NAiS

PROGRAMMABLE CONTROLLER

FP Σ

User’s Manual

[Applicable PLC]

FPΣ Control units

- **FPG-C32T**
- **FPG-C32T2**
- **FPG-C24R2**

Smart Solutions by NAiS http://www.naisplc.com

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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
Windows software Conforms to IEC61131-3	**FPWIN Pro Ver.4**	All instructions and functions can be used.
Windows software	**FPWIN GR Ver.2**	All instructions and functions can be used.
	FPWIN GR Ver.1	Not used
MS-DOS software	**NPST-GR Ver.4**	Not used
	NPST-GR Ver.3	
Handy programming unit (FP programmer)	**AFP1114V2**	Not used
	AFP1114	
	AFP1112A **AFP1112**	

Notes

Precautions concerning programming tools

- Programming tools used with the FPΣ require FPWIN Pro Ver. 4 or later or Ver. 2 or a subsequent version of the FPWIN GR. Please be aware that other tools cannot be used.
- Either “FPWIN Pro Ver.4.1 or later” or “FPWIN GR Ver. 2.1 or later” are necessary for use the C32T2 and C24R2 types control unit.

Compatibility with the FP0

Program compatibility

The following points require attention if using FP0 programs on the FPΣ.

- **Pulse output function**
  With the FPΣ, please be aware that the following changes have been made to instructions concerning pulse output.

Instruction	For the FP0	For the FPΣ
Trapezoidal control	F168 (SPD1)	F171 (SPDH)
Jog feed	F169 (PLS)	F172 (PLSH)
Data table control	None	F174 (SP0H)
Linear interpolation control	None	F175 (SPSH)
Circular interpolation control	None	F176 (SPCH)
PWM output	F170 (PWM)	F173 (PWMH)

* Linear and circular interpolation control can be used only with the FPΣ Control Unit C32T2.

- **Serial data communication function**
  With the FPΣ, please be aware that the following changes have been made to instructions concerning serial data communication.

Instruction	For the FP0	For the FPΣ
Serial data communication	F144 (TRNS)	F159 (MTRN)

* The F159 (MTRN) instruction is used only with an FPΣ in which the conventional F144 (TRNS) instruction has been set up to correspond to multiple communication ports. Please be aware that the conventional F144 (TRNS) instruction cannot be used with the FPΣ.

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 1:N communication 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

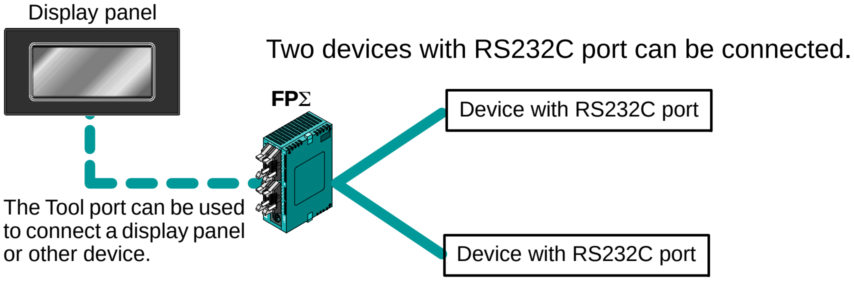
Display panel
Two devices with RS232C port can be connected.
FPΣ
Device with RS232C port
Device with RS232C port
The Tool port can be used to connect a display panel or other device.

Figure 1: Features-communication (RS232C)

1:N communication possible with up to 99 stations (units)

When using the 1-channel RS485 type communication cassette

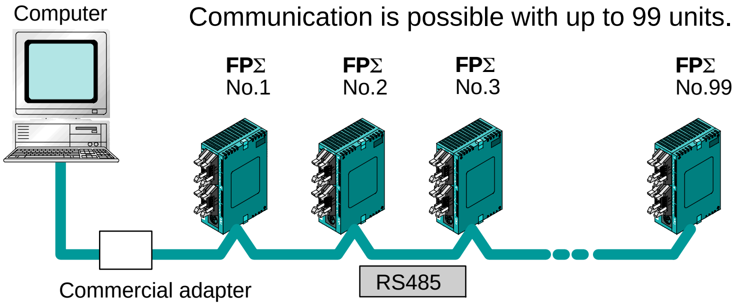

Figure 2: Features-communication (C-NET)

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

When using the 1-channel RS485 type communication cassette

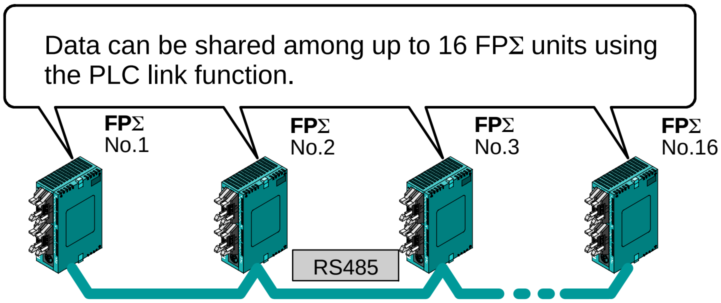

Data can be shared among up to 16 FPΣ units using the PLC link function.
FPΣ No.1
FPΣ No.2
FPΣ No.3
FPΣ No.16
RS485

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

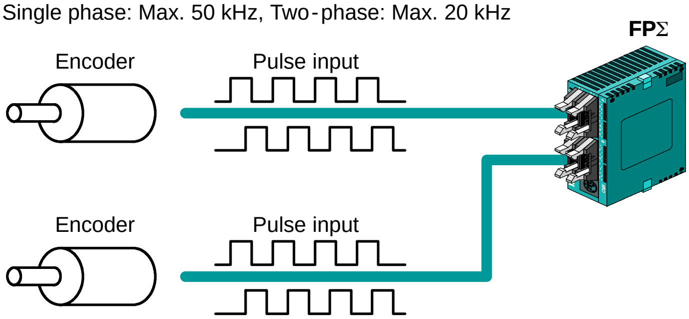


Figure 4: Features-High-speed counter

Positioning control based on pulse output supported

CW/CCW and Pulse/sign outputs are supported.

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

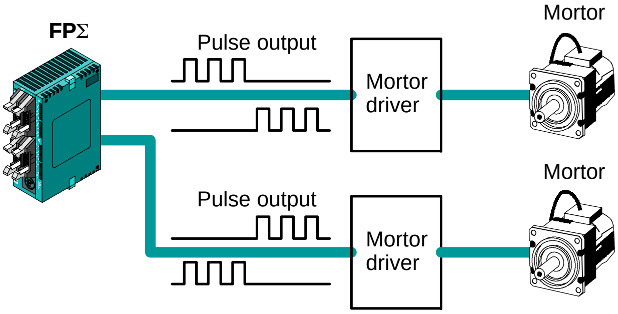


Figure 5: Features-Pulse output

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	Number of I/O points	Part No.	Product No.
FPΣ Control unit	Input: 16 points/Transistor output: 16 points	FPG-C32T	AFPG2543
	Input: 16 points/Transistor output: 16 points	FPG-C32T2	AFPG2643
	Input: 16 points/Relay output: 8 points	FPG-C24R2	AFPG2423

1.2.2 FPΣ Expansion Unit

Name	Number of I/O points	Part No.	Product No.
FPΣ expansion I/O unit	Input: 32 points/Transistor output: 32 points	FPG-XY64D2T	AFPG3467

* The FPΣ expansion I/O unit can be used for “FPG-C32T2 and FPG-C24R2” FPΣ control units.

1.2.3 Units for FP0 and FPΣ

The FPΣ can be used the FP0 series expansion I/O unit, power supply unit, and intelligent unit.

1.2.4 Communication Cassette

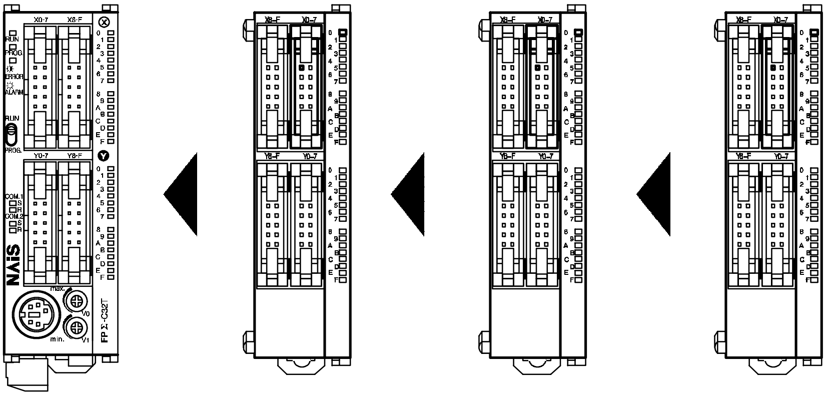
A detachable communication cassette (optional) should be used when using the various functions such as the computer link, serial data communication, and PLC link functions.

Name	Description	Part No.	Product 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	AFPG801
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	AFPG802
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	AFPG803

1.3 Restrictions on Unit Combinations

This section contains restrictions on unit combinations.

1.3.1 Restrictions on the Number of Expansion Units (for FP0 expansion unit)



(Maximum possible expansion is with a total of three units)

Control unit Unit 1 for expansion Unit 2 for expansion Unit 3 for expansion

Figure 6: Restriction on unit combinations

Up to three expansion units can be added at the right of the FPΣ, these expansion units being either expansion units or intelligent units from the earlier FP0 series, or a combination of the two.

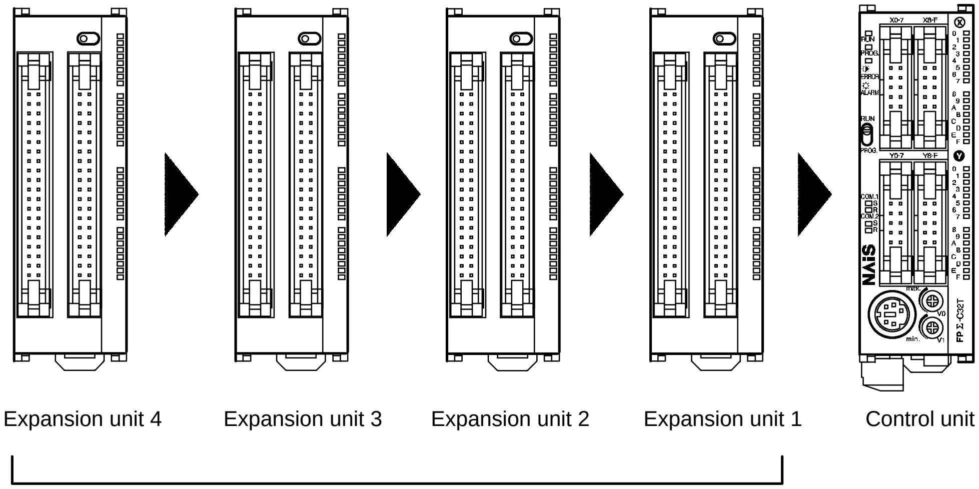
There are no restrictions on the type and the order in which expansion units are installed.

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

Controllable I/O Points

Type of control unit	Number of I/O points when using control unit	Number of I/O points when using FP0 expansion unit
FPG-C32T **FPG-C32T2**	32 points	Max. 128 points
FPG-C24R2	24 points	Max. 120 points

1.3.2 Restrictions on the Number of Units for Expansion (for FPΣ expansion unit)



Max. possible expansion is with a total of four units.

Up to four dedicated FPΣ expansion units can be added at the left of the FPΣ.

The 64 points type expansion unit consist of 32 input points and 32 transistor output points.

Controllable I/O Points

Type of control unit	Number of I/O points when using control unit	Number of I/O points when using FPΣ expansion unit
FPG-C32T2	32 points	Max. 288 points
FPG-C24R2	24 points	Max. 280 points

The FPΣ expansion unit cannot be used for FPG-C32T.

Tip

If using FP0 expansion units and FPΣ expansion units in combination, the number of input and output points can be expanded to a maximum of 384 points for the FPG-C32T2 and 376 points for the FPG-C24R2.

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 Pro Ver. 4" or "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.

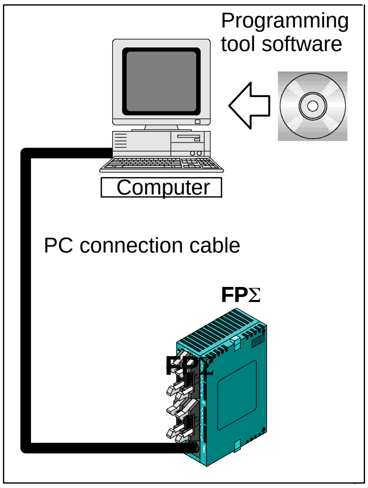


Figure 7: Programming tools

1.4.2 Software Environment and Suitable Cable

Standard ladder diagram tool software "FPWIN-GR Ver.2"

Type of software		OS (Operating system)	Hard disk capacity	Part No.	Product No.
FPWIN-GR Ver. 2 English-language menu	English-language software	Windows 95/98/ Me/2000/NT (Ver. 4.0 or later)	30MB or more	FPWINGRF-EN2	AFPS10520
	Upgrade (to upgrade from Ver.1.1)			FPWINGRR-EN2	AFPS10520R

Conforms to IEC61131-3 programming tool software "FPWIN-Pro Ver.4"

Type of software		OS (Operating system)	Hard disk capacity	Part No.	Product No.
FPWIN Pro Ver. 4 Full type (for all type FP series PLC)	English-language menu	Windows 95/98/ Me/2000/NT (Ver. 4.0 or later)	100MB or more	FPWINPROF-EN4	AFPS50540
FPWIN Pro Ver. 4 Small type (for FP0, FPΣ, FP1, and FP-M)	English-language menu			FPWINPROS-EN4	AFPS51540

Type of computer and suitable cable

Type of computer	Cable	Cable specification
IBM PC/AT or its compatible machine	Part No.: AFC8503	D-Sub 9-pin female-Mini DIN 5-pin male
	Part No.: AFC8513	D-Sub 25-pin male-Mini DIN 5-pin male

Chapter 2

Specifications and Functions of Control Unit

2.1 Parts and Functions

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

2.1.1 Parts and Functions

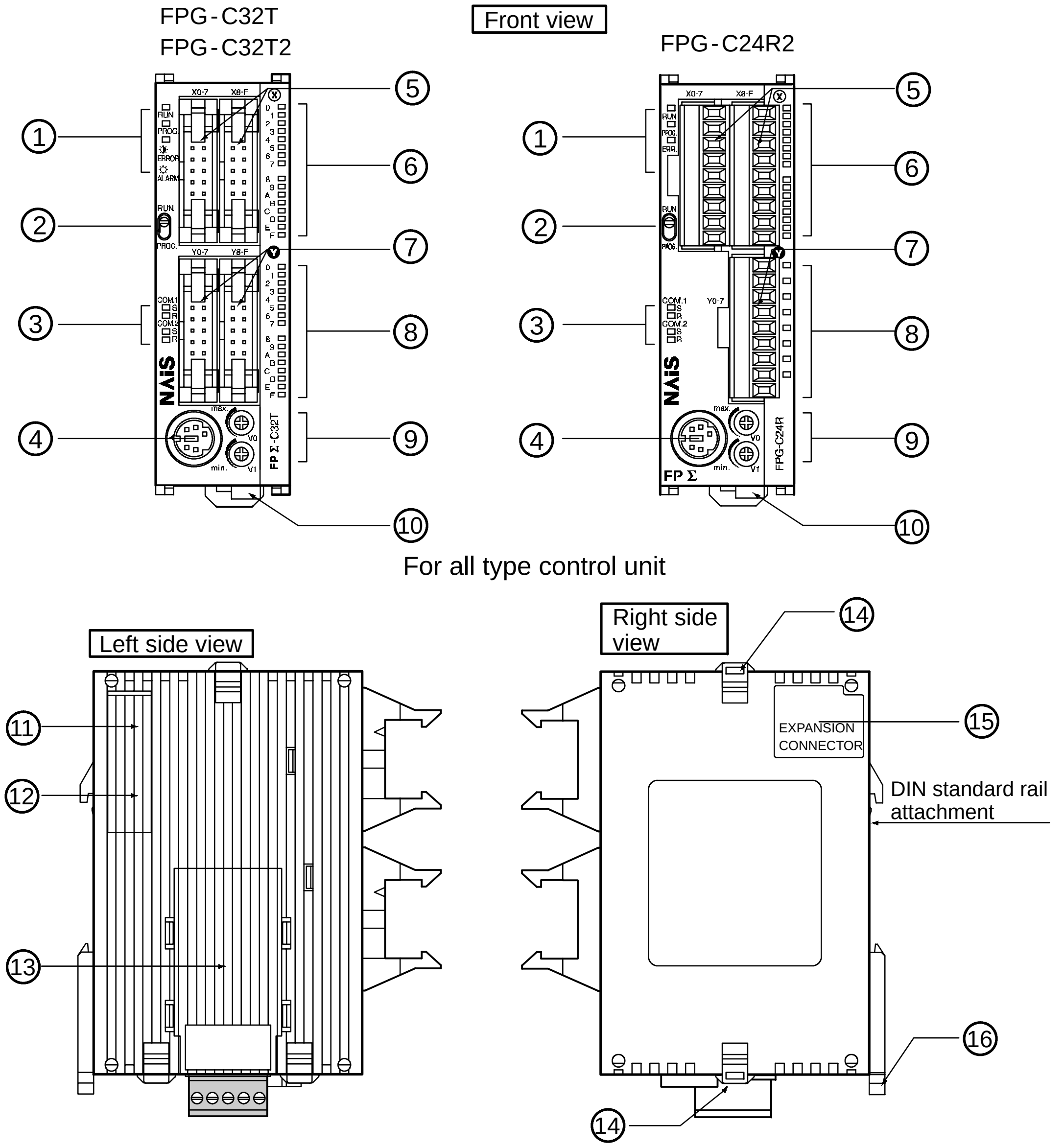


Figure 8: FPΣ Parts and Functions

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)

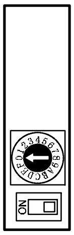
Supply 24 V DC. It is connected using the power supply cable (AFP0581) that comes with the unit.

⑪ Left-side connector for FPΣ expansion

This is used to connect dedicated FPΣ expansion units on the left side of the control unit with the internal circuits.
*The FPG-C32T2 and FPG-C24R2 control units are equipped with this connector, but the FPG-C32T is not.

⑫ Unit No. (Station No.) setting switch

This unit No. (station No.) is specified when using the communication functions provided on the optional communication cassettes.



The unit No. (station No.) 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)

⑬ 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

⑭ Expansion hook

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

⑮ Right-side connector for FP0 expansion

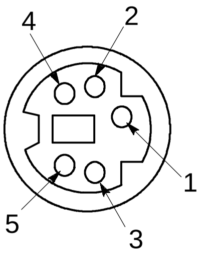
Connects an expansion unit to the internal circuit of the control unit.

⑯ 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

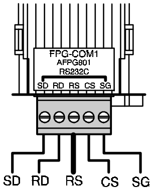
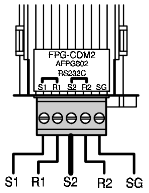
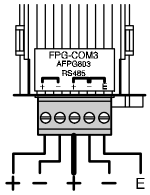
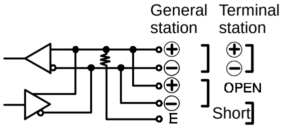
Figure 10: FPΣ Parts and Functions (Tool port)

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	 FPG-COM1 AFPG801 RS232C SD RD RS CS SG SD RD RS CS SG 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	 FPG-COM2 AFPG802 RS232C S1 R1 S2 R2 SG S1 R1 S2 R2 SG 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	 FPG-COM3 AFPG803 RS485 + − + − E + − + − E 

2.2 Input and Output Specifications

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

2.2.1 Input Specifications

Input specifications (for all type)

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		For C32T, C32T2: 16 points/common For C24R2: 8 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 input X0, X1, X3, X4: 1 ms or less: normal input 5 μs or less: high-speed counter, pulse catch, interrupt input settings For input X2, X5 to X7: 1 ms or less: normal input 100 μs or less: high-speed counter, pulse catch, interrupt input settings For input X8 to XF: 1 ms or less: normal input only
	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.

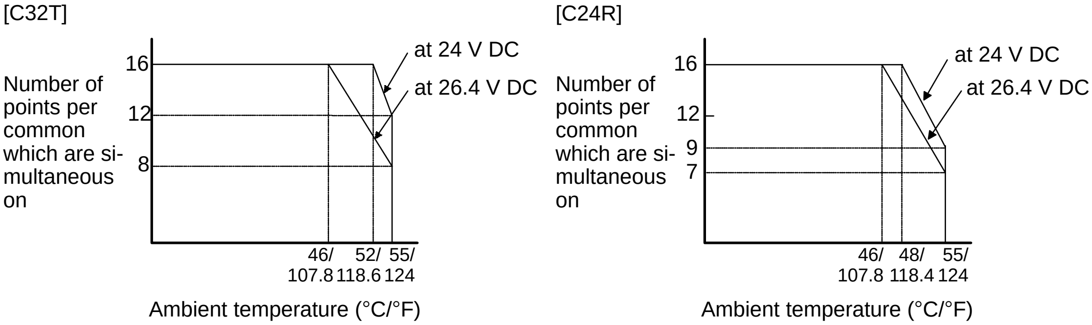


Figure 11: FPΣ Limitations on number of simultaneous input on points

Internal circuit diagram

[X0, X1, X3, X4]

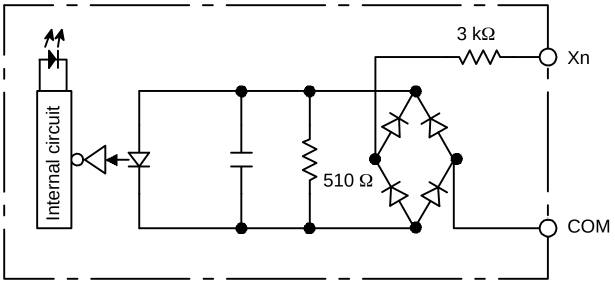
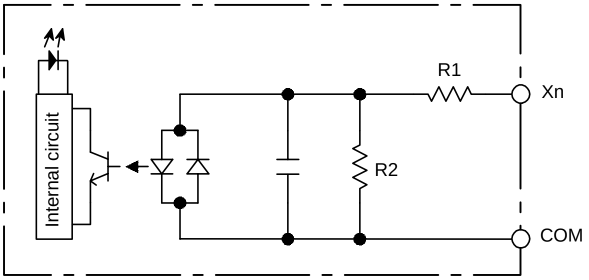


Figure 12: FPΣ Internal circuit diagram (Input-1)

[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 (for C32T and C32T2)

Item		Description
Insulation method		Optical coupler
Output type		Open collector (NPN)
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		0.5 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: 0.2 ms or less
	on → off	For Y0, Y1, Y3, Y4 (at 15 mA or more): 8 µs or less For Y2, Y5 to YF: 0.5 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.

