 15 of “D”.	8
Character strings instructions					
F257	**Comparing character strings**	**SCMP**	S1, S2	These instructions compare two specified character strings and output the judgment results to a special internal relay.	10
F258	**Character string coupling**	**SADD**	S1, S2, D	These instructions couple one character string with another.	12
F259	**Number of characters in a character string**	**LEN**	S, D	These instructions determine the number of characters in a character string.	6
F260	**Search for character string**	**SSRC**	S1, S2, D	The specified character is searched in a character string.	10
F261	**Retrieving data from character strings (right side)**	**RIGHT**	S1, S2, D	These instructions retrieve a specified number of characters from the right side of the character string.	8
F262	**Retrieving data from character strings (left side)**	**LEFT**	S1, S2, D	These instructions retrieve a specified number of characters from the left side of the character string.	8
F263	**Retrieving a character string from a character string**	**MIDR**	S1, S2, S3, D	These instructions retrieve a character string consisting of a specified number of characters from the specified position in the character string.	10
F264	**Writing a character string to a character string**	**MIDW**	S1, S2, D, n	These instructions write a specified number of characters from a character string to a specified position in the character string.	12
F265	**Replacing character strings**	**SREP**	S, D, p, n	A specified number of characters in a character string are rewritten, starting from a specified position in the character string.	12

No.	Name	Boolean	Operand	Description	Steps
Integer type data processing instructions					
F270	**Maximum value (word data (16-bit))**	**MAX**	S1, S2, D	Searches the maximum value in the word data table between the “S1” and “S2”, and stores it in the “D”. The address relative to “S1” is stored in “D+1”.	8
F271	**Maximum value (double word data (32-bit))**	**DMAX**	S1, S2, D	Searches for the maximum value in the double word data table between the area selected with “S1” and “S2”, and stores it in the “D”. The address relative to “S1” is stored in “D+2”.	8
F272	**Minimum value (word data (16-bit))**	**MIN**	S1, S2, D	Searches for the minimum value in the word data table between the area selected with “S1” and “S2”, and stores it in the “D”. The address relative to “S1” is stored in “D+1”.	8
F273	**Minimum value (double word data (32-bit))**	**DMIN**	S1, S2, D	Searches for the minimum value in the double word data table between the area selected with “S1” and “S2”, and stores it in the “D”. The address relative to “S1” is stored in “D+2”.	8
F275	**Total and mean values (word data (16-bit))**	**MEAN**	S1, S2, D	The total value and the mean value of the word data with sign from the area selected with “S1” to the “S2” are stored in the “D”.	8
F276	**Total and mean values (double word data (32-bit))**	**DMEAN**	S1, S2, D	The total value and the mean value of the double word data with sign from the area selected with “S1” to “S2” are stored in the “D”.	8
F277	**Sort (word data (16-bit))**	**SORT**	S1, S2, S3	The word data with sign from the area specified by “S1” to “S2” are sorted in ascending order (the smallest word is first) or descending order (the largest word is first).	8
F278	**Sort (double word data (32-bit))**	**DSORT**	S1, S2, S3	The double word data with sign from the area specified by “S1” to “S2” are sorted in ascending order (the smallest word is first) or descending order (the largest word is first).	8
F282	**Scaling of 16–bit data**	**SCAL**	S1, S2, D	These instructions search for a specified character in a character string, and carry out scaling.	8
F283	**Scaling of 32–bit data**	**DSCAL**	S1, S2, D	These instructions search for a specified character in a character string, and carry out scaling.	10
F285	**16-bit data upper and lower limit control**	**LIMT**	S1, S2, S3, D	When S1 > S3, S1 → D When S2 < S3, S2 → D When S1 ≦ S3 ≦ S2, S3 → D	10
F286	**32-bit data upper and lower limit control**	**DLIMT**	S1, S2, S3, D	When (S1+1, S1) > (S3+1, S3), (S1+1, S1) → (D+1, D) When (S2+1, S2) < (S3+1, S3), (S2+1, S2) → (D+1, D) When (S1+1, S1) ≦ (S3+1, S3) ≦ (S2+1, S2), (S3+1, S3) → (D+1, D)	16
F287	**16-bit data deadband control**	**BAND**	S1, S2, S3, D	When S1 > S3, S3 – S1 → D When S2 < S3, S3 – S2 → D When S1 ≦ S3 ≦ S2, 0 → D	10
F288	**32-bit data deadband control**	**DBAND**	S1, S2, S3, D	When (S1+1, S1) > (S3+1, S3), (S3+1, S3) – (S1+1, S1) → (D+1, D) When (S2+1, S2) < (S3+1, S3), (S3+1, S3) – (S2+1, S2) → (D+1, D) When (S1+1, S1) ≦ (S3+1, S3) ≦ (S2+1, S2), 0 → (D+1, D)	16