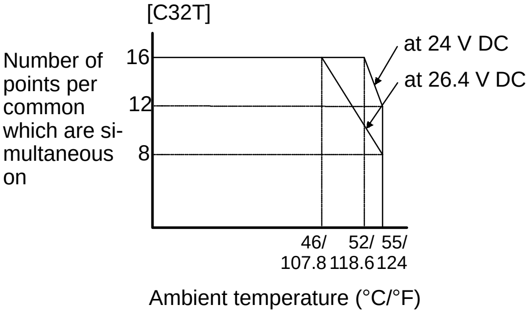


Figure 14: FPΣ Limitations on number of simultaneous output on points

Internal circuit diagram

[Y0, Y1, Y3, Y4]

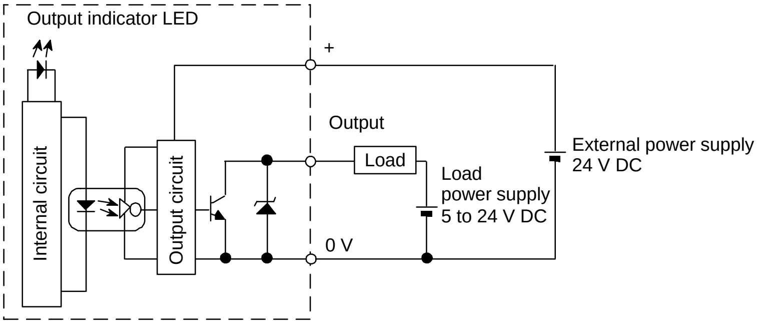


Figure 15: FPΣ Internal circuit diagram (output - 1)

[Y2, Y5 to YF]

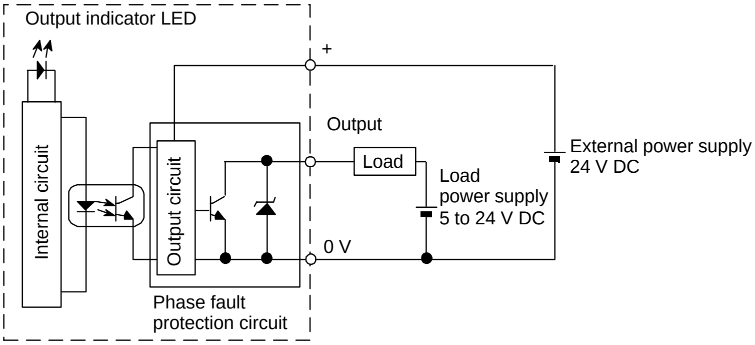


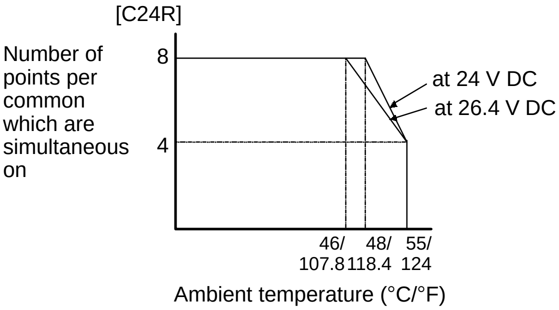
Figure 16: FPΣ Internal circuit diagram (output - 2)

Relay output specifications (for C24R2)

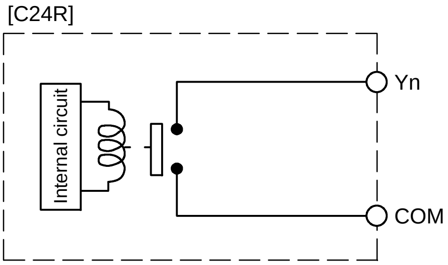
Item		Description
Output type		1a (1 Form A, Normally open)
Rated control capacity		2 A 250 V AC, 2 A 20 V DC (4.5 A per common or later)
Output points per common		8 points/common
Response time	**off → on**	Approx. 10 ms
	on → off	Approx. 8 ms
Mechanical lifetime		Min. 20,000,000 operations
Electrical lifetime		Min. 100,000 operations
Surge absorber		-
Operating mode indicator		LED display

Limitations on number of simultaneous output on points

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



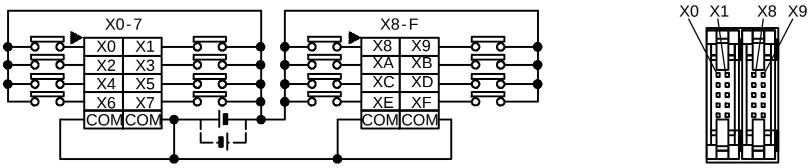
Internal circuit diagram



2.3 Terminal Layout Diagram

2.3.1 Control Unit (for C32T and C32T2)

Input



Note

The four COM terminals of input circuit are connected internally.

Output

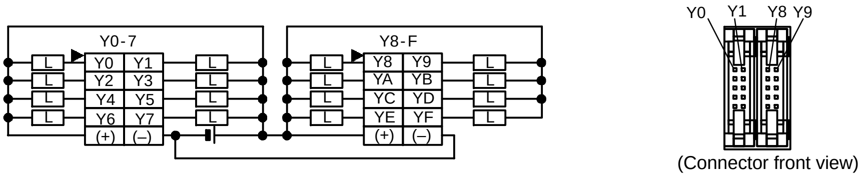


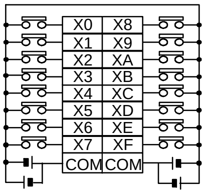
Figure 17: FPΣ Terminal layout diagram (I/O connector)

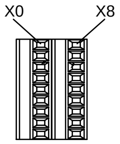
Notes

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

2.3.2 Control Unit (for C24R2)

Input

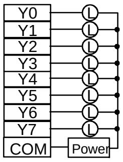


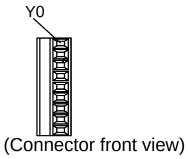


Note

The two COM terminals of input circuit are not connected internally.

Output





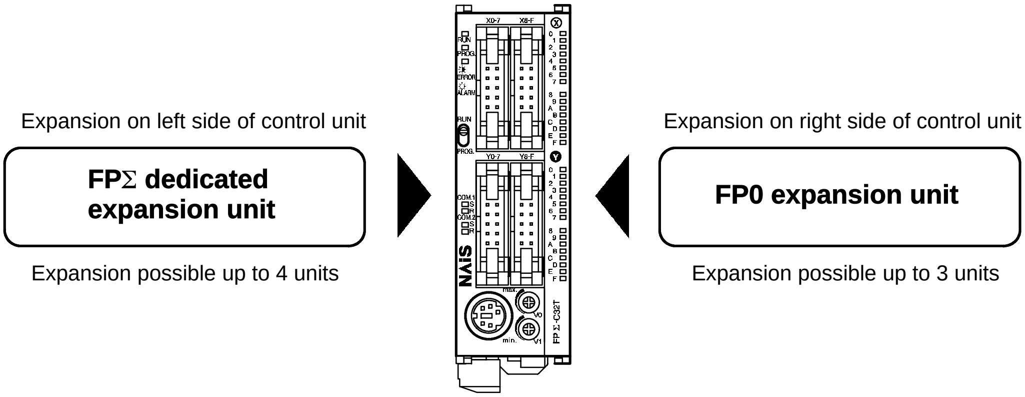
Chapter 3

Expansion

3.1 Type of Expansion Unit

Expansion I/O units, power supply units, and intelligent units from the earlier FP0 series can be used with the FPΣ, in addition to the dedicated expansion units designed expressly for the FPΣ.

Expansion units used for the earlier FP0 series are connected on the right side of the control unit, just as they were with the FP0. Dedicated expansion units for the FPΣ are connected to the left side of the control unit.


Expansion on left side of control unit
FPΣ dedicated expansion unit
Expansion possible up to 4 units
Expansion on right side of control unit
FP0 expansion unit
Expansion possible up to 3 units
NAiS
FPΣ-C32T

Control unit

3.2 Expansion Method of Units for FP0 and FPΣ

The previously available expansion I/O unit or intelligent unit for FP0 is expanded by connecting to the right side of control unit.

Because unit expansion is done using the right-side connector for FP0 expansion and expansion hook on the side of the unit, no expansion cable is needed.

① Peel the seal on the side of the unit so that the internal right-side connector for FP0 expansion is exposed.

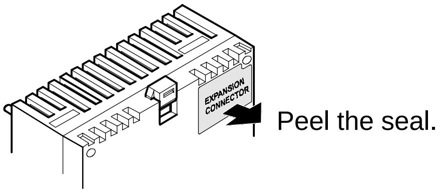


Figure 18: Expansion method procedure-1

② Raise the expansion hooks on the top and bottom sides of the unit with a screwdriver.

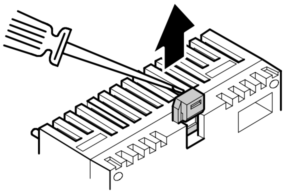


Figure 19: Expansion method procedure-2

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.

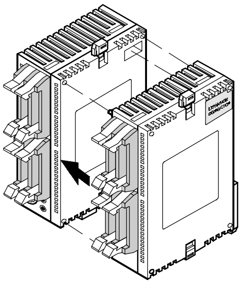


Figure 20: Expansion method procedure-3

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

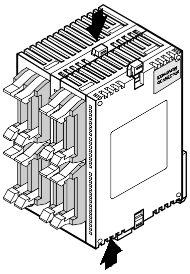


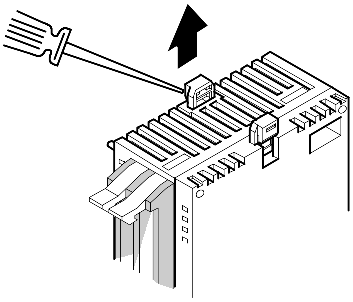
Figure 21: Expansion method procedure-4

3.3 Expansion Method of FPΣ Expansion Unit

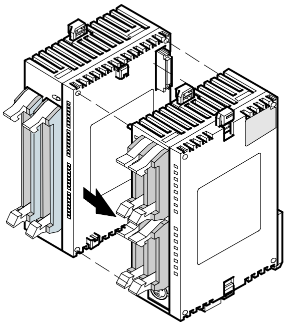
The dedicated expansion unit for FPΣ is expanded by connecting to the left side of the control unit. Because unit expansion is done using the left-side connector for FPΣ expansion and expansion hook on the side of the unit, no expansion cable is needed.

① Remove the cover on the left side of the unit so that the internal left-side connector for FPΣ expansion is exposed.

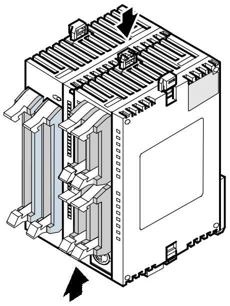
② Raise the expansion hooks on the top and bottom sides of the unit with a screwdriver.



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.



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

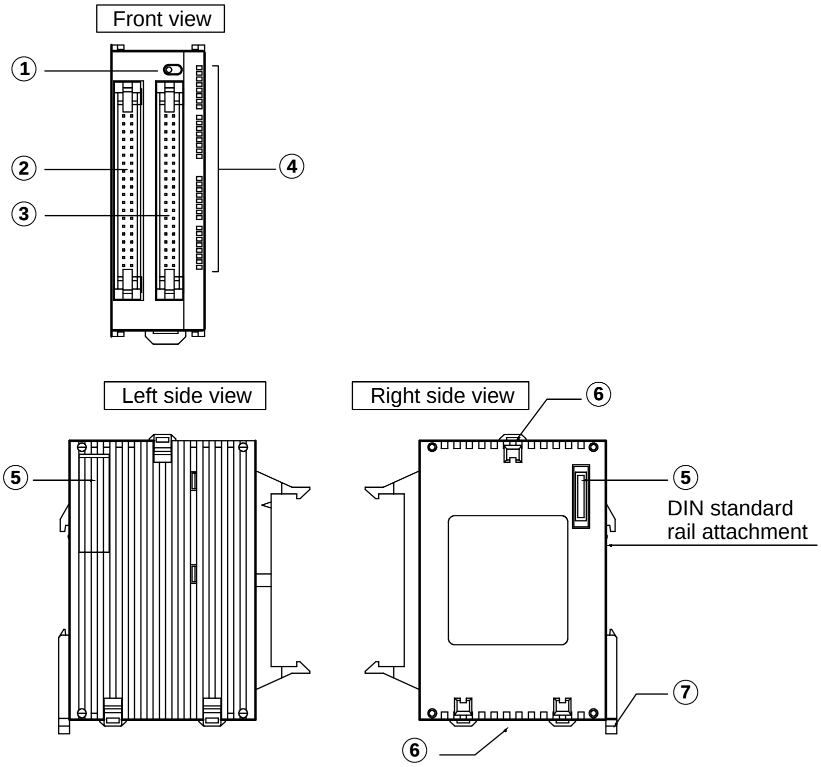


3.4 Specifications of FPΣ Expansion Unit

3.4.1 FPΣ Expansion I/O Unit

Parts and Functions

FPG-XY64D2T
(Input: 32 points / Transistor output: 32 points)



① **LED display selection switch**

Switches between the input (32 points) and output (32 points) of the LED display.

② **Input connector (40 pins)**

③ **Output connector (40 pins)**

④ **Input and Output indicator LEDs**

⑤ **FPΣ expansion connector**

This expansion connector is used to connect the dedicated unit for FPΣ.

⑥ **Expansion hook**

This hook is used to secure expansion unit. The hook is also used for installation on FP0 mounting plate (flat type)(Part No.: AFP0804).

⑦ **DIN rail attachment lever**

The expansion unit enables attachment at a touch to a DIN rail. The lever is also used for installation on FP0 mounting plate (slim 30 type)(Part No.: AFP0811).

Input specifications

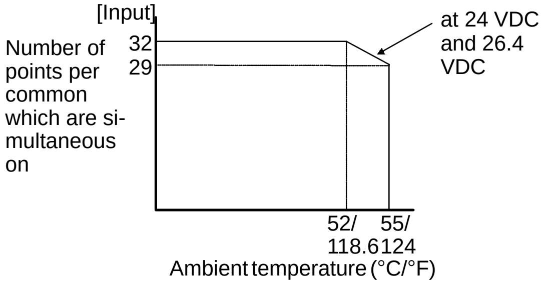
Item		Description
Insulation method		Optical coupler
Rated input voltage		24 V DC
Operating voltage range		21.6 to 26.4 V DC
Rated input current		Approx. 3.5 mA
Input points per common		32 points/common (Either the positive or negative of input power supply can be connected to common terminal.)
Min. on voltage/Min. on current		19.2 V DC/3 mA
Max. off voltage/Max. off current		2.4 V DC/1.3 mA
Input impedance		Approx. 6.8 kΩ
Response time	**off → on**	0.2 ms or less
	on → off	0.3 ms or less
Operating mode indicator		LED display

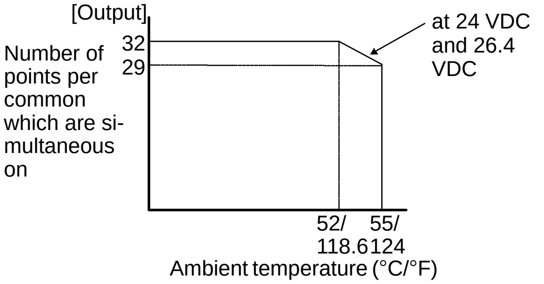
Transistor output specifications

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		0.1 A
Max. surge current		0.5 A
Output points per common		32 points/common
Off state leakage current		100 μA or less
On state voltage drop		0.5 V or less
Response time	**off → on**	0.2 ms or less
	on → off	0.5 ms or less
External power supply for driving internal circuit	**Voltage**	21.6 to 26.4 V DC
	Current	15 mA or less
Surge absorber		Zener diode
Operating mode indicator		LED display
Phase fault protection		Thermal protection

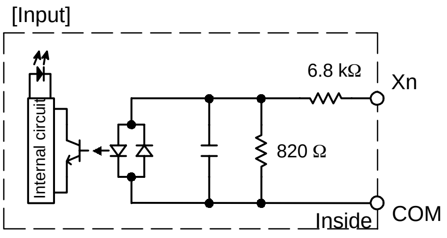
Limitations on number of simultaneous on points

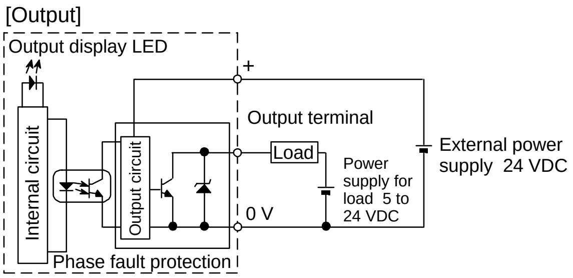
Keep the number of points which are simultaneously on within the following range as determined by the ambient temperature.



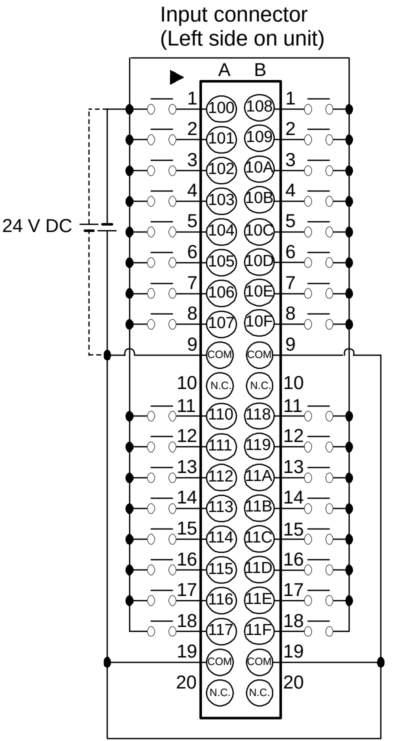


Internal circuit diagram

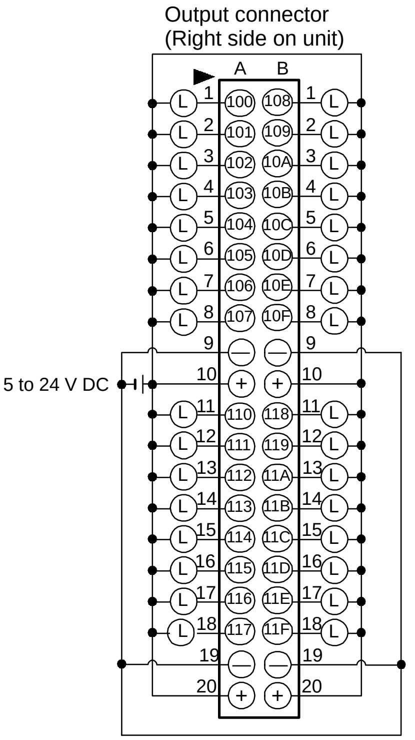




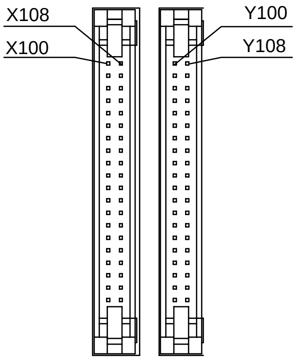
Terminal layout diagram



The COM terminals are connected internally with the same connector.



Although “+” and “-” terminals are connected internally with the same connector, it is recommended that they also be connected externally.



(Front view of connector)

Note: The number in the connector are for the first expansion.

Chapter 4

I/O Allocation

4.1 I/O Allocation

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

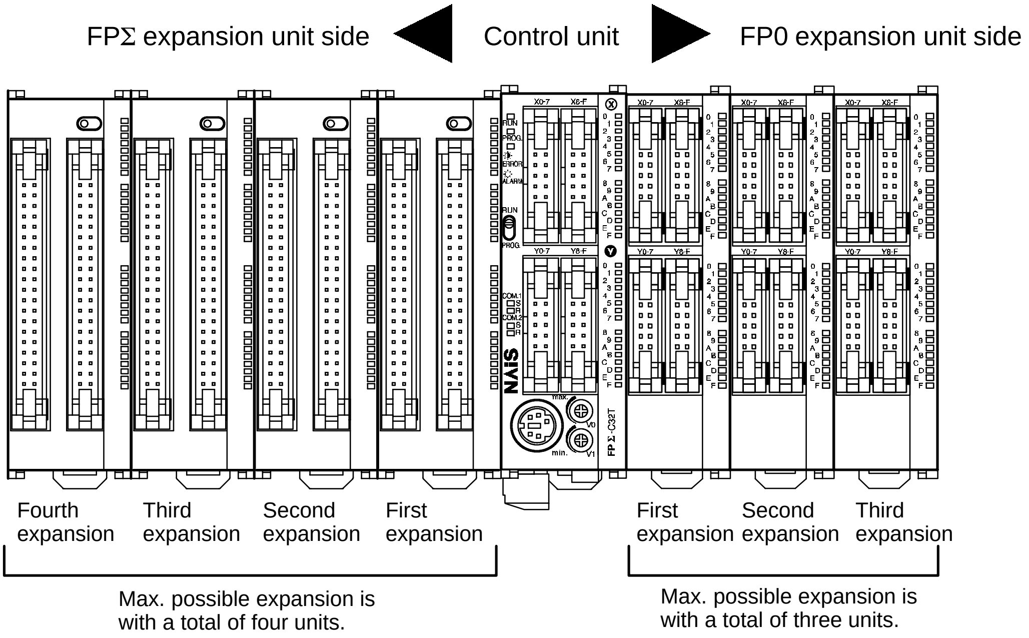


Figure 22: FPΣ I/O allocation

4.1.1 I/O Number of FPΣ Control Unit

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

Type of control unit		I/O number
FPG-C32T **FPG-C32T2**	**Input (16 points)**	X0 to XF
	Output (16 points)	Y0 to YF
FPG-C24R2	**Input (16 points)**	X0 to XF
	Output (8 points)	Y0 to Y7

4.1.2 I/O Number of FPΣ Expansion Unit (for left side expansion)

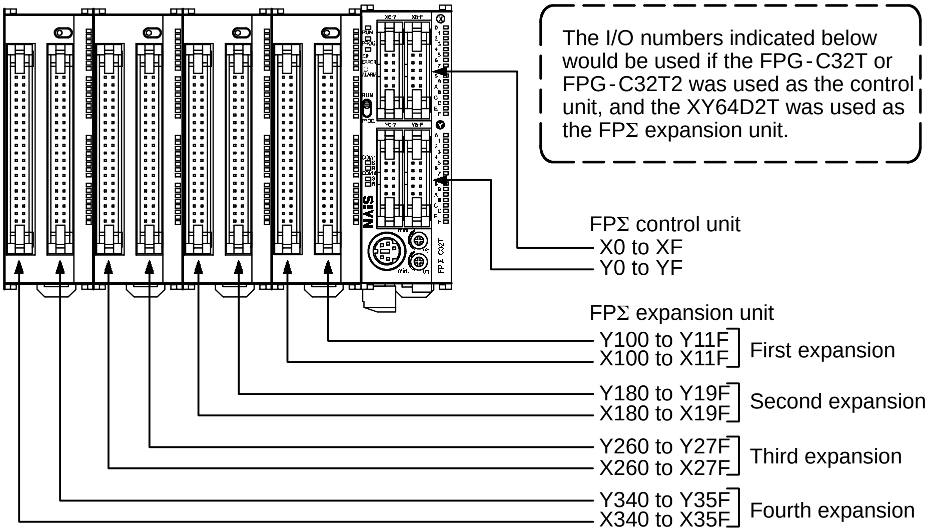
I/O do not need to be set as I/O allocation is performed automatically when an expansion unit is added.

The I/O allocation of expansion unit is determined by the installation location.

Type of expansion unit		First expansion	Second expansion	Third expansion	Fourth expansion
XY64D2T	**Input (32 points)**	X100 to X11F	X180 to X19F	X260 to X27F	X340 to X35F
	Output (32 points)	Y100 to Y11F	Y180 to Y19F	Y260 to Y27F	Y340 to Y35F

Note

The FPΣ expansion unit nearest the control unit has the lowest I/O number, so that the unit closest to the control unit is the first unit, the one next to that the second, and so on. Consequently, the I/O numbers in the illustration below start with the lowest number at the right and proceed in sequential order.



The I/O numbers indicated below would be used if the FPG-C32T or FPG-C32T2 was used as the control unit, and the XY64D2T was used as the FPΣ expansion unit.

4.1.3 I/O Number of FP0 Expansion Unit (for right side expansion)

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

4.1.4 I/O Number of FP0 Analog I/O Unit (for right side expansion)

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)

4.1.5 I/O Number of FP0 A/D Conversion Unit (for right side expansion)

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)			

4.1.6 I/O Number of FP0 I/O Link Unit (for right side expansion)

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

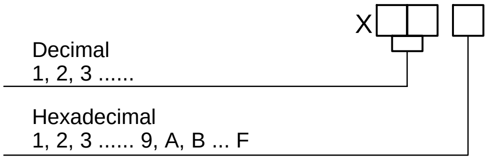
Unit	First expansion	Second expansion	Third expansion
Input (32 points)	X20 to X3F	X40 to X5F	X60 to X7F
Output (32 points)	Y20 to Y3F	Y40 to Y5F	Y60 to Y7F

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.



Chapter 5

Installation and Wiring

5.1 Installation

This section explains installation environment and installation method of FPΣ.

5.1.1 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.

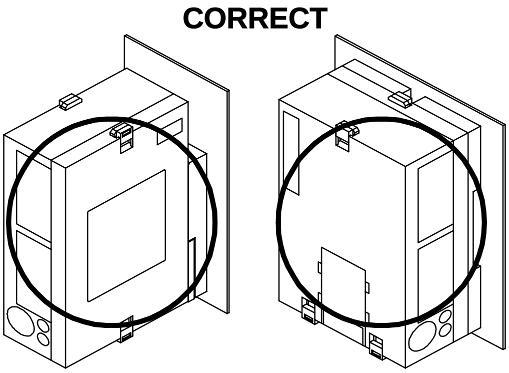
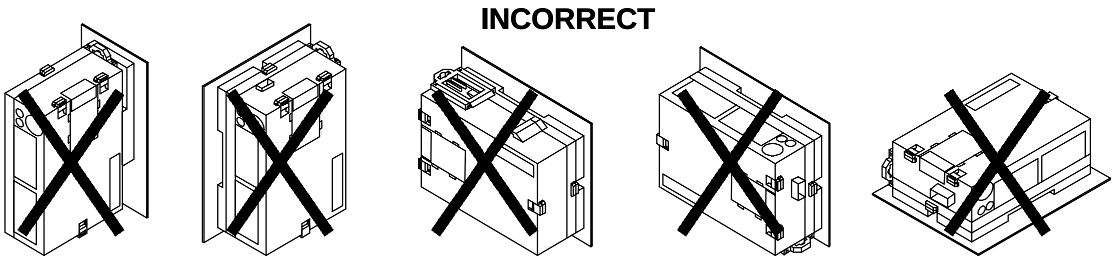


Figure 23: FPΣ Installation - heat discharge

Do not install the FPΣ control unit as shown below.



Upside - down

Installation which blocks the air duct

Installations such that the input and output connectors face down

Input and output connectors on top

Horizontal installation of the unit

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.

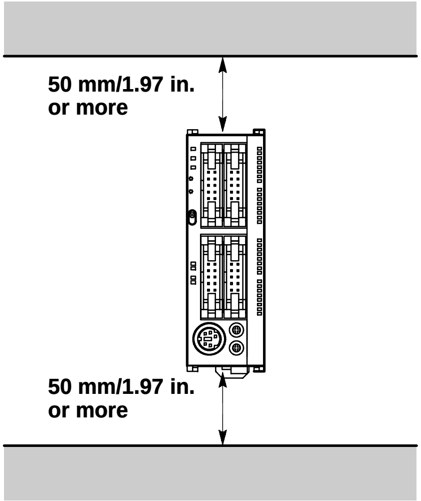


Figure 25: FPΣ Installation space‑1

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.

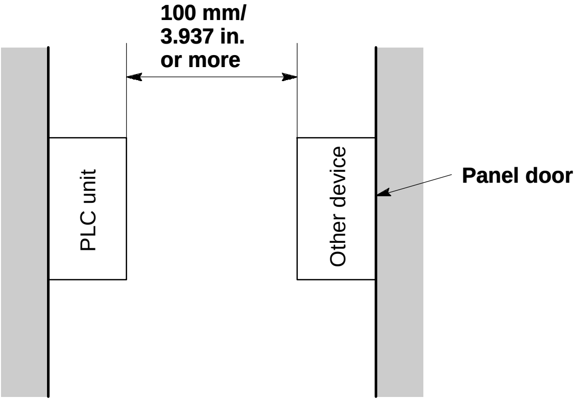


Figure 26: FPΣ Installation space‑2

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.

5.1.2 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.

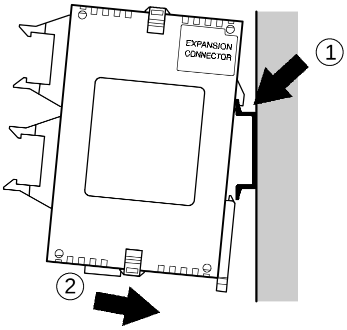


Figure 27: Installation method

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.

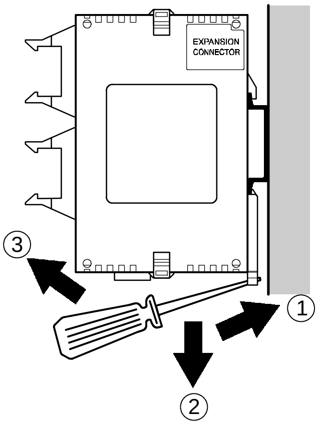


Figure 28: Removal method

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.

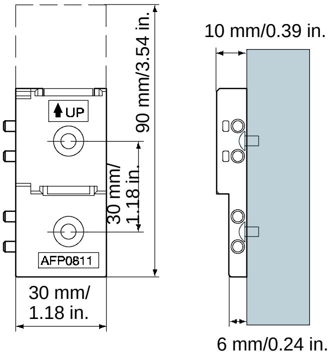


Figure 29: FPΣ Installation-optional slim 30 type mounting plate

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

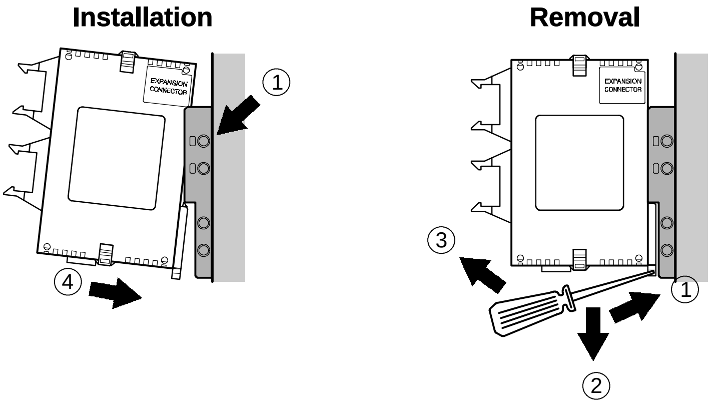


Figure 30: FPΣ Installation using slim 30 type mounting plate

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

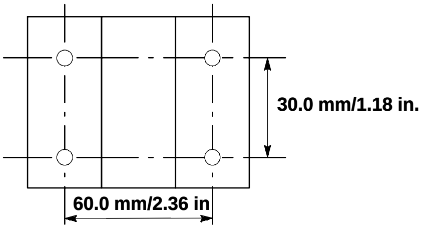


Figure 31: FPΣ Installation using two expansion units

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.

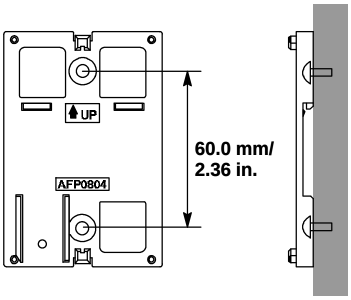


Figure 32: FPΣ Installation-optional flat type mounting plate

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.

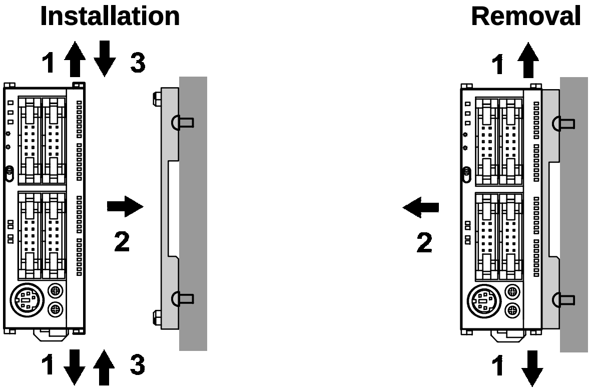


Figure 33: FPΣ Installation using flat type mounting plate

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

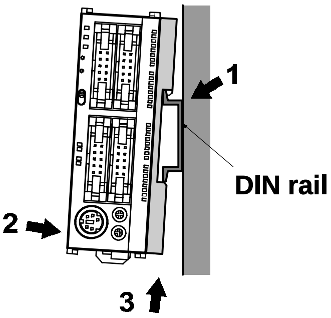


Figure 34: FPΣ Installation on DIN rail using flat type mounting plate

Note

The flat type mounting plate (AFP0804) should be used only with the control unit as a stand-alone unit. It should not be used when the control unit is being used in combination with an FP0 expansion unit or FPΣ expansion unit.

5.2 Wiring of Power Supply

This section explains power supply wiring of FPΣ.

5.2.1 Wiring of Power Supply

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

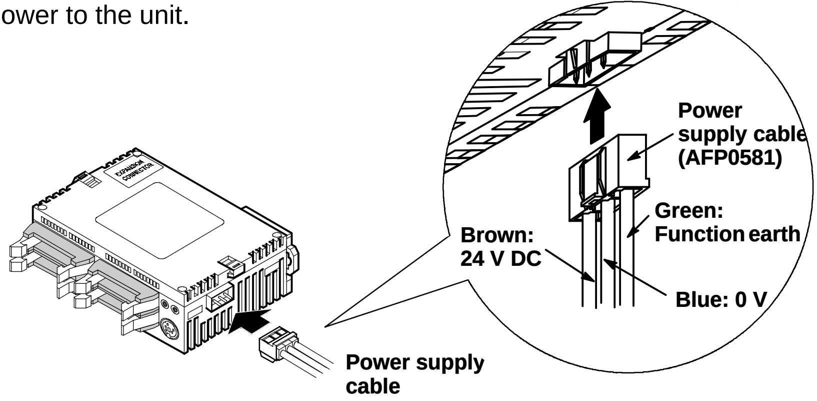


Figure 35: FPΣ Wiring of power supply

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.

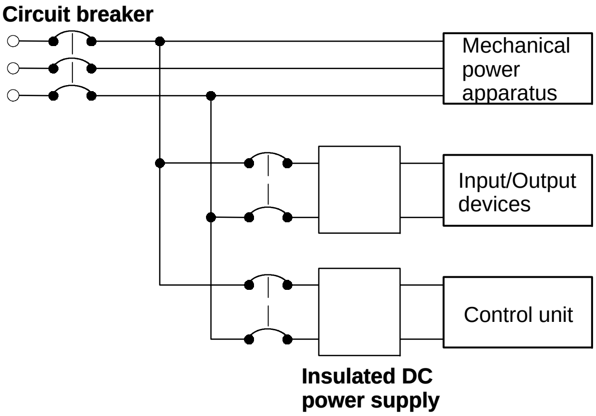


Figure 36: FPΣ Power supply wiring system

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.

5.2.2 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.

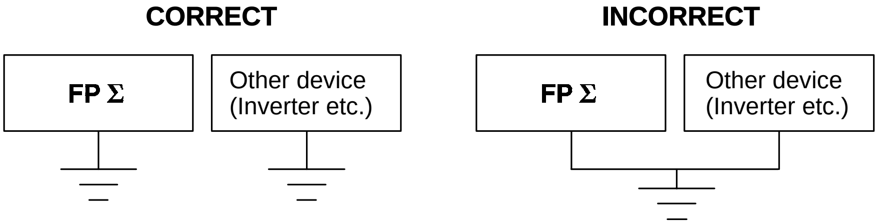


Figure 37: FPΣ Grounding

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.

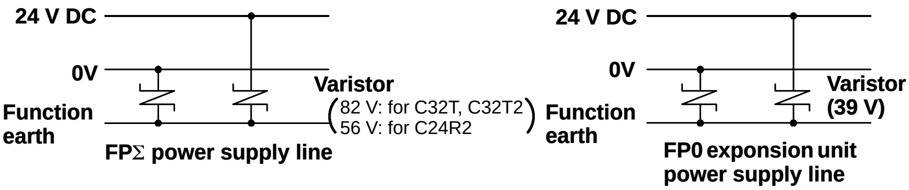


Figure 38: Power supply line of FPΣ and FP0 expansion unit

5.3 Wiring of Input and Output

This section explains input wiring and output wiring of FPΣ.

5.3.1 Input Wiring

Connection of photoelectric sensor and proximity sensor

Relay output type

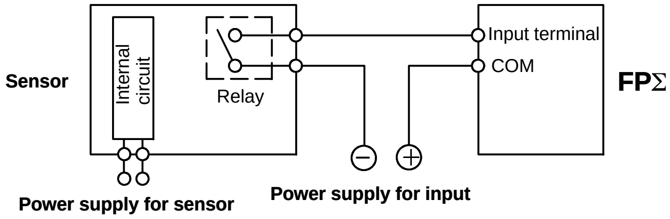


Figure 39: FPΣ Relay output type sensor

NPN open collector output type

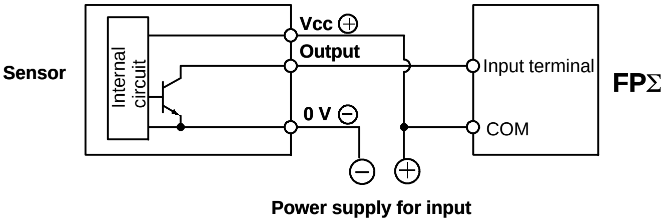


Figure 40: FPΣ NPN open collector output type sensor

Voltage output (Universal output) type

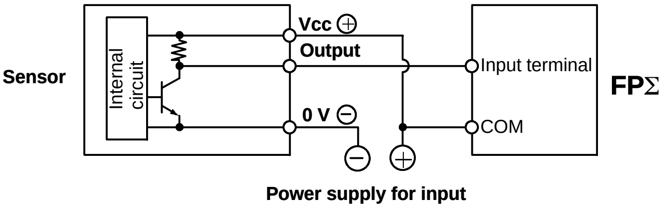


Figure 41: FPΣ Voltage output (universal output) type sensor

Two-wire output type

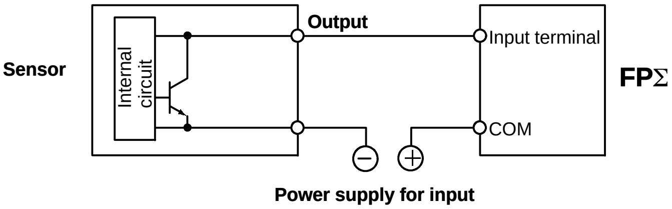


Figure 42: FPΣ Two-wire output type sensor

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.

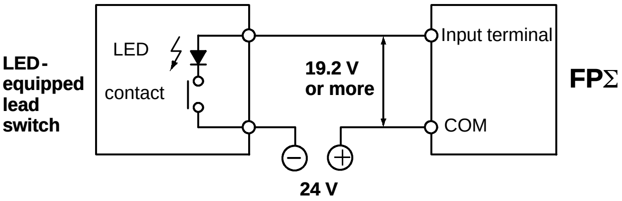


Figure 43: FPΣ Precaution when using LED-equipped lead switch

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.

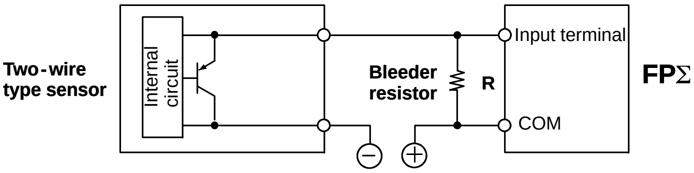


Figure 44: FPΣ Precaution when using two-wire type sensor

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: $R \leqq \frac{13.44}{5.6 \times I - 2.4}$ (kΩ)

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

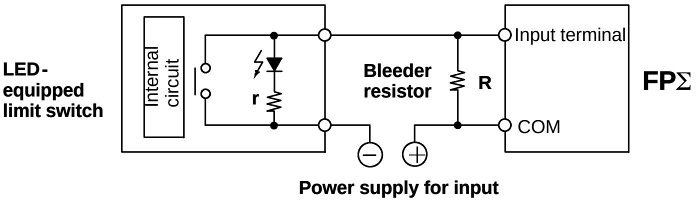
The wattage W of the resistor is:

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

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 (kΩ)

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.

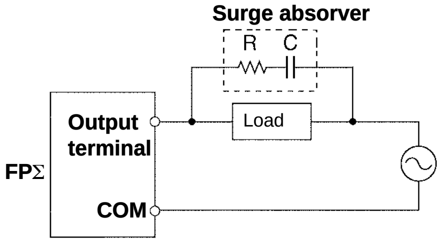
5.3.2 Output Wiring

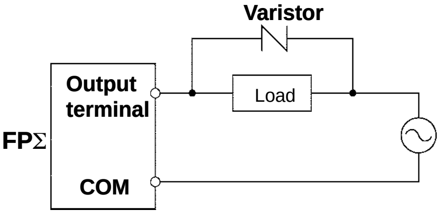
Protective circuit for inductive loads

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

When switching DC inductive loads with relay output type, be sure to connect a diode across the ends of the load.

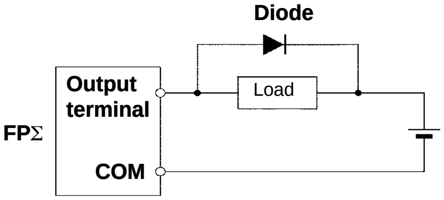
When using an AC inductive load





Example of surge absorber: R: 50 Ω, C: 0.47 µF

When using a DC inductive load



Diode:

Reverse voltage (V_R): 3 times the load voltage
Average rectified forward current (I_0): Load current or more

Precautions when using capacitive loads

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

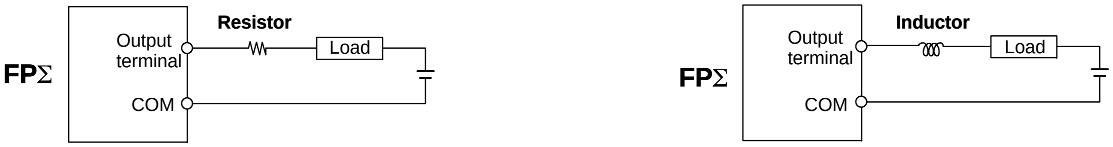


Figure 46: FPΣ Precautions when using capacitive loads

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.