No.	Name	Boolean	Operand	Description	Steps
Integer type data processing instructions					
F289	**16-bit data zone control**	**ZONE**	S1, S2, S3, D	When S3 < 0, S3 + S1 → D When S3 = 0, 0 → D When S3 > 0, S3 + S2 → D	10
F290	**32-bit data zone control**	**DZONE**	S1, S2, S3, D	When (S3+1, S3) < 0, (S3+1, S3) + (S1+1, S1) → (D+1, D) When (S3+1, S3) = 0, 0 → (D+1, D) When (S3+1, S3) > 0, (S3+1, S3) + (S2+1, S2) → (D+1, D)	16
Floating-point type real number operation instructions					
F309	**Floating-point type data move**	**FMV**	S, D	(S+1, S) → (D+1, D)	8
F310	**Floating-point type data addition**	**F+**	S1, S2, D	(S1+1, S1) + (S2+1, S2) →(D+1, D)	14
F311	**Floating-point type data subtraction**	**F–**	S1, S2, D	(S1+1, S1) – (S2+1, S2) → (D+1, D)	14
F312	**Floating-point type data multiplication**	**F***	S1, S2, D	(S1+1, S1) × (S2+1, S2) → (D+1, D)	14
F313	**Floating-point type data division**	**F%**	S1, S2, D	(S1+1, S1) ÷ (S2+1, S2) → (D+1, D)	14
F314	**Floating-point type data sine operation**	**SIN**	S, D	SIN (S+1, S) → (D+1, D)	10
F315	**Floating-point type data co-sine operation**	**COS**	S, D	COS (S+1, S) → (D+1, D)	10
F316	**Floating-point type datatang-ent operation**	**TAN**	S, D	TAN (S+1, S) → (D+1, D)	10
F317	**Floating-point type data arc-sine operation**	**ASIN**	S, D	SIN^{-1} (S+1, S) → (D+1, D)	10
F318	**Floating-point type data arccosine operation**	**ACOS**	S, D	COS^{-1} (S+1, S) → (D+1, D)	10
F319	**Floating-point type data arctangent operation**	**ATAN**	S, D	TAN^{-1} (S+1, S) → (D+1, D)	10
F320	**Floating-point type data natu-ral logarithm**	**LN**	S, D	LN (S+1, S) → (D+1, D)	10
F321	**Floating-point type data exponent**	**EXP**	S, D	EXP (S+1, S) → (D+1, D)	10

No.	Name	Boolean	Operand	Description	Steps
F322	**Floating-point type data logarithm**	**LOG**	S, D	LOG (S+1, S) → (D+1, D)	10
F323	**Floating-point type data power**	**PWR**	S1, S2, D	(S1+1, S1) ∧ (S2+1, S2) → (D+1, D)	14
F324	**Floating-point type data square root**	**FSQR**	S, D	$\sqrt{(S+1, S)}$ → (D+1, D)	10
F325	**16-bit integer data to floating-point type data conversion**	**FLT**	S, D	Converts the 16-bit integer data with sign specified by "S" to real number data, and the converted data is stored in "D".	6
F326	**32-bit integer data to floating-point type data conversion**	**DFLT**	S, D	Converts the 32-bit integer data with sign specified by (S+1, S) to real number data, and the converted data is stored in (D+1, D).	8
F327	**Floating-point type data to 16-bit integer conversion (the largest integer not exceeding the floating-point type data)**	**INT**	S, D	Converts real number data specified by (S+1, S) to the 16-bit integer data with sign (the largest integer not exceeding the floating-point data), and the converted data is stored in "D".	8
F328	**Floating-point type data to 32-bit integer conversion (the largest integer not exceeding the floating-point type data)**	**DINT**	S, D	Converts real number data specified by (S+1, S) to the 32-bit integer data with sign (the largest integer not exceeding the floating-point data), and the converted data is stored in (D+1, D).	8
F329	**Floating-point type data to 16-bit integer conversion (rounding the first decimal point down to integer)**	**FIX**	S, D	Converts real number data specified by (S+1, S) to the 16-bit integer data with sign (rounding the first decimal point down), and the converted data is stored in "D".	8
F330	**Floating-point type data to 32-bit integer conversion (rounding the first decimal point down to integer)**	**DFIX**	S, D	Converts real number data specified by (S+1, S) to the 32-bit integer data with sign (rounding the first decimal point down), and the converted data is stored in (D+1, D).	8