5.3.3 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.

5.4 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 suitable wires given below. Also, use the required pressure connection tools for connecting the wires.

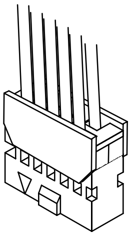


Figure 47: FPΣ Supplied MIL connector

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

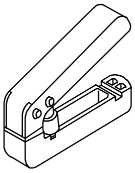


Figure 48: FPΣ Pressure connection tool

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.

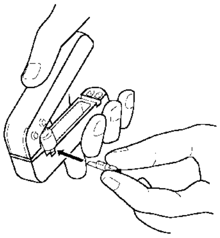


Figure 49: FPΣ MIL connector assembly procedure - 1

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

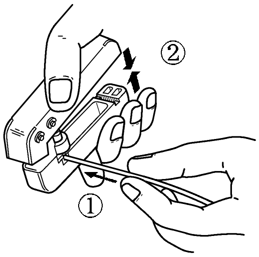


Figure 50: FPΣ MIL connector assembly procedure - 2

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

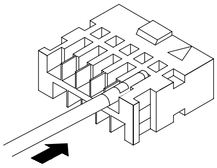


Figure 51: FPΣ MIL connector assembly procedure - 3

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

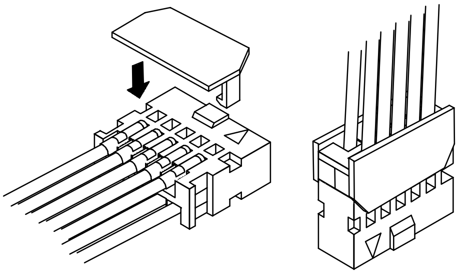
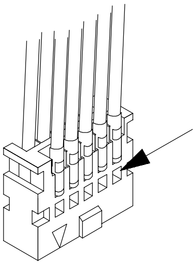


Figure 52: FPΣ MIL connector assembly procedure - 4

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.



Press the housing against the pressure connection tool so that the contact puller pin comes in contact with this section.

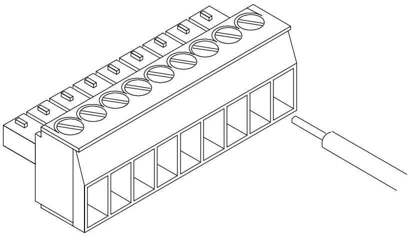
Figure 53: FPΣ MIL connector - rewiring

Tip

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

5.5 Wiring of Terminal Block Type

A screw-down connection type for terminal block is used. The suitable wires are given below.



Terminal block socket

Item	Description
Number of pin	9 pins
Manufacturer	Phoenix Contact Co.
Model	MC1,5/9-ST-3,5
Product number	1840434

Suitable wires

Size	Nominal cross-sectional area
AWG #22	0.3 mm^2
AWG #24 to 16	0.2 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 (mm^2)	Size	Part No.
Phoenix Contact Co.	0.25	AWG #24	AI 0,25 - 6YE
	0.50	AWG #20	AI 0,5 - 6WH
	0.75	AWG #18	AI 0,75 - 6GY
	1.00	AWG #18	AI 1 - 6RD
	0.5 x 2	AWG #20 (for 2 pcs.)	AI - TWIN 2 x 0.5 - 8WH

Pressure welding tool for pole terminals

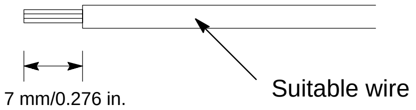
Manufacturer	Phoenix Contact Co.
Part No.	CRIMPFOX UD6
Product number	12 04 43 6

When tightening the terminals of the terminal block, use a screwdriver (Phoenix Contact Co., Product No. 1205037) with a blade size of 0.4 × 2.5. The tightening torque should be 0.22 to 0.25 N·m (2.3 to 2.5 kgf·cm) or less.

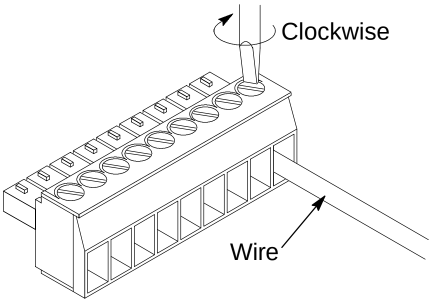
Wiring method

Procedure:

1. **Remove a portion of the wire's insulation.**

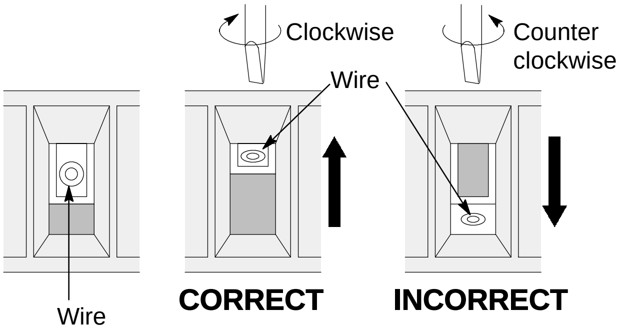


2. **Insert the wire into the terminal block until it contacts the back of the block socket, and then tighten the screw clockwise to fix the wire in place.**



Notes

- **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.**



5.6 Safety Measures

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

5.6.1 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.

5.6.2 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.)

5.6.3 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.

5.7 Backup Battery

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

5.7.1 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.

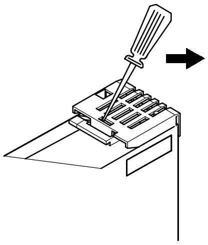


Figure 54: FPΣ Backup battery installation procedure‑1

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

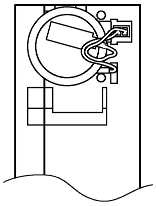


Figure 55: FPΣ Backup battery installation procedure‑2

③ Insert the battery cover from above.

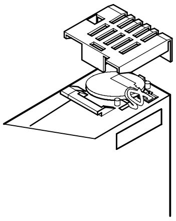


Figure 56: FPΣ Backup battery installation procedure‑3

5.7.2 System Register Setting

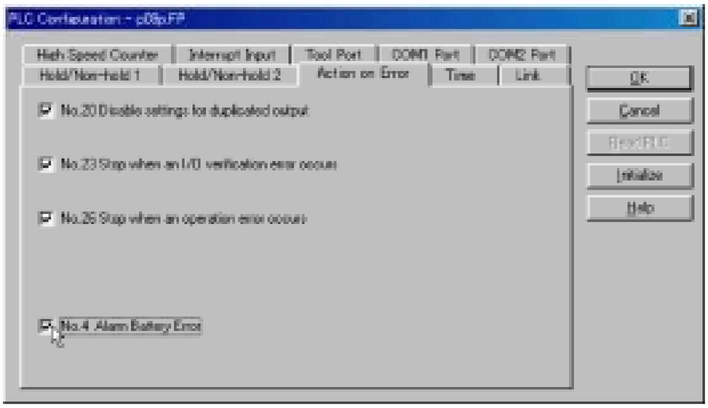
Setting the battery error alarm

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



☑ No.20 Disable settings for duplicated output

☑ No.23 Stop when an I/O verification error occurs

☑ No.26 Stop when an operation error occurs

☑ No.4 Alarm Battery Error

Figure 57: 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”.

5.7.3 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 6

High-speed Counter and Pulse Output Functions

6.1 Overview of Each Functions

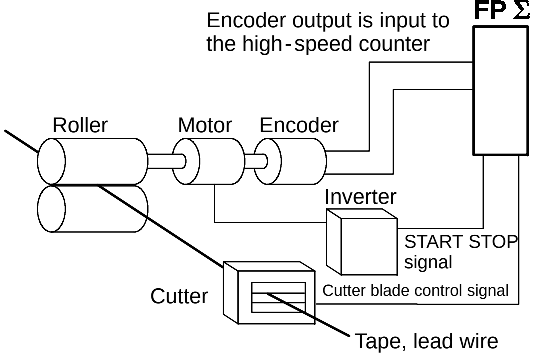
This section explains about the functions that use built-in high-speed counter of FPΣ.

6.1.1 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.

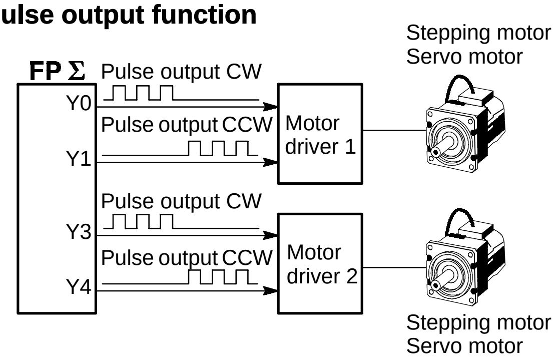
High-speed counter function


FP Σ
Encoder output is input to the high-speed counter
Roller
Motor
Encoder
Inverter
START STOP signal
Cutter
Cutter blade control signal
Tape, lead wire

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 58: FPΣ High-speed counter function

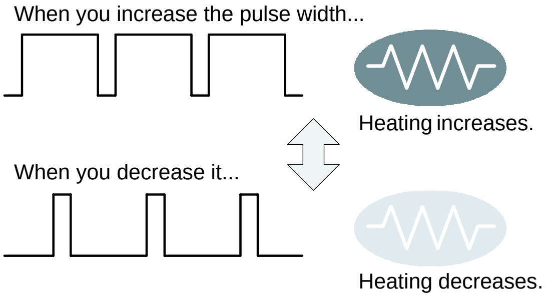
Pulse output function



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 59: 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 60: FPΣ PWM output function

6.1.2 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.

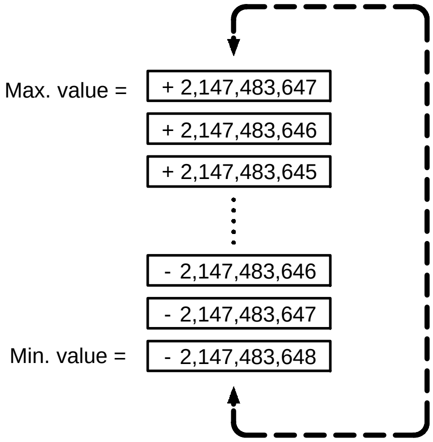


Figure 61: Counting range of high-speed counter

Note

When the linear interpolation instruction F175 or the circular interpolation instruction F176 is used, the value for the target value or the amount of travel should be set so that it is within the range indicated below.

-8,388,608 to +8,388,607 (24-bit binary, with sign)

The F175 and F176 instructions can be used only with the C32T2 control unit.

6.2 Function Specifications and Restricted Items

This section contains specifications and restriction of functions.

6.2.1 Table of Specifications

High-speed counter function specifications

Input/output contact number being used			**Built-in high-speed counter channel no.**	**Memory area being used**			**Performance specifications**		**Related instructions**
On/off output	**Count input mode**	**Input contact number (value in parenthesis is reset input) *Note 1**		**Control flag**	**Elapsed value area**	**Target value area**	**Minimum input pulse width *Note 2**	**Maximum counting speed**	
Specify the desired output from Y0 to Y7 using instruction	**Addition input, Subtraction 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 instruction	**2-phase input, One input, Direction distinction**	**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)	

Notes

1) **Reset input X2 can be set to either CH0 or CH1. Reset input X5 can be set to either CH2 or CH3.**
2) **For information on min. input pulse width, see page 6 - 12.**

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 instructions**
	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) · Using two channels: Max. 60 kHz (×2-channel) · Using linear interpolation: Max. 100 kHz · Using circular interpolation: Max. 20 kHz	**F0 (MV), F1 (DMV), F171 (SPDH), F172 (PLSH)** **F174 (SP0H) F175 (SPSH) F176 (SPCH)**
CH2	Y3	Y4	Y5	X5	DT90052 <bit4>	R903C	DT90200 to DT90201	DT90202 to DT90203		

Note

The linear and circular interpolation control functions can be used with the C32T2 control unit only.

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 Hz to 12.5 kHz (0.0 to 99.9 %) · When the resolution is 100, 15.6 kHz to 41.7 kHz (0 to 99 %)	**F0 (MV), F1 (DMV), F173 (PWMH)**
CH2	**Y3**	R903C		

6.2.2 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 (Addition input and Subtraction input)				High-speed counter function (Two-phase input, One input, and Direction distinction)	
		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 “6.2.1” 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 F176)

When any of the instructions related to the high-speed counter “**F166** to **F176”** 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 6 - 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 6 - 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.

Example 3:

When linear interpolation control is being carried out on CH0 and CH2, a composite speed of up to 100 kHz may be used for the pulse output function. When circular interpolation control is being carried out, the maximum composite speed that may be used is 20 kHz.

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 60 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 60 kHz, the maximum counting speed of the high-speed counter is 15 kHz in the two-phase and one channel mode.

Note

The linear and circular interpolation control functions can be used with the C32T2 control unit only.

6.2.3 Booting Time

The booting time is the time from when the instruction is executed, to the time that the pulse is actually output.

Type of instruction	Booting time
Pulse output instruction F171 (SPDH) trapezoidal control/home return	If CW/CCW is set : approx.200μs (with 30 steps setting) : approx.400μs (with 60 steps setting) If Pulse/Sign is set : approx.500μs (with 30 steps setting) (*) : approx.700μs (with 60 steps setting) (*)
Pulse output instruction F172 (PLSH) JOG operation	If CW/CCW is set: approx. 20 μs If Pulse/Sign is set: approx. 320 μs (*)
Pulse output instruction F174 (SP0H) Data table control	If CW/CCW is set: approx. 30 μs If Pulse/Sign is set: approx. 330 μs (*)
PWM output instruction F173 (PWMH)	Approx. 30 μs

(*) If Pulse/Sign is set, a waiting time (approx. 300 μs) is included from the time that the Sign output goes on until the pulse output instruction can be executed.

6.3 High-speed Counter Function

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

6.3.1 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.

6.3.2 Types of Input Modes

Addition input mode

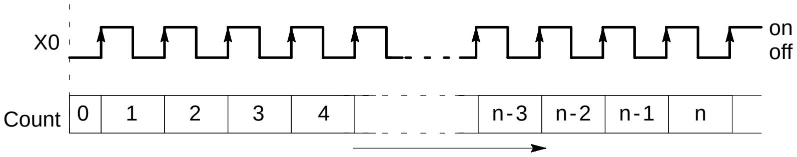


Figure 62: FPΣ High-speed counter function - addition input mode

Subtraction input mode

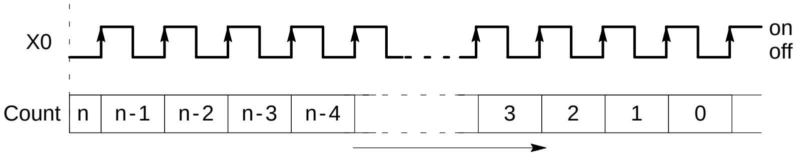
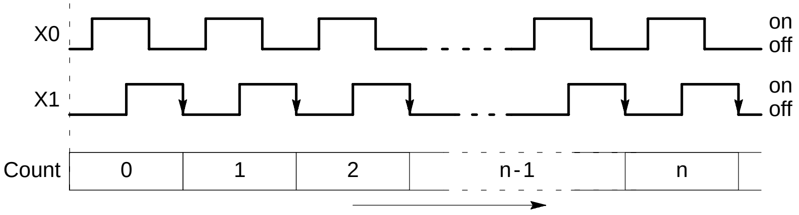


Figure 63: FPΣ High-speed counter function - subtraction input mode

Two-phase input mode (Phase difference input mode)

(Incremental input: CW)



(Decremental input: CCW)

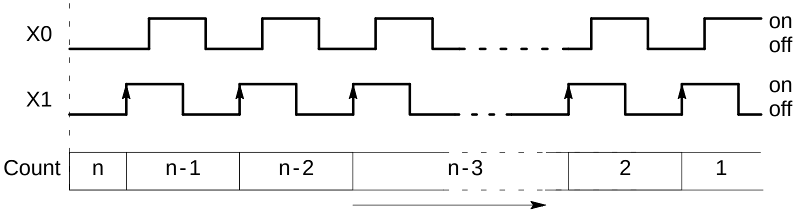


Figure 64: FPΣ High-speed counter function - two-phase input mode

One input mode (Addition and subtraction input mode)

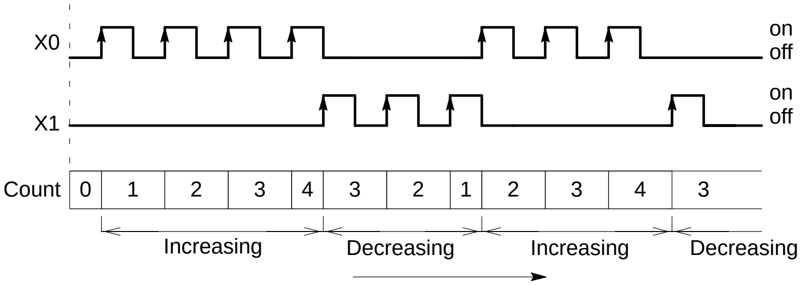


Figure 65: FPΣ High-speed counter function - One input mode

Direction distinction mode

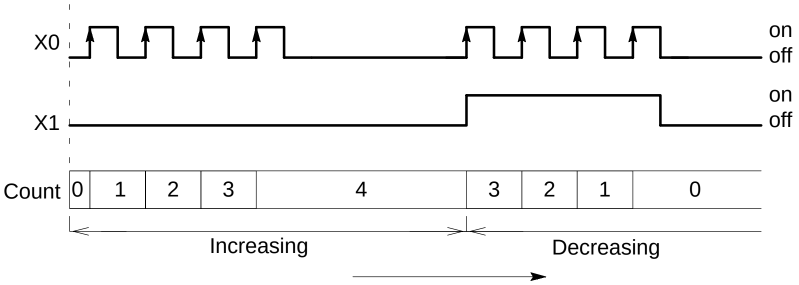


Figure 66: FPΣ High-speed counter function - direction distinction mode

6.3.3 Min. Input Pulse Width

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

Single phase

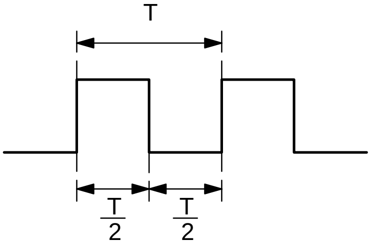


Figure 67: FPΣ High-speed counter function - min. input pulse width (single phase)

Two-phase

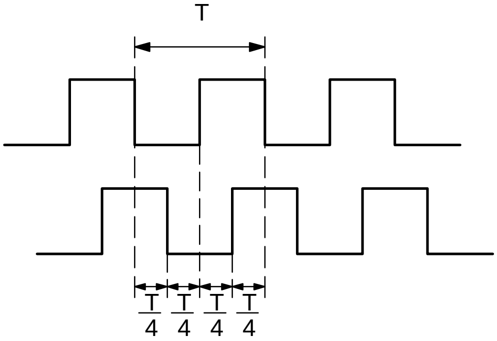


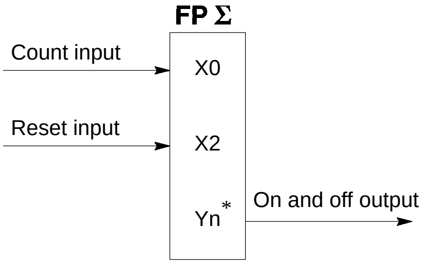
Figure 68: FPΣ High-speed counter function - min. input pulse width (two-phase)

6.3.4 I/O Allocation

The inputting and outputting, as shown in the table on page 6 - 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)**.

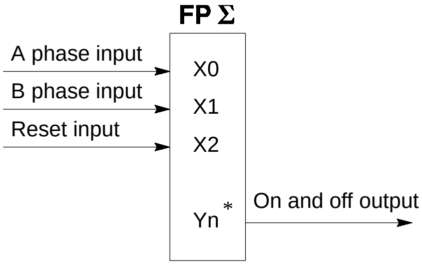
When using CH0 with incremental input and reset input



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

Figure 69: 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 70: FPΣ High-speed counter function - I/O allocation-2

6.3.5 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** to **F176**
- Clear target value match interrupt

Example:

Performing a software reset

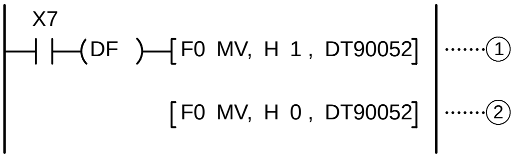


Figure 71: FPΣ Program of high-speed counter control instruction “F0”

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.

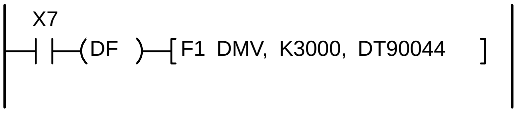
Specify this instruction together with the special data register DT90044.

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.

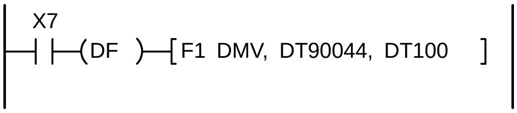


Set the initial value of K3000 in the high-speed counter

Figure 72: FPΣ Program (1) of elapsed value change and read instruction “F1”

Example 2:

Reading the elapsed value



Read the elapsed value of the high-speed counter and copies it to DT100 and DT101

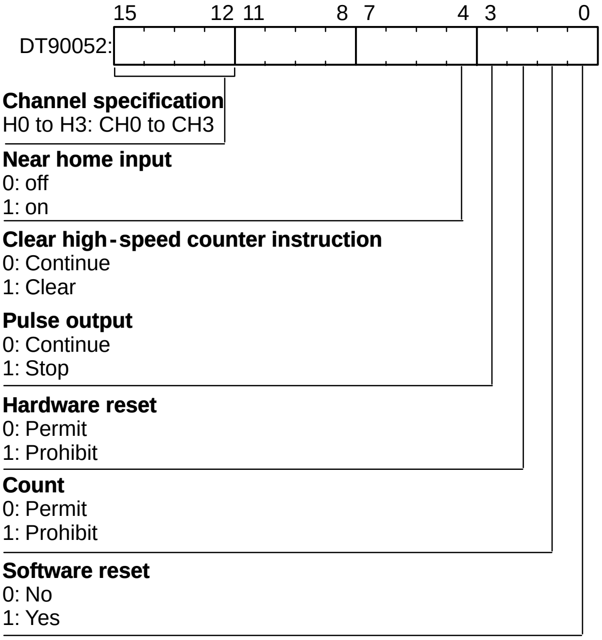
Figure 73: FPΣ Program (2) of elapsed value change and read instruction “F1”

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



Channel specification
H0 to H3: CH0 to CH3

Near home input
0: off
1: on

Clear high-speed counter instruction
0: Continue
1: Clear

Pulse output
0: Continue
1: Stop

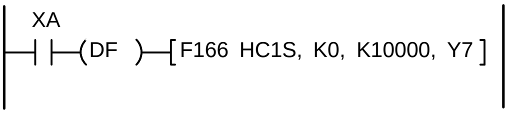
Hardware reset
0: Permit
1: Prohibit

Count
0: Permit
1: Prohibit

Software reset
0: No
1: Yes

Target value match on instruction (F166)

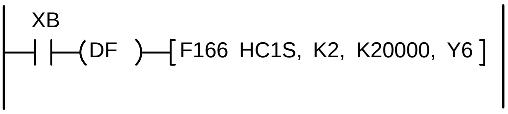
Example 1:



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

Figure 74: FPΣ Program (1) of target value match on instruction “F166”

Example 2:

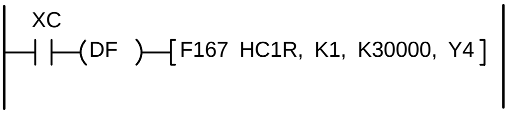


If the elapsed value (DT90200 and DT90201) for channel 2 matches K20000, output Y6 turns on.

Figure 75: FPΣ Program (2) of target value match on instruction “F166”

Target value match off instruction (F167)

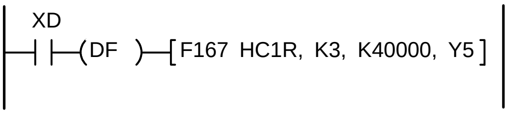
Example 1:



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

Figure 76: 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 77: FPΣ Program (2) of target value match off instruction “F167”

6.3.6 Sample Program

Positioning operations with a single speed inverter

Wiring example

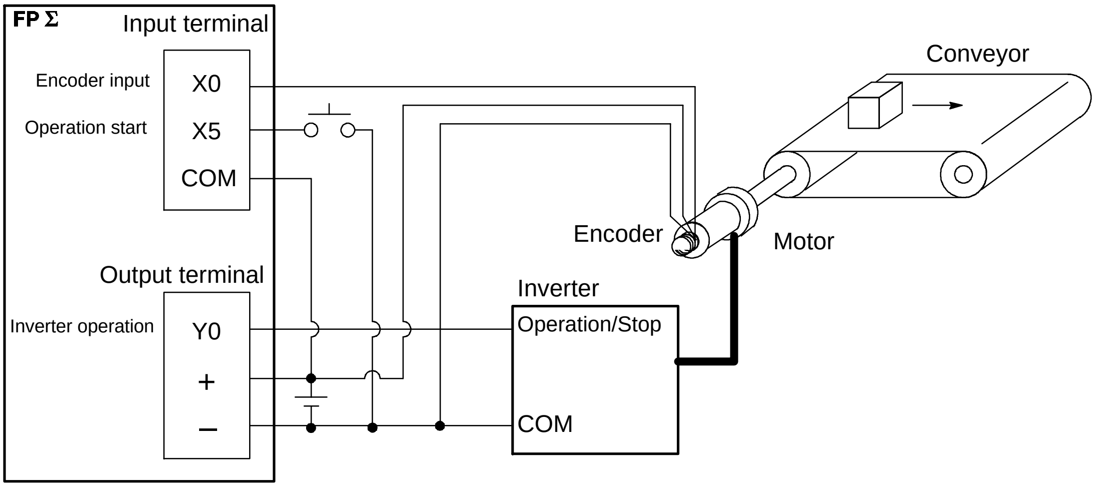
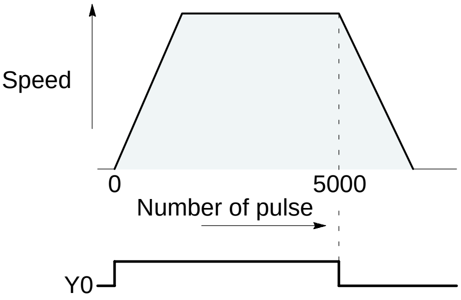


Figure 78: FPΣ High-speed counter function - sample program 1 (wiring)

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 79: 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.

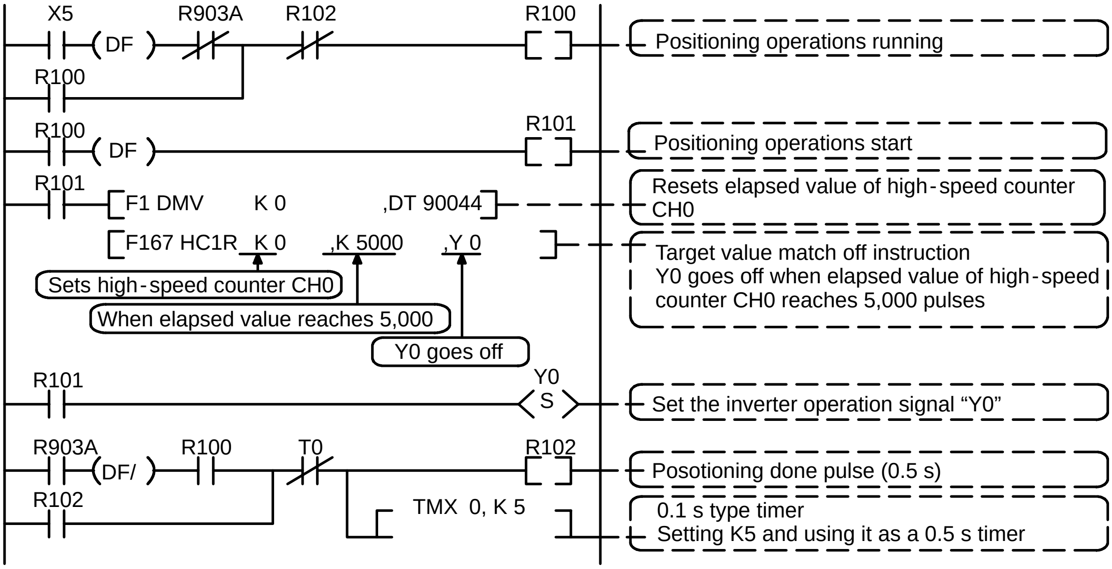

X5
R903A
R102
R100
DF
R100
Positioning operations running
R100
DF
R101
Positioning operations start
R101
F1 DMV K 0 ,DT 90044
Resets elapsed value of high-speed counter CH0
F167 HC1R K 0 ,K 5000 ,Y 0
Target value match off instruction
Y0 goes off when elapsed value of high-speed counter CH0 reaches 5,000 pulses
Sets high-speed counter CH0
When elapsed value reaches 5,000
Y0 goes off
R101
Y0
S
Set the inverter operation signal “Y0”
R903A
DF/
R100
T0
R102
Posotioning done pulse (0.5 s)
R102
TMX 0, K 5
0.1 s type timer
Setting K5 and using it as a 0.5 s timer

Figure 80: FPΣ High-speed counter function - sample program 1 (program)

Positioning operations with a double speed inverter

Wiring example

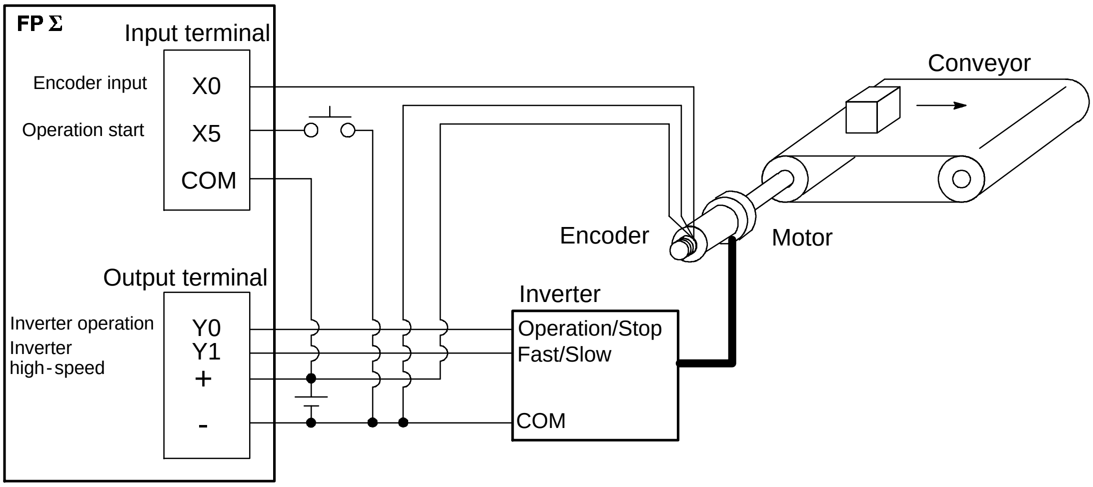
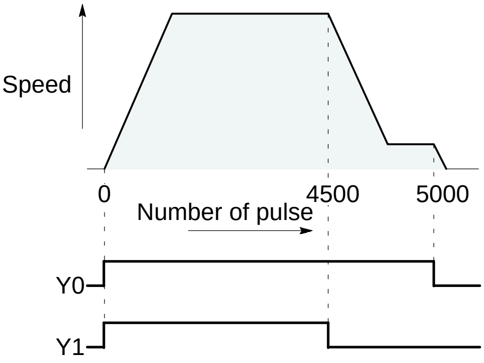


Figure 81: FPΣ High-speed counter function - sample program 2 (wiring)

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 82: 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.

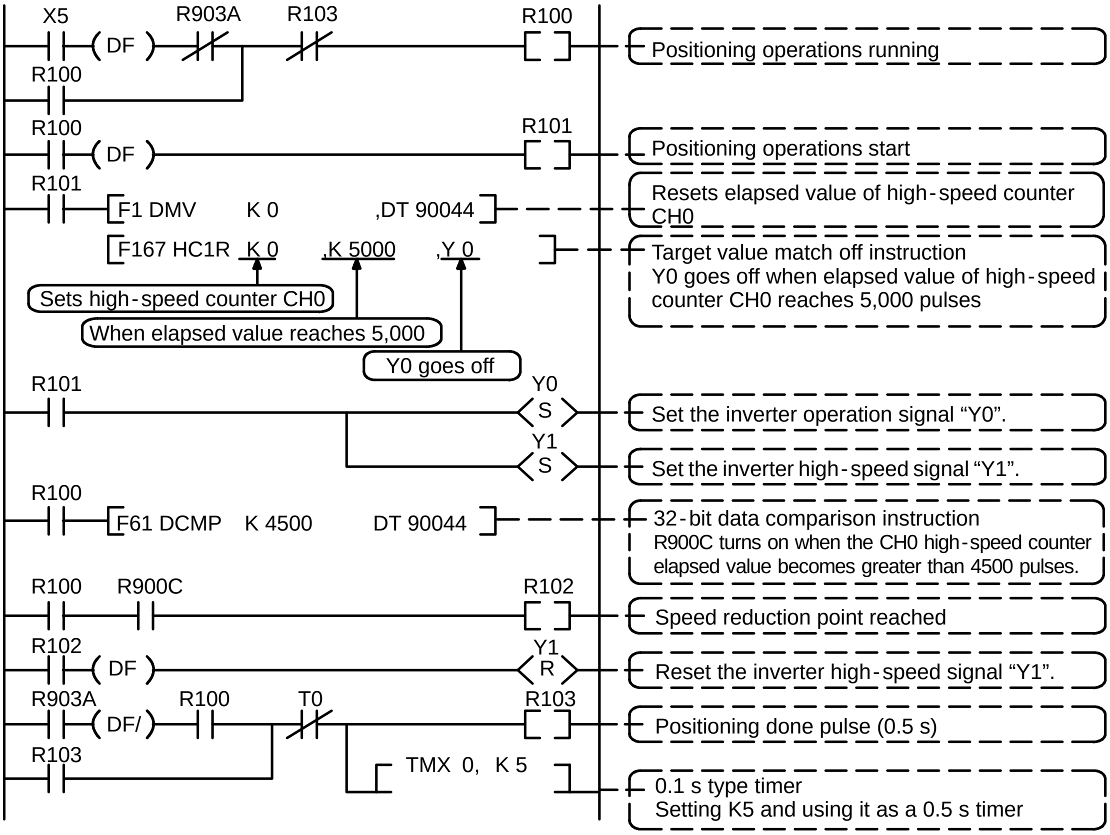

X5
R903A
R103
R100
DF
Positioning operations running
R100
R100
R101
DF
Positioning operations start
R101
F1 DMV K 0 ,DT 90044
Resets elapsed value of high-speed counter CH0
F167 HC1R K 0 ,K 5000 ,Y 0
Target value match off instruction
Y0 goes off when elapsed value of high-speed counter CH0 reaches 5,000 pulses
Sets high-speed counter CH0
When elapsed value reaches 5,000
Y0 goes off
R101
Y0
S
Set the inverter operation signal “Y0”.
Y1
S
Set the inverter high-speed signal “Y1”.
R100
F61 DCMP K 4500 DT 90044
32-bit data comparison instruction
R900C turns on when the CH0 high-speed counter elapsed value becomes greater than 4500 pulses.
R100
R900C
R102
Speed reduction point reached
R102
DF
Y1
R
Reset the inverter high-speed signal “Y1”.
R903A
DF/
R100
T0
R103
Positioning done pulse (0.5 s)
R103
TMX 0, K 5
0.1 s type timer
Setting K5 and using it as a 0.5 s timer

Figure 83: FPΣ High-speed counter function - sample program 2 (program)

6.4 Pulse Output Function

This section explains about the pulse output function of FPΣ.

6.4.1 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.

A dedicated instruction, **F172 (PLSH)**, is available for jogging operation, which causes pulses to be output as long as the execution condition is on. A target value can also be set, so that pulse output stops at the point when the target value is matched.

A dedicated instruction, **F174 (PL0H)**, is available that outputs pulses in conformance with the data table, so that positioning control can be carried out in accordance with the data table.

A dedicated instruction, **F175 (SPSH)**, is available for linear interpolation control. This enables pulses to be output using linear interpolation control, by specifying the composite speed, the acceleration/deceleration time, and the target value.

A dedicated instruction, **F176 (SPCH)**, is available for circular interpolation control. The user can select one of two circular forming methods, one by specifying the pass positions and the other by specifying a center position. Pulses are output using circular interpolation control, by specifying the various parameters.

Note

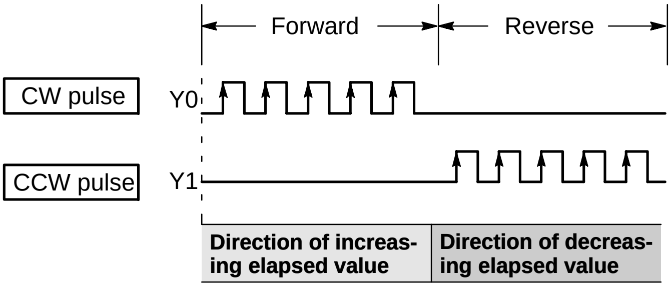
The linear interpolation control instruction F175(SPSH) and circular interpolation control instruction F176(SPCH) can be used with the C32T2 control unit only.

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.”

6.4.2 Types of Pulse Output Method

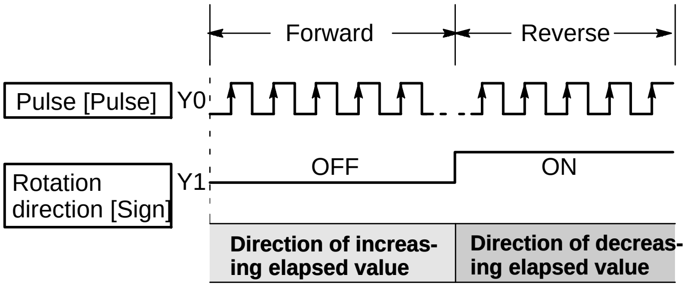
CW/CCW output method


Forward
Reverse
CW pulse
Y0
CCW pulse
Y1
Direction of increasing elapsed value
Direction of decreasing elapsed value

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

Figure 84: FPΣ Pulse output function - CW/CCW output method

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

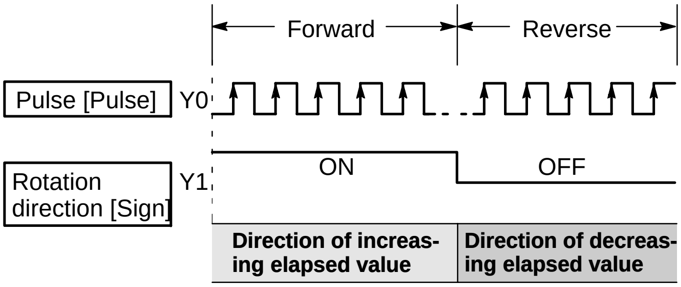

Forward
Reverse
Pulse [Pulse]
Y0
Rotation direction [Sign]
Y1
OFF
ON
Direction of increasing elapsed value
Direction of decreasing elapsed value

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 85: FPΣ Pulse output function - Pulse/sign output method 1

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


Forward
Reverse
Pulse [Pulse]
Y0
Rotation direction [Sign]
Y1
ON
OFF
Direction of increasing elapsed value
Direction of decreasing elapsed value

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 86: FPΣ Pulse output function - Pulse/sign output method 2

6.4.3 I/O Allocation

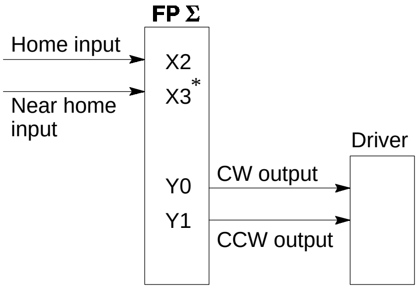
Double pulse input driver (CW pulse input and CCW pulse input method)

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 6 - 6.)

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

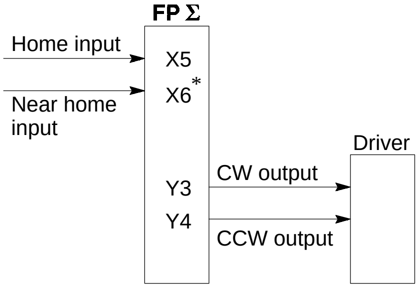
When using CH0



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

Figure 87: 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 88: FPΣ Pulse output function - I/O allocation when using CH2 (double pulse input)

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

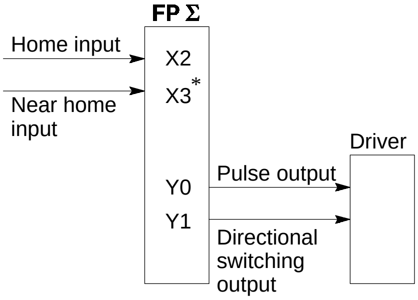
One output point is used as a pulse output and the other output is used as a direction output.

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 6 - 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.

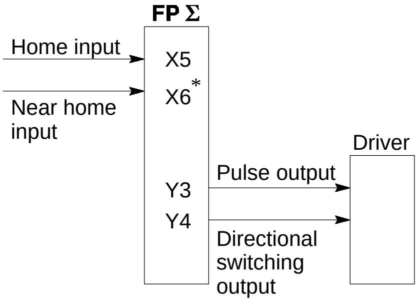
When using CH0



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

Figure 89: 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 90: FPΣ Pulse output function - I/O allocation when using CH2 (single pulse input)

6.4.4 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	Addition
Negative	Pulse output from CCW	Pulse output when direction output is on	Pulse output when direction output is off	Subtraction

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	Addition
Target value less than current value	Pulse output from CCW	Pulse output when direction output is on	Pulse output when direction output is off	Subtraction

Home return

Until the home position 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 home position proximity 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. Also, the pulse output can be stopped when the specified target value is matched.

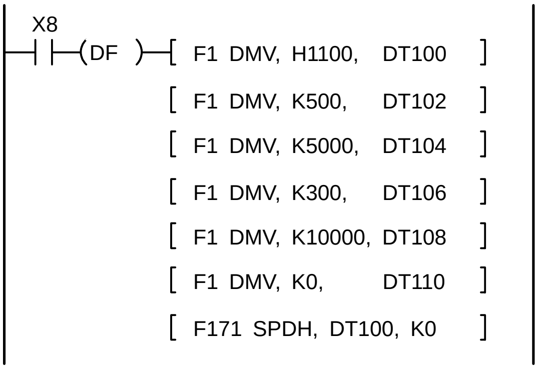
The direction output and output frequency are specified by **F172 (PLSH)** instruction.