No.	Name	Boolean	Operand	Description	Steps
F331	**Floating-point type data to 16-bit integer conversion (rounding the first decimal point off to integer)**	**ROFF**	S, D	Converts real number data specified by (S+1, S) to the 16-bit integer data with sign (rounding the first decimal point off), and the converted data is stored in “D”.	8
F332	**Floating-point type data to 32-bit integer conversion (rounding the first decimal point off to integer)**	**DROFF**	S, D	Converts real number data specified by (S+1, S) to the 32-bit integer data with sign(rounding the first decimal point off), and the converted data is stored in (D+1, D).	8
F333	**Floating-point type data rounding the first decimal point down**	**FINT**	S, D	The decimal part of the real number data specified in (S+1, S) is rounded down, and the result is stored in (D+1, D).	8
F334	**Floating-point type data rounding the first decimal point off**	**FRINT**	S, D	The decimal part of the real number data stored in (S+1, S) is rounded off, and the result is stored in (D+1, D).	8
F335	**Floating-point type data sign changes**	**F+/–**	S, D	The real number data stored in (S+1, S) is changed the sign, and the result is stored in (D+1, D).	8
F336	**Floating-point type data absolute**	**FABS**	S, D	Takes the absolute value of real number data specified by (S+1, S), and the result (absolute value) is stored in (D+1, D).	8
F337	**Floating-point type data degree → radian**	**RAD**	S, D	The data in degrees of an angle specified in (S+1, S) is converted to radians (real number data), and the result is stored in (D+1, D).	8
F338	**Floating-point type data radian → degree**	**DEG**	S, D	The angle data in radians (real number data) specified in (S+1, S) is converted to angle data in degrees, and the result is stored in (D+1, D).	8

No.	Name	Boolean	Operand	Description	Steps
Floating-point type real number data processing instructions					
F345	**Floating-point type data compare**	**FCMP**	S1, S2	(S1+1, S1) > (S2+1, S2) → R900A: on (S1+1, S1) = (S2+1, S2) → R900B: on (S1+1, S1) < (S2+1, S2) → R900C: on	10
F346	**Floating-point type data band compare**	**FWIN**	S1, S2, S3	(S1+1, S1) > (S3+1, S3) → R900A: on (S2+1, S2) ≦ (S1+1, S1) ≦ (S3+1,S3) → R900B: on (S1+1, S1) < (S2+1, S2) → R900C: on	14
F347	**Floating-point type data upper and lower limit control**	**FLIMT**	S1, S2, S3, D	When (S1+1, S1) > (S3+1, S3), (S1+1, S1) → (D+1, D) When (S2+1, S2) < (S3+1, S3), (S2+1, S2) → (D+1, D) When (S1+1, S1) ≦ (S3+1, S3) ≦ (S2+1, S2), (S3+1, S3) → (D+1, D)	18
F348	**Floating-point type data dead-band control**	**FBAND**	S1, S2, S3, D	When (S1+1, S1) > (S3+1, S3), (S3+1, S3) – (S1+1, S1) → (D+1, D) When (S2+1, S2) < (S3+1, S3), (S3+1, S3) – (S2+1, S2) → (D+1, D) When (S1+1, S1) ≦ (S3+1, S3) ≦ (S2+1, S2), 0.0 → (D+1, D)	18
F349	**Floating-point type data zone control**	**FZONE**	S1, S2, S3, D	When (S3+1, S3) < 0.0, (S3+1, S3) + (S1+1, S1) → (D+1, D) When (S3+1, S3) = 0.0, 0.0 → (D+1, D) When (S3+1, S3) > 0.0, (S3+1, S3) + (S2+1, S2) → (D+1, D)	18
Process control instruction					
F355	**PID processing**	**PID**	S	PID processing is performed depending on the control value (mode and parameter) specified by (S to S+2) and (S+4 to S+10), and the result is stored in the (S+3).	4
Data compare instructions					
F373	**16-bit data revision detection**	**DTR**	S, D	If the data in the 16-bit area specified by “S” has changed since the previous execution, internal relay R9009 (carry flag) will turn on. “D” is used to store the data of the previous execution.	6
F374	**32-bit data revision detection**	**DDTR**	S, D	If the data in the 32-bit area specified by (S+1, S) has changed since the previous execution, internal relay R9009 (carry flag) will turn on. (D+1, D) is used to store the data of the previous execution.	6