6.4.5 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 300ms, and a movement amount of 10,000 pulses.



```
[ F1  DMV,  H1100,   DT100  ]
[ F1  DMV,  K500,    DT102  ]
[ F1  DMV,  K5000,   DT104  ]
[ F1  DMV,  K300,    DT106  ]
[ F1  DMV,  K10000,  DT108  ]
[ F1  DMV,  K0,      DT110  ]
[ F171  SPDH,  DT100,  K0   ]
```

Figure 91: 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	:300 ms
DT108 **DT109**	Target value *4	:10,000 pulses
DT110 **DT111**	Pulse stop	:K0

Pulse output diagram

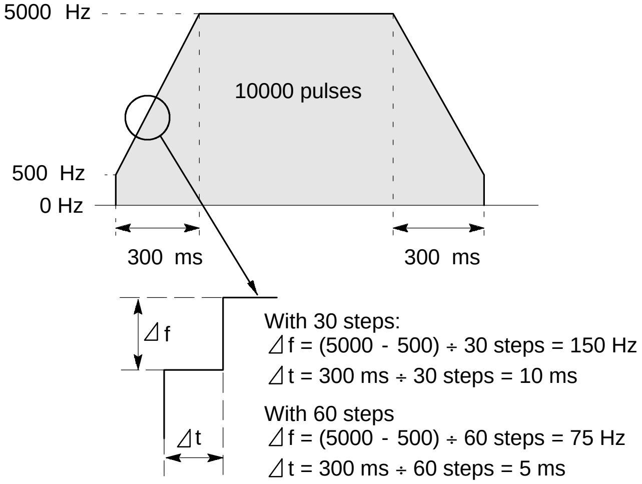

5000 Hz
10000 pulses
500 Hz
0 Hz
300 ms
300 ms
⊿f
⊿t
With 30 steps:
⊿f = (5000 - 500) ÷ 30 steps = 150 Hz
⊿t = 300 ms ÷ 30 steps = 10 ms
With 60 steps
⊿f = (5000 - 500) ÷ 60 steps = 75 Hz
⊿t = 300 ms ÷ 60 steps = 5 ms

Figure 92: FPΣ Pulse output diagram of “F171” instruction

(*1): **Control code <H constant>**

H j j j j j j j j

0: Fixed

Number of acceleration/deceleration steps

0: 30 steps
1: 60 steps (Can be specified for only Ver. 2.0 or later.)

Duty (on width)

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

Frequency range

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

Operation mode and output method

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)] (Max. error near 9.8 kHz approximately -0.9 kHz)
* Set “K1” to specify 1.5 Hz.
48 Hz to 100 KHz [K48 to K100000 (units: Hz)] (Max. error near 100 kHz approximately -3 kHz)
191 Hz to 100 KHz [K191 to K100000 (units: Hz)] (Max. error near 100 kHz approximately -0.8 kHz

(*3): Acceleration/deceleration time (ms) “K constant”
With 30 steps: K30 to K32767
With 60 steps: K36 to K32767

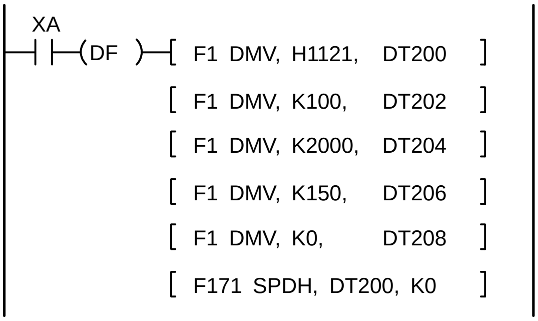
(*4): Target value “K constant”
K-2147483648 to K2147483647

Figure 93: FPΣ Control code of “F171” 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.



```
[ F1  DMV,  H1121,   DT200  ]
[ F1  DMV,  K100,    DT202  ]
[ F1  DMV,  K2000,   DT204  ]
[ F1  DMV,  K150,    DT206  ]
[ F1  DMV,  K0,      DT208  ]
[ F171  SPDH,  DT200,  K0   ]
```

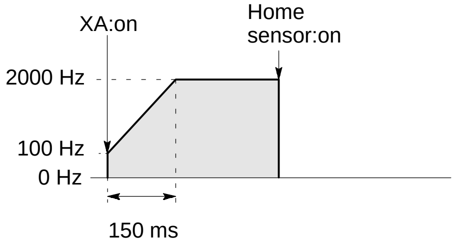
Figure 94: FPΣ Program of positioning control instruction “F171”

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 home position proximity input is not used)



Pulse output diagram (when home position proximity input is used)

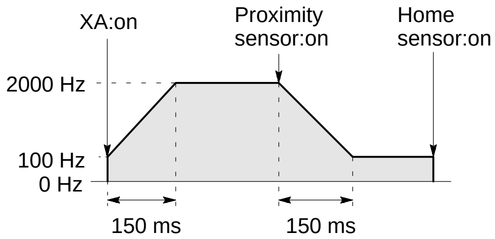


Figure 95: FPΣ Pulse output diagram of “F171” instruction

(*1): **Control code <H constant>**

H j j j j j j j j

0: Fixed

Number of acceleration/deceleration steps

0: 30 steps
1: 60 steps (Can be specified for only Ver. 2.0 or later.)

Duty (on width)

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

Frequency range

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)] (Max. error near 9.8 kHz approximately -0.9 kHz)
* Set “K1” to specify 1.5 Hz.
48 Hz to 100 KHz [K48 to K100000 (units: Hz)] (Max. error near 100 kHz approximately -3 kHz)
191 Hz to 100 KHz [K191 to K100000 (units: Hz)] (Max. error near 100 kHz approximately -0.8 kHz

(*3): Acceleration/deceleration time (ms) “K constant”
With 30 steps: K30 to K32767
With 60 steps: K36 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 96: FPΣ Control code of “F171” instruction

Tip

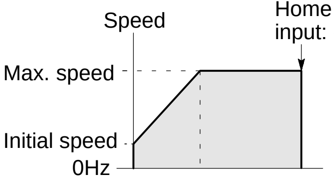
Home return operation modes

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

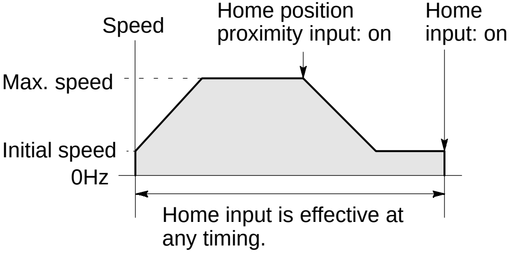
Type I home return

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, home position proximity input is not used.

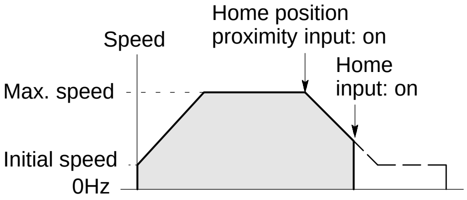
When home position proximity input is not used



When home position proximity input is used



When home input is input while the home position proximity input is decelerating



Type II home return

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

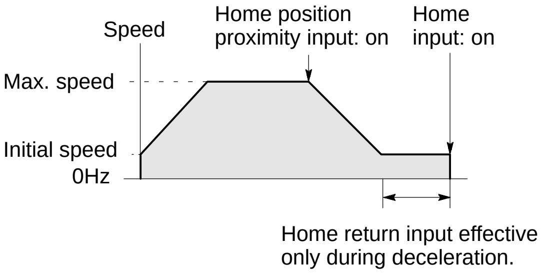
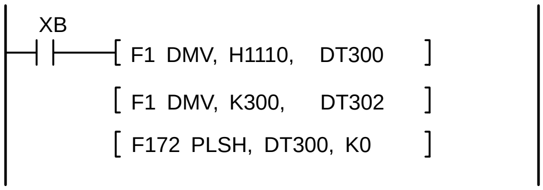


Figure 97: FPΣ Home return operation modes

Pulse output instruction (F172) (JOG operation, target value setting)

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.



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

Figure 98: 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

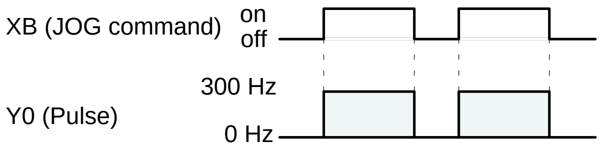


Figure 99: FPΣ Pulse output diagram of “F172” instruction

(*1): **Control code <H constant>**

H j j j j j j j j

0: Fixed

Target value setting

0: Mode with no target value
1: Target value match stop mode
(Can be specified for only Ver. 2.0 or later.)

Duty (on width)

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

Frequency range

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

Output method

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

(*2): Frequency (Hz) “K constant”
1.5 Hz to 9.8 KHz [K1 to K9800 (units: Hz)] (Max. error near 9.8 kHz approximately -0.9 kHz)
* Set “K1” to specify 1.5 Hz.
48 Hz to 100 KHz [K48 to K100000 (units: Hz)] (Max. error near 100 kHz approximately -3 kHz)
191 Hz to 100 KHz [K191 to K100000 (units: Hz)] (Max. error near 100 kHz approximately -0.8 kHz

(*3): Target value (Absolute value) (Can be specified for only Ver. 2.0 or later.)
This is used when setting the target value match stop mode. (Absolute only)

Designate the target value setting in the range indicated below. If an out of range value is designated, the number of pulses output will be different than the desinated value. The target value setting is ignored in the no count mode.

Output method	Range of target values which can be designated
Addition counting	Designate a value larger than the current value.
Subtraction counting	Designate a value smaller than the current value.

Figure 100: FPΣ Control code of “F172” instruction

Tip

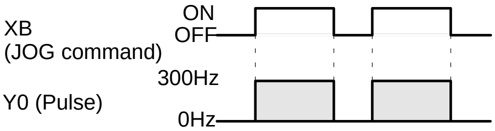
There are two operation modes in which jogging feed can be carried out with the FPΣ, one in which no target value is specified, and one in which feed stops when the target value is reached.

Normal jogging feed (mode in which no target value is specified)
Pulses are output in accordance with the condition set for the data table, as long as the condition is on.

Data table

DT300 DT301	Control code *1	: H1110
DT302 DT303	Frequency *2	: 300 Hz

Pulse output diagram

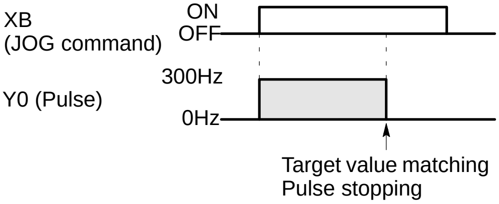


Mode in which output stops when the target value is reached (supported in Ver. 2.0 and subsequent versions)
With Ver. 2.0 and subsequent versions of the FPΣ (control unit C32T2), a mode can be used in which a target value is specified for jogging operation, and pulses are stopped when that target value is reached. As shown below, the control code is used to select this mode, and the target value (an absolute value) is then specified in the data table.

Data table

DT300 DT301	Control code *1	: H11110
DT302 DT303	Frequency *2	: 300 Hz
DT304 DT305	Target value *3	: K1000

Pulse output diagram



Positioning control instruction (F174) (Data table control)

The positioning performs according to the specified data table in order.

```
   R0
 ┤ ├─[F1  DMV  ,  H  1200,  DT400]   Control code: "H1200"
       [F1  DMV  ,  K  1000,  DT402]   Frequency 1: 1,000Hz
       [F1  DMV  ,  K  1000,  DT404]   Target value 1: 1,000 pulses
       [F1  DMV  ,  K  2500,  DT406]   Frequency 2: 2,500Hz
       [F1  DMV  ,  K  2000,  DT408]   Target value 2: 2,000 pulses
       [F1  DMV  ,  K  5000,  DT410]   Frequency 3: 5,000Hz
       [F1  DMV  ,  K  5000,  DT412]   Target value 3: 5,000 pulses
       [F1  DMV  ,  K  1000,  DT414]   Frequency 4: 1,000Hz
       [F1  DMV  ,  K  2000,  DT416]   Target value 4: 2,000 pulses
       [F1  DMV  ,  K     0,  DT418]   Output pulse stops
   R10
 ┤ ├─(DF)─[F174  SP0H,DT400,K0]        Pulse output control
```

When the execution condition R10 goes on, pulses are output from Y0 at a frequency of 1,000 Hz, and positioning begins.
At the point when 1,000 pulses have been counted, the frequency switches to 2,500 Hz. Positioning is then carried out sequentially in accordance with the values of the data table, until it stops at the data table containing the pulse output stop value (K0).
When the program is run, the data table and pulse output diagram are as shown below.

Positioning data table

DT400 **DT401**	Control code *1	:H 1200
DT402 **DT403**	Frequency 1 *2	:1000 Hz
DT404 **DT405**	Target value 1 *3	:1000 pulses
DT406 **DT407**	Frequency 2	:2500 Hz
DT408 **DT409**	Target value 2	:2500 pulses
DT410 **DT411**	Frequency 3	:500 Hz
DT412 **DT413**	Target value 3	:5000 pulses
DT414 **DT415**	Frequency 4	:1000 Hz
DT416 **DT417**	Target value 4	:2000 pulses
DT418 **DT419**	Pulse output stop setting	:K0

(*1): Control code (H constant)

H j j j j j j j j

Upper word
0: Fixed

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

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

Operation mode

0: Incremental	Specifies the amount of travel (number of pulses)
1: Absolute	Specifies the target value (absolute value)

Output method

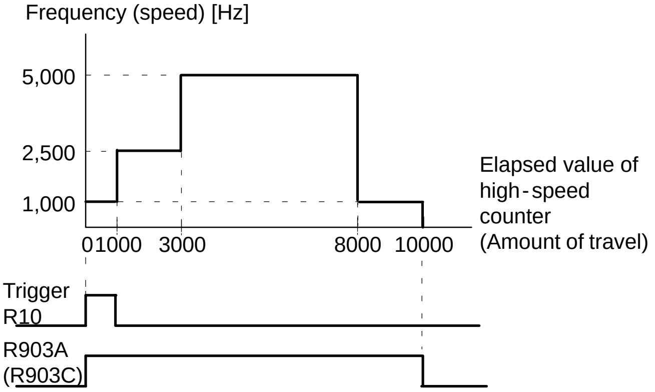
0: CW	(addition counting)
1: CCW	(subtraction counting)
2: PLS+SIGN (forward off)	(addition counting)
3: PLS+SIGN (reverse on)	(subtraction counting)
4: PLS+SIGN (forward on)	(addition counting)
5: PLS+SIGN (reverse off)	(subtraction counting)

(*2): Frequency (Hz) "K constant"
1.5 Hz to 9.8 kHz [K1 to K9800 (units: Hz)] (Max. error near 9.8 kHz: approx. -0.9 kHz)
* Set "1" to specify 1.5 Hz.
48 Hz to 100 kHz [K48 to K100000 (units: Hz)] (Max. error near 100 kHz: approx. -3 kHz)
191 Hz to 100 kHz [K191 to K100000 (units: Hz)] (Max. error near 100 kHz: approx. -0.8 kHz)

(*3): Target value (K-2147483648 to K2147483647)
The value of the 32-bit data specified for the target value should be within the range indicated in the table below.

Specification of control code		**Range of allowable target values**
Operation mode	**Output method**	
Incremental	**Addition counting**	Specifies a positive value.
	Subtraction counting	Specifies a negative value.
Absolute	**Addition counting**	Specifies a value larger than the current value
	Subtraction counting	Specifies a value smaller than the current value

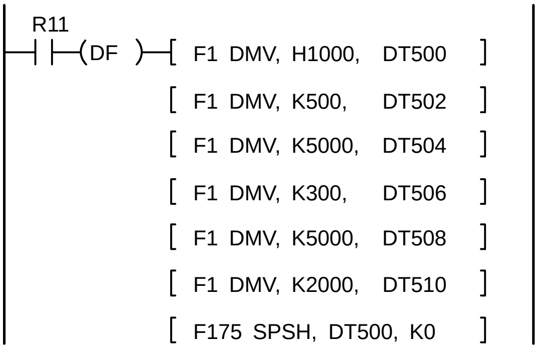
Pulse output diagram



When the execution condition (trigger) R10 of the **F174 (SP0H)** instruction goes on, the high-speed counter control flag R903A (R903C) goes on. When the elapsed value reaches 10,000 and pulse output stops, R903A (R903C) goes off.

Pulse output instruction (F175) (Linear interpolation)

The linear interpolation controls with two axes according to the specified data table.



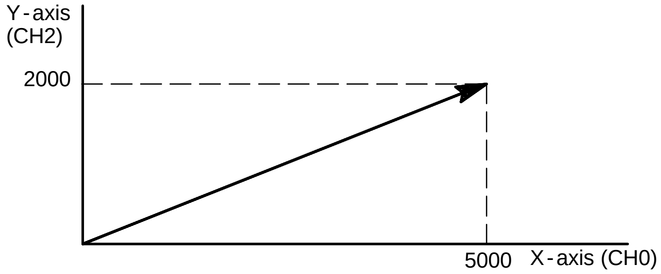
```
[ F1  DMV,  H1000,   DT500   ]
[ F1  DMV,  K500,    DT502   ]
[ F1  DMV,  K5000,   DT504   ]
[ F1  DMV,  K300,    DT506   ]
[ F1  DMV,  K5000,   DT508   ]
[ F1  DMV,  K2000,   DT510   ]
[ F175  SPSH,  DT500,  K0    ]
```

Pulses are output from the X axis (CH0) and the Y axis (CH2), so that the composite speed is an initial speed of 500 Hz, the maximum speed is 5,000 Hz, and the acceleration/deceleration time is 300 ms. The two axes are controlled so that a linear path is followed to the target position.
When the program is run, the data table and positioning path are as shown below.

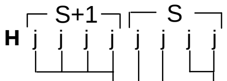
Positioning data table

DT500 **DT501**	Control code: H1000	(*1)	**Setting area** Designated with user program
DT502 **DT503**	Composite speed (Initial speed): 500 Hz	(*2)	
DT504 **DT505**	Composite speed (Maximum speed): 5000 Hz	(*2)	
DT506 **DT507**	Acceleration/Deceleration time: 300ms	(*3)	
DT508 **DT509**	Target value (X-axis) (CH0): 5000 pulses	(*4)	
DT510 **DT511**	Target value (Y-axis) (CH2): 2000 pulses	(*4)	
DT512 **DT513**	X-axis (CH0) component speed (Initial speed)	(*5)	**Operation result storage area** Parameters for each axis component, calculated due to instruction execution, are stored here.
DT514 **DT515**	X-axis (CH0) component speed (Maximum speed)		
DT516 **DT517**	Y-axis (CH2) component speed (Initial speed)		
DT518 **DT519**	Y-axis (CH2) component speed (Maximum speed)		
DT520	X-axis (CH0) frequency range	(*6)	
DT521	Y-axis (CH2) frequency range		
DT522	X-axis (CH0) number of acceleration/deceleration steps	(*7)	
DT523	Y-axis (CH2) number of acceleration/deceleration steps	(*7)	

Positioning path



(*1): Control code (H constant)



0: Fixed

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

0: Fixed

Operation mode and output method

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

(*2): Composite speed (Initial speed, Maximum speed) (Hz) <K constant>
1.5Hz to 100kHz [K1 to K100000]
However, 1.5Hz is for an angle of 0deg or 90deg only.
Also, specify K1 when specifying 1.5 Hz.
If the component speed drops lower than the minimum speed for each frequency range, then the speed will become the corrected component speed, so be careful. (See *6)
When simultaneously using a high-speed counter, periodical interrupt or PLC link, do not set to 60kHz or higher.
If initial speed is set equal to maximum speed, pulses will be output with no acceleration/deceleration.

(*3): Acceleration/deceleration time (ms) “K constant”
K0 to K32767
If this is 0, pulses will be output for the initial speed (composite speed) as is, with no acceleration/deceleration.

(*4): Target value
K-8388608 to K8388607
When operating only one axis,
a) In incremental mode, set the target value for the axis which will not be operated to 0.
b) In absolute mode, set the target value for the axis which will not be operated the same as the current value.

(*5): Component speed (Initial speed and maximum speed of each axis)

This is stored as 2 words in real numbers type.

$$\text{X-axis component speed} = \frac{\text{(Composite speed) x (X-axis movement distance)}}{\sqrt{((\text{X-axis movement distance})^2 + (\text{Y-axis movement distance})^2)}}$$

$$\text{Y-axis component speed} = \frac{\text{(Composite speed) x (Y-axis movement distance)}}{\sqrt{((\text{X-axis movement distance})^2 + (\text{Y-axis movement distance})^2)}}$$

Example:
Even if the initial speed is corrected (See *6), the calculation value will be stored as is in the operation result storage area.

(*6): Frequency range

The system automatically selects the frequency range for each component of each axis.
Range 0: 1.5Hz to 9.8kHz
Range 1: 48Hz to 100kHz
Range 2: 191Hz to 100kHz

a) If maximum speed ≦ 9800Hz
   If initial speed < 1.5Hz, initial speed is corrected to 1.5Hz, and range 0 is selected.
   If initial speed ≧ 1.5Hz, range 0 is selected.
b) If 9800Hz < maximum speed ≦ 100000Hz,
   If initial speed < 48Hz, initial speed is corrected to 48Hz, and range 0 is selected.
   If 48Hz ≦ initial speed < 191Hz, range 1 is selected.
   If initial speed ≧ 191Hz, range 2 is selected.