12.9 MEWTOCOL–COM Communication commands

Table of MEWTOCOL–COM commands

Command name	Code	Description
Read contact area	RC (RCS) (RCP) (RCC)	Reads the on and off status of contacts. – Specifies only one point. – Specifies multiple contacts. – Specifies a range in word units.
Write contact area	WC (WCS) (WCP) (WCC)	Turns contacts on and off. – Specifies only one point. – Specifies multiple contacts. – Specifies a range in word units.
Read data area	RD	Reads the contents of a data area.
Write data area	WD	Writes data to a data area.
Read timer/counter set value area	RS	Reads the value set for a timer/counter.
Write timer/counter set value area	WS	Writes a timer/counter setting value.
Read timer/counter elapsed value area	RK	Reads the timer/counter elapsed value.
Write timer/counter elapsed value area	WK	Writes the timer/counter elapsed value.
Register or Reset contacts monitored	MC	Registers the contact to be monitored.
Register or Reset data monitored	MD	Registers the data to be monitored.
Monitoring start	MG	Monitors a registered contact or data.
Preset contact area (fill command)	SC	Embeds the area of a specified range in a 16–point on and off pattern.
Preset data area (fill command)	SD	Writes the same contents to the data area of a specified range.
Read system register	RR	Reads the contents of a system register.
Write system register	WR	Specifies the contents of a system register.
Read the status of PLC	RT	Reads the specifications of the programmable controller and error codes if an error occurs.
Remote control	RM	Switches the operation mode of the programmable controller.
Abort	AB	Aborts communication.

12.10 Hexadecimal/Binary/BCD

Decimal	Hexadecimal	Binary data	BCD data (Binary Coded Decimal)
0	0000	0000 0000 0000 0000	0000 0000 0000 0000
1	0001	0000 0000 0000 0001	0000 0000 0000 0001
2	0002	0000 0000 0000 0010	0000 0000 0000 0010
3	0003	0000 0000 0000 0011	0000 0000 0000 0011
4	0004	0000 0000 0000 0100	0000 0000 0000 0100
5	0005	0000 0000 0000 0101	0000 0000 0000 0101
6	0006	0000 0000 0000 0110	0000 0000 0000 0110
7	0007	0000 0000 0000 0111	0000 0000 0000 0111
8	0008	0000 0000 0000 1000	0000 0000 0000 1000
9	0009	0000 0000 0000 1001	0000 0000 0000 1001
10	000A	0000 0000 0000 1010	0000 0000 0001 0000
11	000B	0000 0000 0000 1011	0000 0000 0001 0001
12	000C	0000 0000 0000 1100	0000 0000 0001 0010
13	000D	0000 0000 0000 1101	0000 0000 0001 0011
14	000E	0000 0000 0000 1110	0000 0000 0001 0100
15	000F	0000 0000 0000 1111	0000 0000 0001 0101
16	0010	0000 0000 0001 0000	0000 0000 0001 0110
17	0011	0000 0000 0001 0001	0000 0000 0001 0111
18	0012	0000 0000 0001 0010	0000 0000 0001 1000
19	0013	0000 0000 0001 0011	0000 0000 0001 1001
20	0014	0000 0000 0001 0100	0000 0000 0010 0000
21	0015	0000 0000 0001 0101	0000 0000 0010 0001
22	0016	0000 0000 0001 0110	0000 0000 0010 0010
23	0017	0000 0000 0001 0111	0000 0000 0010 0011
24	0018	0000 0000 0001 1000	0000 0000 0010 0100
25	0019	0000 0000 0001 1001	0000 0000 0010 0101
26	001A	0000 0000 0001 1010	0000 0000 0010 0110
27	001B	0000 0000 0001 1011	0000 0000 0010 0111
28	001C	0000 0000 0001 1100	0000 0000 0010 1000
29	001D	0000 0000 0001 1101	0000 0000 0010 1001
30	001E	0000 0000 0001 1110	0000 0000 0011 0000
31	001F	0000 0000 0001 1111	0000 0000 0011 0001
•	•	•	•
•	•	•	•
•	•	•	•
63	003F	0000 0000 0011 1111	0000 0000 0110 0011
•	•	•	•
•	•	•	•
•	•	•	•
255	00FF	0000 0000 1111 1111	0000 0010 0101 0101
•	•	•	•
•	•	•	•
•	•	•	•
9999	270F	0010 0111 0000 1111	1001 1001 1001 1001

12.11 ASCII Codes

b_3	b_2	b_1	b_0	ASCII HEX code								
				b_7								
				b_6	0	0	0	0	1	1	1	1
				b_5	0	0	1	1	0	0	1	1
				b_4	0	1	0	1	0	1	0	1
				Least significant digit / Most significant digit	0	1	2	3	4	5	6	7
0	0	0	0	0	NUL	DEL	SPACE	0	@	P	‘	p
0	0	0	1	1	SOH	DC_1	!	1	A	Q	a	q
0	0	1	0	2	STX	DC_2	”	2	B	R	b	r
0	0	1	1	3	ETX	DC_3	#	3	C	S	c	s
0	1	0	0	4	EOT	DC_4	$	4	D	T	d	t
0	1	0	1	5	ENQ	NAK	%	5	E	U	e	u
0	1	1	0	6	ACK	SYN	&	6	F	V	f	v
0	1	1	1	7	BEL	ETB	’	7	G	W	g	w
1	0	0	0	8	BS	CAN	(	8	H	X	h	x
1	0	0	1	9	HT	EM	)	9	I	Y	i	y
1	0	1	0	A	LF	SUB	*	:	J	Z	j	z
1	0	1	1	B	VT	ESC	+	;	K	[	k	{
1	1	0	0	C	FF	FS	,	<	L	¥	l	|
1	1	0	1	D	CR	GS	–	=	M	]	m	}
1	1	1	0	E	SO	RS	.	>	N	^	n	~
1	1	1	1	F	SI	US	/	?	O	_	o	DEL

Index

G

H

I

J

L

M

O

P

R

S

T

U

W

Record of changes

Manual No.	Date	Description of changes
ARCT1F333E/ ACG–M333E	AUG. 2001	First edition

GLOBAL NETWORK

Europe http://www.mew–europe.com/

■ **Germany** **Matsushita Electric Works (Europe) AG**
Rudolf–Diesel–Ring 2, D–83607 Holzkirchen, Germany
Tel: 49–8024–648–0