(*7): Number of acceleration/deceleration steps

The system automatically calculates the number of acceleration/deceleration steps in the range 0 to 60 steps.
If the operation result is 0, pulses are output for the initial speed (composite speed) as is, with no acceleration/deceleration.
The number of acceleration/deceleration steps is found using the formula:
acceleration/deceleration time (ms) x component initial speed (Hz).
Example:
With incremental, initial speed 300Hz, maximum speed 5kHz, acceleration/deceleration time 0.5s, CH0 target value 1000, CH2 target value 50

$$\text{CH0 component initial speed} = \frac{300 \times 1000}{\sqrt{(1000^2 + 50^2)}} = 299.626\text{Hz}$$

$$\text{CH2 component initial speed} = \frac{300 \times 50}{\sqrt{(1000^2 + 50^2)}} = 14.981\text{Hz}$$

CH0 number of acceleration/deceleration steps = $500 \times 10^{-3} \times 299.626 \fallingdotseq 147.8 \Rightarrow 60$ steps
CH2 number of acceleration/deceleration steps = $500 \times 10^{-3} \times 14.981 \fallingdotseq 7.4 \Rightarrow 7$ steps

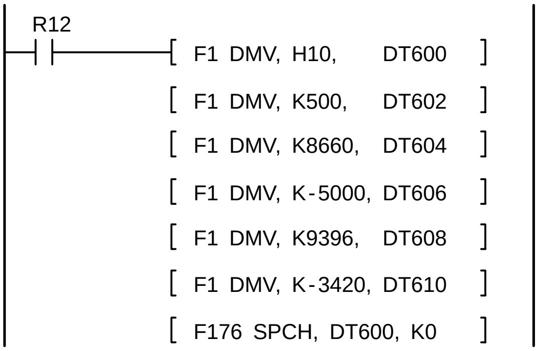
Note

The linear interpolation control instruction can be used with the C32T2 control unit only.

Pulse output instruction (F176) (Circular interpolation)

The circular interpolation controls with two axes according to the specified data table.

This instruction calculates the component speed at each scan, and corrects it while moving along the circular. If the scan time is shorter than the specified frequency timing by more than 10 times, the constant scan function should be used, and if the scan time is longer than the specified frequency timing, the instruction should be written in an interrupt program and used in period interrupts.



```
[ F1 DMV, H10,     DT600 ]
[ F1 DMV, K500,    DT602 ]
[ F1 DMV, K8660,   DT604 ]
[ F1 DMV, K-5000,  DT606 ]
[ F1 DMV, K9396,   DT608 ]
[ F1 DMV, K-3420,  DT610 ]
[ F176 SPCH, DT600, K0   ]
```

Assume that the execution conditions for this instruction always hold.
When the execution conditions are off, pulse output stops.

Pulses are output from the X axis (CH0) and the Y axis (CH2) at a composite speed of 2,000 Hz, and the two axes are controlled so that a circular path is followed to the target position.
In the program, operation is being carried out in the mode in which absolute and pass positions are specified. Pulses are output from the current position (θ 60°, Xs = 5000, Ys = 8660) using circular interpolation control, and when the pass position (θ -20°, Xp = 9396, Yp = -3420) has been passed, pulse output stops at the target position (θ -30°, Xe = 8660, Ye = -5000).

Note

Assume that the execution conditions for this instruction always hold. When the execution conditions are off, pulse output stops.

When the program is run, the data table and positioning path are as shown below.

Positioning data table

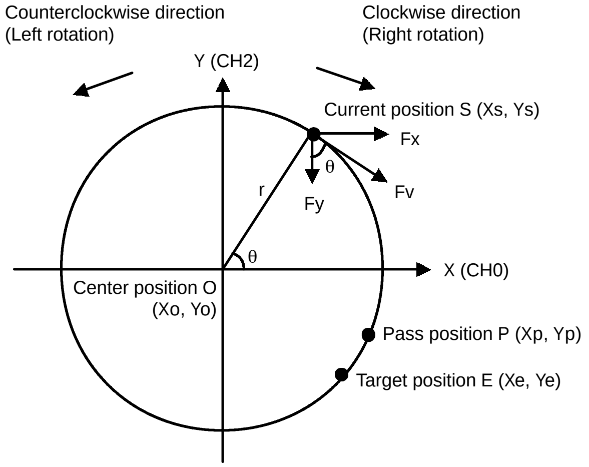
Pass position setting method

Data register	Content		
DT600 **DT601**	Control code: H10	(*1)	**Setting area** Designated with user program
DT602 **DT603**	Composite speed: 500 Hz	(*2)	
DT604 **DT605**	Target value (X-axis) (CH0): 8660 pulses	(*3)	
DT606 **DT607**	Target value (Y-axis) (CH2): -5000 pulses		
DT608 **DT609**	Pass value (X-axis) (CH0): 9396 pulses		
DT610 **DT611**	Pass value (Y-axis) (CH2): -3420 pulses		
DT612 **DT613**	Radius: 10000 pulses		**Operation result storage area** Parameters for each axis component, calculated due to instruction execution, are stored here.
DT614 **DT615**	X-axis (CH0) Center position: 0 pulse		
DT616 **DT617**	Y-axis (CH2) Center position: 0 pulse		

Center position setting method

Data register	Content		
DT600 **DT601**	Control code: H110	(*1)	**Setting area**
DT602 **DT603**	Composite speed: 2000 Hz	(*2)	
DT604 **DT605**	Target value (X-axis) (CH0): 8660 pulses	(*3)	
DT606 **DT607**	Target value (Y-axis) (CH2): -5000 pulses	(*3)	
DT608 **DT609**	X-axis (CH0) Center position: 0 pulse		
DT610 **DT611**	Y-axis (CH2) Center position: 0 pulse		
DT612 **DT613**	Radius: 10000 pulses		**Operation result storage area**

Positioning path

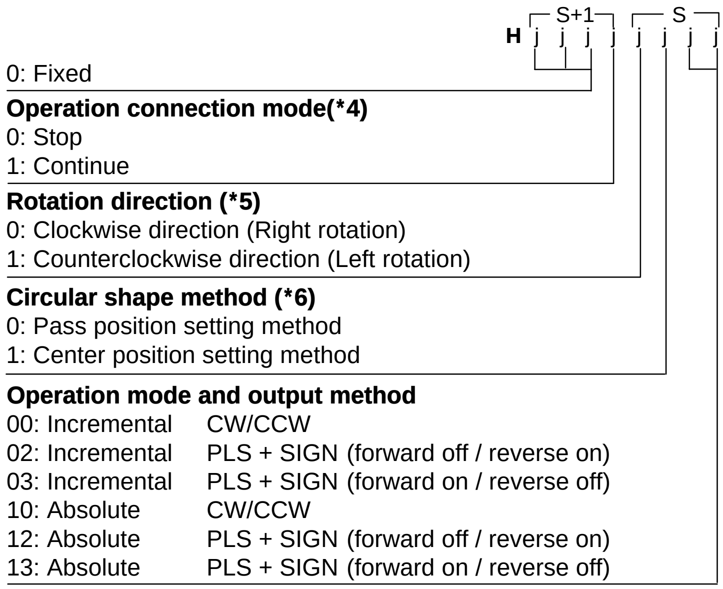


Let CH0 be the X-axis, and CH2 be the Y-axis.

Fv:	Composite speed	O (Xo, Yo):	Center point (Center position)
Fx:	X-axis component speed	S (Xs, Ys):	Start point (Current position)
Fy:	Y-axis component speed	P (Xp, Yp):	Pass point (Pass position)
r:	Radius	E (Xe, Ye):	End point (Target position)

$$Fx = Fv \sin\theta = Fv \frac{|Ye - Yo|}{r} \qquad Fy = Fv \cos\theta = Fv \frac{|Xe - Xo|}{r}$$

(*1): Control code (H constant)



0: Fixed

Operation connection mode(*4)
0: Stop
1: Continue

Rotation direction (*5)
0: Clockwise direction (Right rotation)
1: Counterclockwise direction (Left rotation)

Circular shape method (*6)
0: Pass position setting method
1: Center position setting method

Operation mode and output method

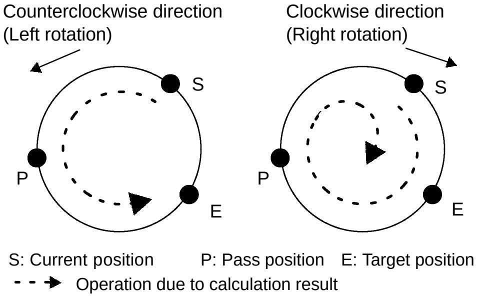
00: Incremental	CW/CCW
02: Incremental	PLS + SIGN (forward off / reverse on)
03: Incremental	PLS + SIGN (forward on / reverse off)
10: Absolute	CW/CCW
12: Absolute	PLS + SIGN (forward off / reverse on)
13: Absolute	PLS + SIGN (forward on / reverse off)

(*2): Composite speed (Frequency) "K constant"
100 Hz to 20 kHz [K100 to K20000]

(*3): Target position and pass position
K-8388608 to K8388607

(*4): Operation connection mode
Stop:
When stop (0) is specified, it will stop when the target position is reached.
Continue:
When the following circular interpolation data table is overwritten when continue (1) is specified after circular interpolation action begins, the following circular interpolation begins when the first circular interpolation that was started up finishes (target position reached). To finish, specify stop (0) for this flag (operation connection mode) after the last circular interpolation action has started.

(*5): Rotation direction
Pulses are output according to the designated direction. Operation differs, as indicated below, depending on the pass position and rotation direction setting.



(*6): Circular shape method
Pass position setting method:
The center position and the radius of the circular are calculated by specifying the pass and target positions for the current position.
Center position setting method:
The radius of the circular is calculated by specifying the center and target positions for the current position.

Note

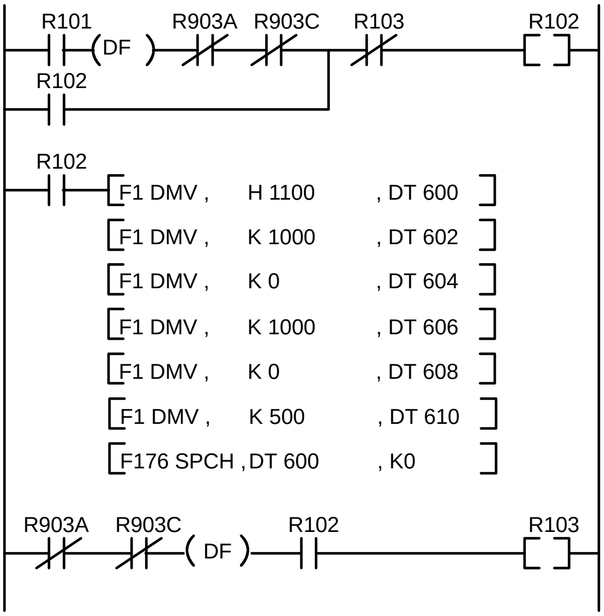
The circular interpolation control instruction can be used with the C32T2 control unit only.

Note

Assume that the execution conditions for this instruction always hold. When the execution conditions are off, pulse output stops.

If you use one-shot relay (ex.: R101 below), pls refer to the following program by using R903A and R903C in order to make internal relay hold. (ex.: R102 below.)

Sample Program



* Current position S = (0.0)
(DT90044, DT90045) = 0, (DT90200, DT90201) = 0

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

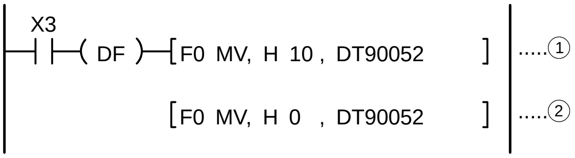


Figure 101: FPΣ Program 1 of pulse output control instruction "F0"

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

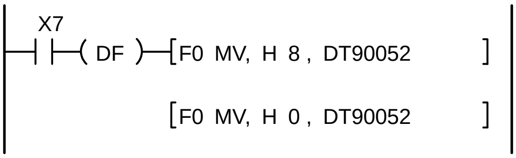
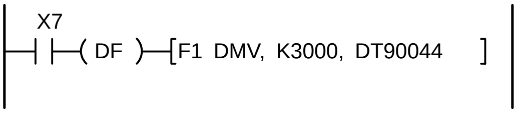


Figure 102: FPΣ Program 2 of pulse output control instruction "F0"

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.

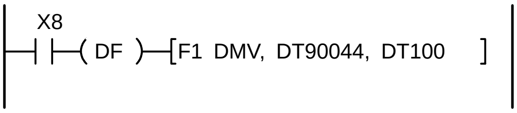
Example 1: Writing the elasped value



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

Figure 103: 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.

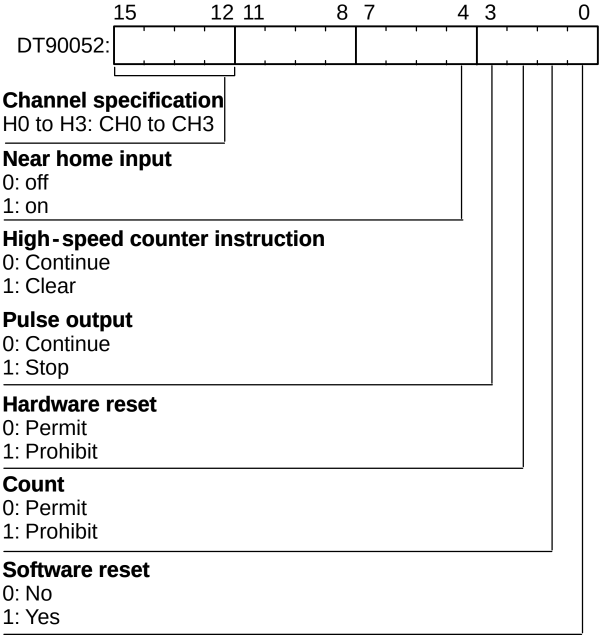
Figure 104: FPΣ Program 2 of elapsed value write and read instruction "F1"

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



Channel specification
H0 to H3: CH0 to CH3

Near home input
0: off
1: on

High-speed counter instruction
0: Continue
1: Clear

Pulse output
0: Continue
1: Stop

Hardware reset
0: Permit
1: Prohibit

Count
0: Permit
1: Prohibit

Software reset
0: No
1: Yes

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

6.4.6 Sample Program for Positioning Control

Wiring example

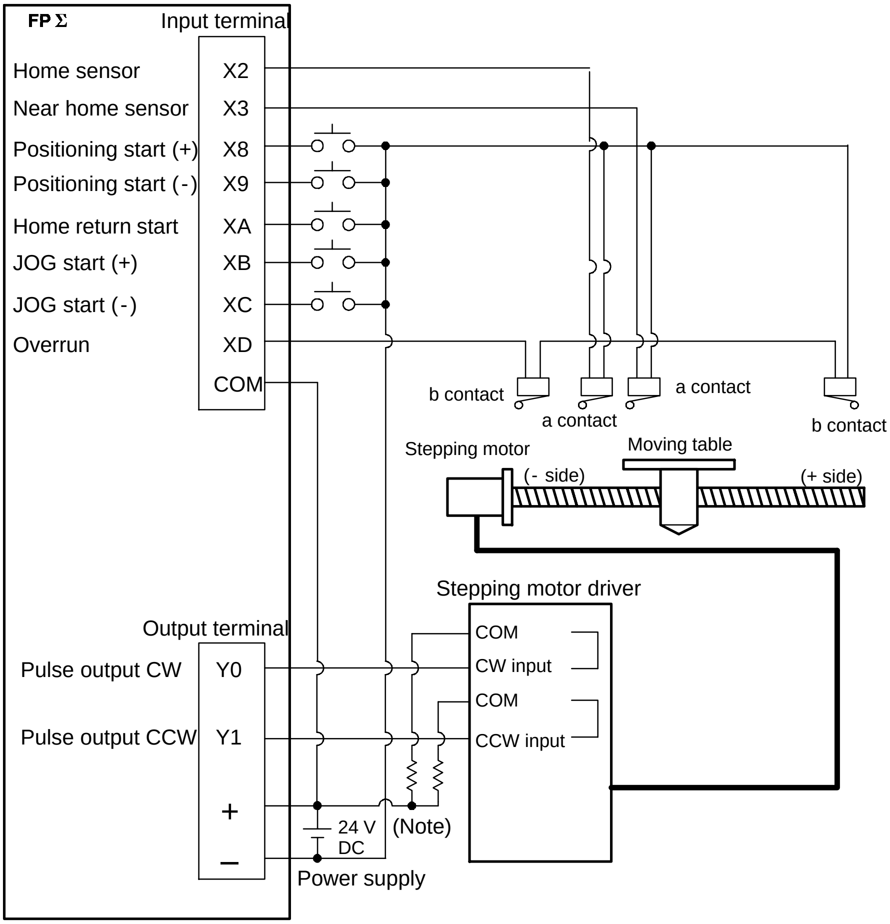


Figure 105: FPΣ Pulse output function - sample program (wiring)

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”.

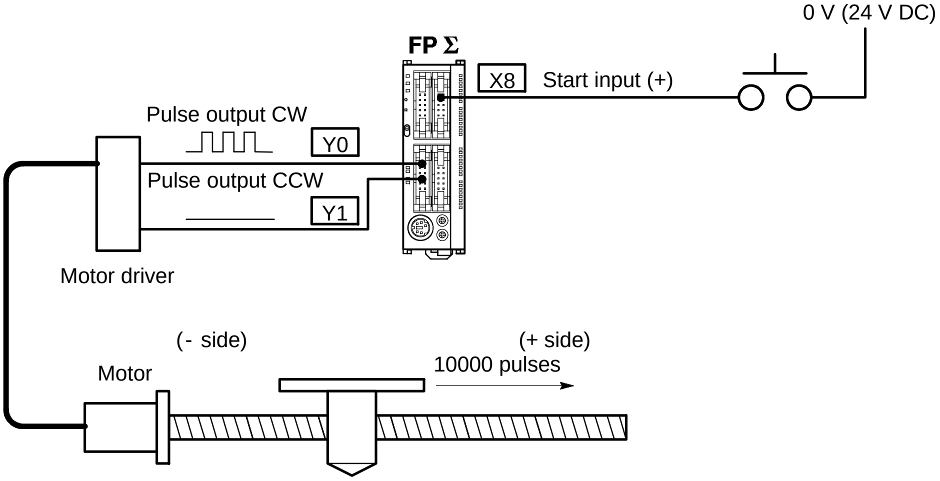
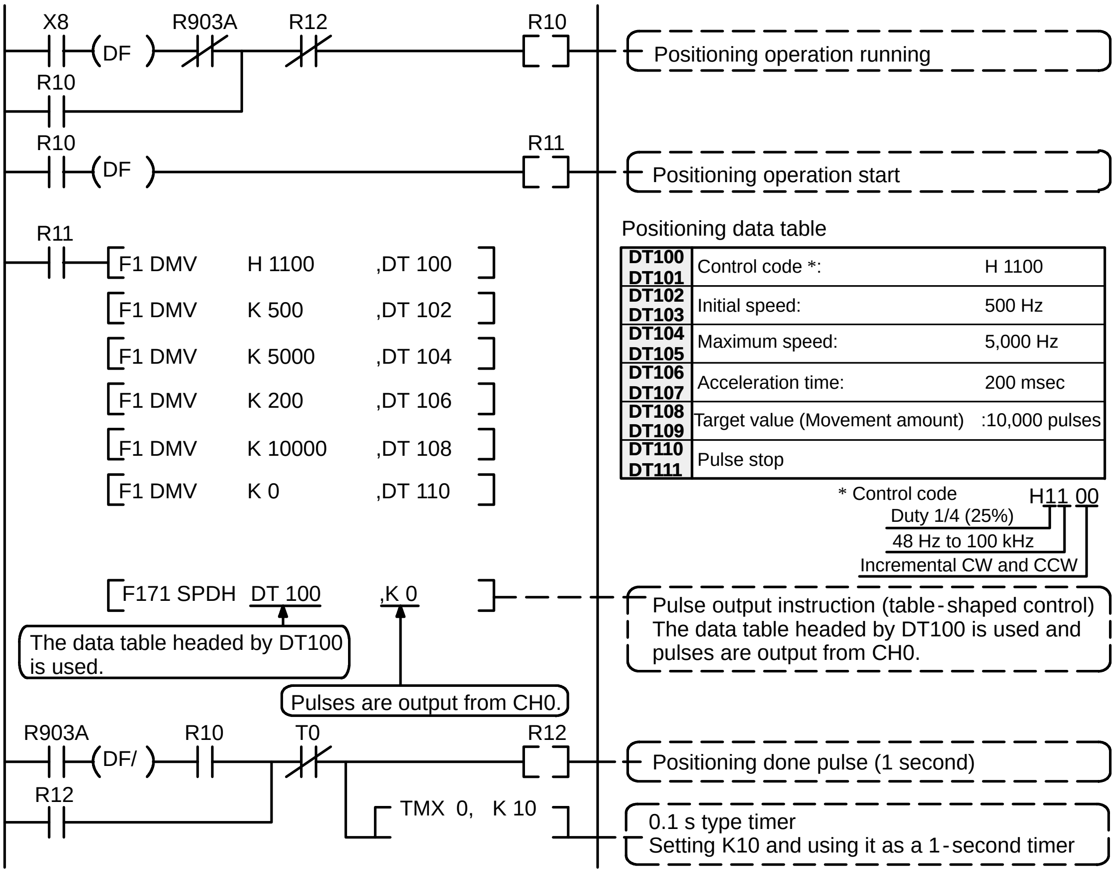


Figure 106: FPΣ Sample program - relative value positioning operation (+ direction)

Program


X8
DF
R903A
R12
R10
Positioning operation running
R10
R10
DF
R11
Positioning operation start
R11
F1 DMV H 1100 ,DT 100
F1 DMV K 500 ,DT 102
F1 DMV K 5000 ,DT 104
F1 DMV K 200 ,DT 106
F1 DMV K 10000 ,DT 108
F1 DMV K 0 ,DT 110
F171 SPDH DT 100 ,K 0
The data table headed by DT100 is used.
Pulses are output from CH0.
Pulse output instruction (table-shaped control)
The data table headed by DT100 is used and pulses are output from CH0.
R903A
DF/
R10
T0
R12
Positioning done pulse (1 second)
R12
TMX 0, K 10
0.1 s type timer
Setting K10 and using it as a 1-second timer
* Control code H11 00
Duty 1/4 (25%)
48 Hz to 100 kHz
Incremental CW and CCW

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 107: FPΣ Sample program - relative value positioning operation (program)