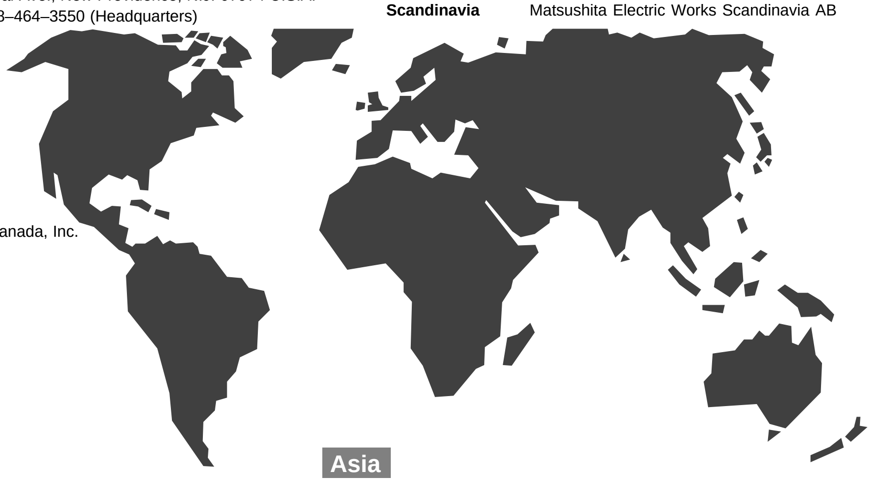
Germany	Matsushita Electric Works Deutschland G.m.b.H.
United Kingdom	Matsushita Electric Works UK Ltd.
• Ireland	Matsushita Electric Works UK Ltd. Irish Branch Office
Austria	Matsushita Electric Works Austria G.m.b.H.
Switzerland	Matsushita Electric Works Schweiz AG
France	Matsushita Electric Works France S.A.R.L.
Italy	Matsushita Electric Works Italia s.r.l.
Benelux	Matsushita Electric Works Benelux B.V.
Spain	Matsushita Electric Works España S.A.
• Portugal	Matsushita Electric Works España S.A. Portuguese Branch Office
Czech	Matsushita Electric Works (CZ) s.r.o.
Scandinavia	Matsushita Electric Works Scandinavia AB

North & South America http://www.aromat.com/

■ **USA** **Aromat Corporation**
629 Central Ave., New Providence, N.J. 07974 U.S.A.
Tel: 1–908–464–3550 (Headquarters)

- **New Jersey**
- **Georgia**
- **Massachusetts**
- **Illinois**
- **Texas**
- **California**
  - **Los Angels**
  - **San Jose**
- **Michigan**

Canada Aromat Canada, Inc.



Representative Office

- **Indonesia**
- **Vietnam**
- **Philippines**
- **India**
- **Turkey**
- **Brazil**

Asia

■ **Singapore** **Matsushita Electric Works (Asia Pacific) Pte. Ltd.**
101 Thomson Road, #25–03/05, United Square, Singapore 307591
Tel: 65–255–5473

Malaysia	Matsushita Electric Works (Malaysia) Sdn. Bhd.
Thailand	Matsushita Electric Works Sales (Thailand) Co., Ltd.
U.A.E.	Matsushita Electric Works (Middle East) FZE.

■ **China** **Matsushita Electric Works (China) Co., Ltd.**
Suite 201 Level 2 Tower W3, The Toners, Oriental Plaza, No.1,
East Chang An Ave., Dong Cheng District, Beijing, 100005 China
Tel: 86–10–8518–1302, 1303

Beijing	Matsushita Electric Works (China) Co., Ltd.
Shanghai	Matsushita Electric Works (China) Co., Ltd. Shanghai Branch Office
Guangzhou	Matsushita Electric Works (China) Co., Ltd. Guangzhou Branch Office
Dalian	Matsushita Electric Works (China) Co., Ltd. Dalian Branch Office
Shenzhen	Matsushita Electric Works (China) Co., Ltd. Shenzhen Branch Office
Chengdu	Matsushita Electric Works (China) Co., Ltd. Chengdu Branch Office

■ **Hong Kong** **Matsushita Electric Works (Hong Kong), Ltd.**
Rm1601, 16/F, Tower 2,
The Gateway, 25 Canton Road,
Tsimshatsui, Kowloon, Hong Kong
Tel: 852–2529–3956

■ **Japan** **Matsushita Electric Works, Ltd.**
Automation Controls Company
1048, Kadoma, Kadoma–shi, Osaka 571–8686, Japan
Tel: 81–06–6908–1050

Please contact ....

Matsushita Electric Works, Ltd.

Automation Controls Company
■ Head Office: 1048, Kadoma, Kadoma-shi, Osaka 571–8686, Japan
■ Telephone: Japan (81) Osaka (06) 6908 - 1050
■ Facsimile: Japan (81) Osaka (06) 6908 - 5781
http://www.nais–e.com/