Pulse output diagram

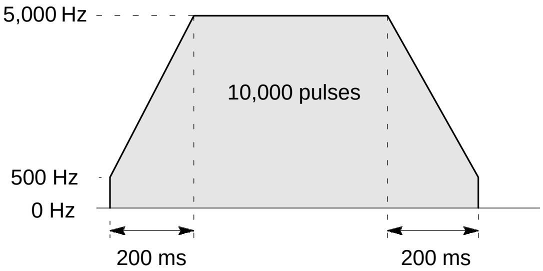


Figure 108: FPΣ Sample program - pulse output diagram

Relative value positioning operation (minus direction)

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

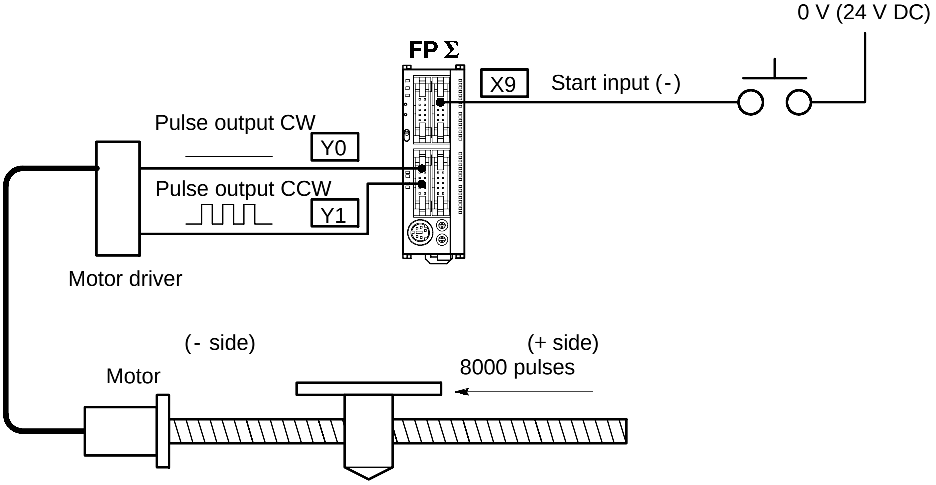
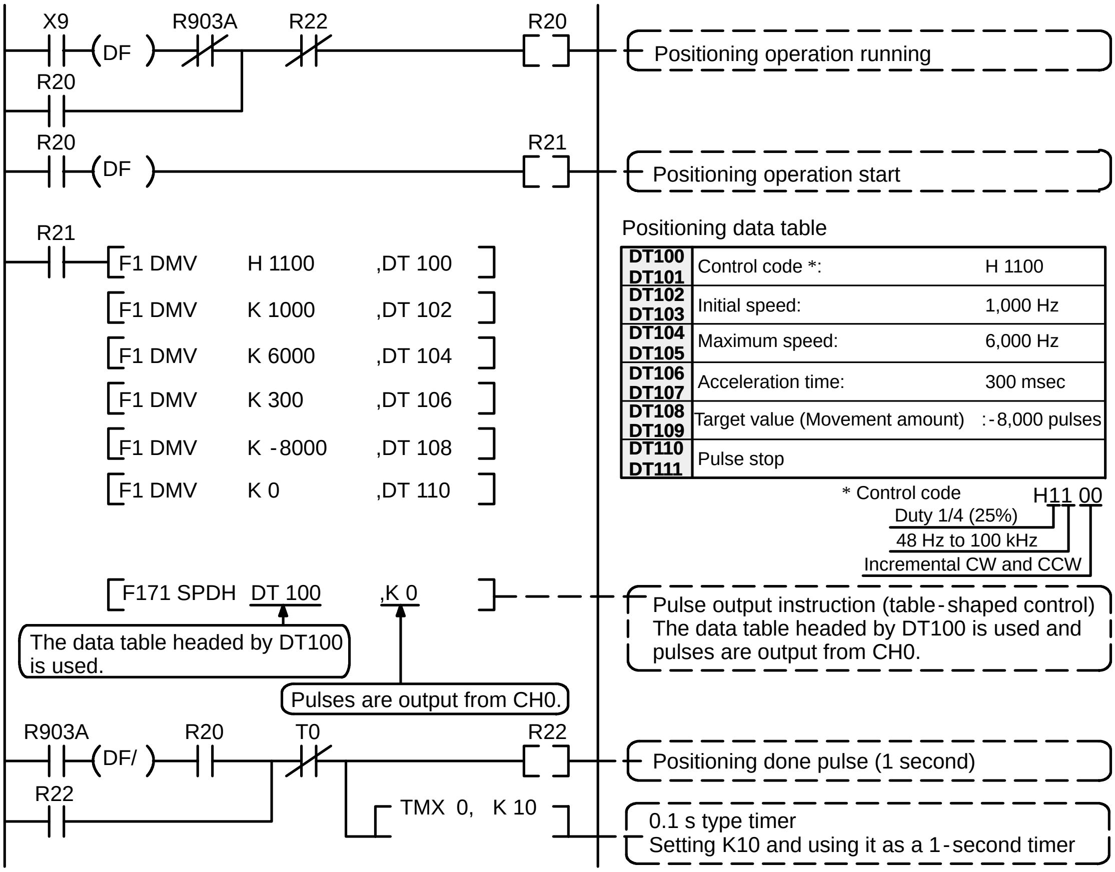


Figure 109: FPΣ Sample program - relative value positioning operation (– direction)

Program


X9
DF
R903A
R22
R20
Positioning operation running
R20
R20
DF
R21
Positioning operation start
R21
F1 DMV H 1100 ,DT 100
F1 DMV K 1000 ,DT 102
F1 DMV K 6000 ,DT 104
F1 DMV K 300 ,DT 106
F1 DMV K -8000 ,DT 108
F1 DMV K 0 ,DT 110
Positioning data table
* Control code H11 00
Duty 1/4 (25%)
48 Hz to 100 kHz
Incremental CW and CCW
F171 SPDH DT 100 ,K 0
The data table headed by DT100 is used.
Pulses are output from CH0.
Pulse output instruction (table-shaped control)
The data table headed by DT100 is used and pulses are output from CH0.
R903A
DF/
R20
T0
R22
R22
Positioning done pulse (1 second)
TMX 0, K 10
0.1 s type timer
Setting K10 and using it as a 1-second timer

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 110: FPΣ Sample program - relative value positioning operation (program)

Pulse output diagram

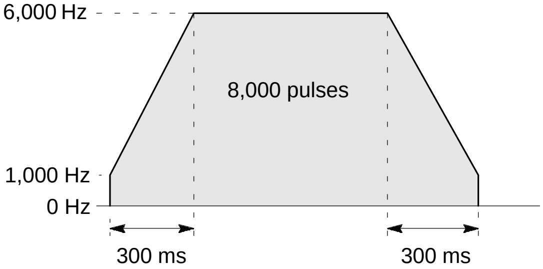
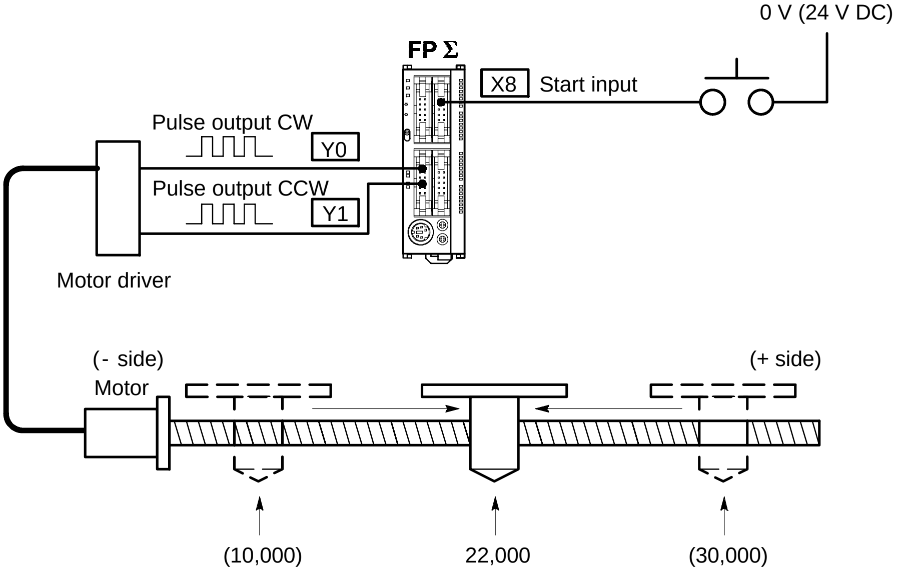


Figure 111: FPΣ Sample program - pulse output diagram

Absolute value positioning operation

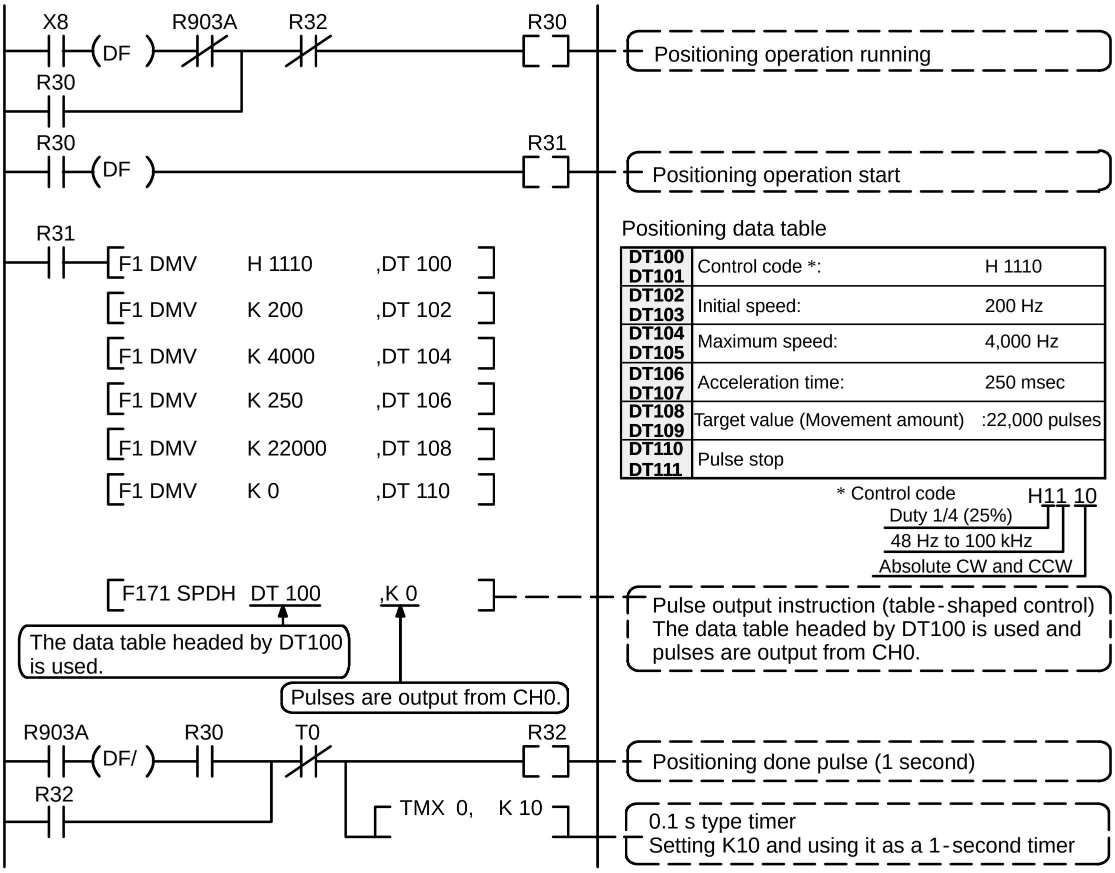
When X1 is turned on, pulses are output from CW output “Y0” or CCW output “Y1” of specified channel CH0. If the current value at that point is larger than “22,000”, the pulses are output from Y1, and if the value is smaller than “22,000”, the pulses are output from Y2.



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

Figure 112: FPΣ Sample program - absolute value positioning operation

Program



Positioning operation running

Positioning operation start

Positioning data table

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	

* Control code H11 10

Duty 1/4 (25%)
48 Hz to 100 kHz
Absolute CW and CCW

Pulse output instruction (table-shaped control)
The data table headed by DT100 is used and pulses are output from CH0.

The data table headed by DT100 is used.

Pulses are output from CH0.

Positioning done pulse (1 second)

0.1 s type timer
Setting K10 and using it as a 1-second timer

Figure 113: FPΣ Sample program - absolute value positioning operation (program)

Pulse output diagram

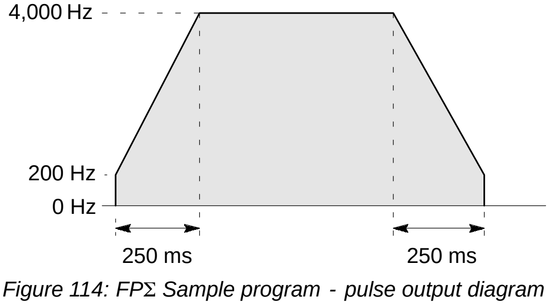


Figure 114: FPΣ Sample program - pulse output diagram

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.

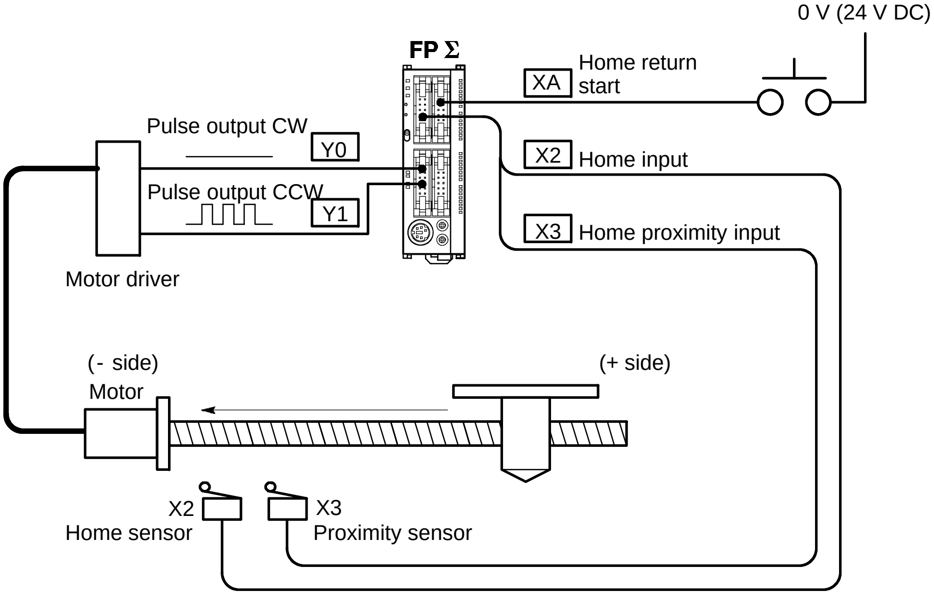
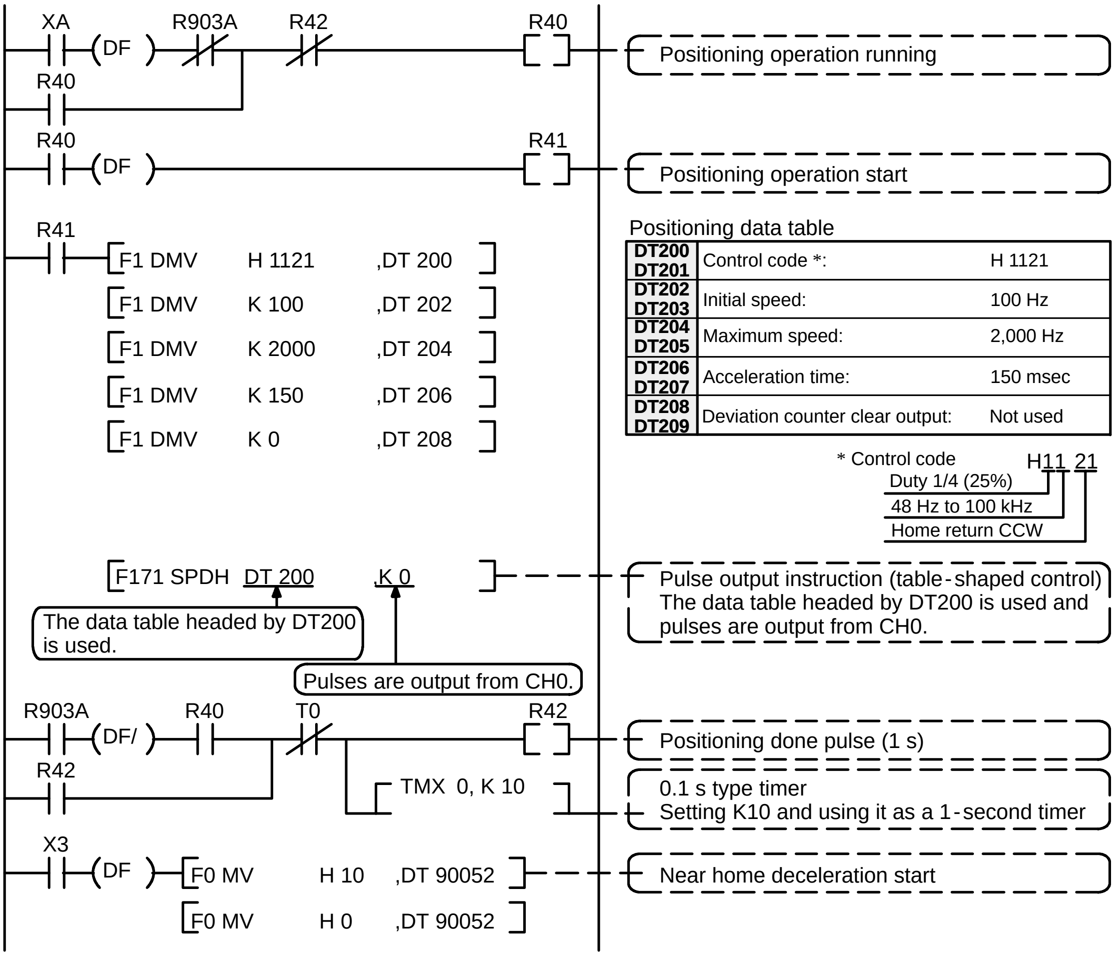


Figure 115: FPΣ Sample program - home return operation (– direction)

Program


XA
DF
R903A
R42
R40
Positioning operation running
R40
R40
DF
R41
Positioning operation start
R41
F1 DMV H 1121 ,DT 200
F1 DMV K 100 ,DT 202
F1 DMV K 2000 ,DT 204
F1 DMV K 150 ,DT 206
F1 DMV K 0 ,DT 208
F171 SPDH DT 200 ,K 0
Pulse output instruction (table-shaped control) The data table headed by DT200 is used and pulses are output from CH0.
The data table headed by DT200 is used.
Pulses are output from CH0.
R903A
DF/
R40
T0
R42
Positioning done pulse (1 s)
R42
TMX 0, K 10
0.1 s type timer
Setting K10 and using it as a 1-second timer
X3
DF
F0 MV H 10 ,DT 90052
F0 MV H 0 ,DT 90052
Near home deceleration start
* Control code H11 21
Duty 1/4 (25%)
48 Hz to 100 kHz
Home return CCW

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 116: FPΣ Sample program - home return operation (program)

Pulse output diagram

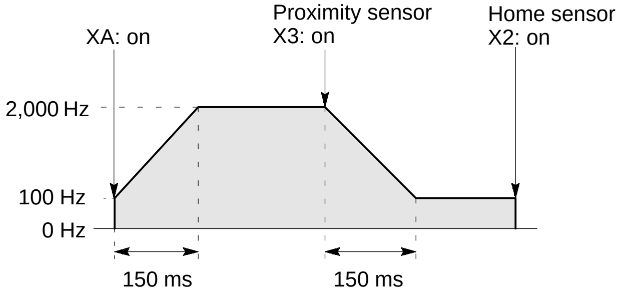


Figure 117: FPΣ Sample program - home return operation (pulse output diagram)

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.

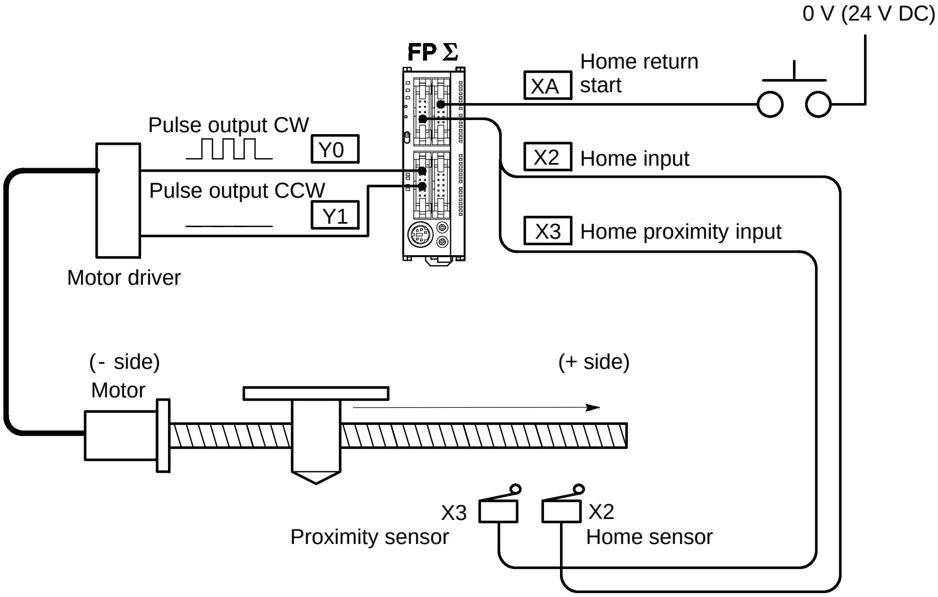
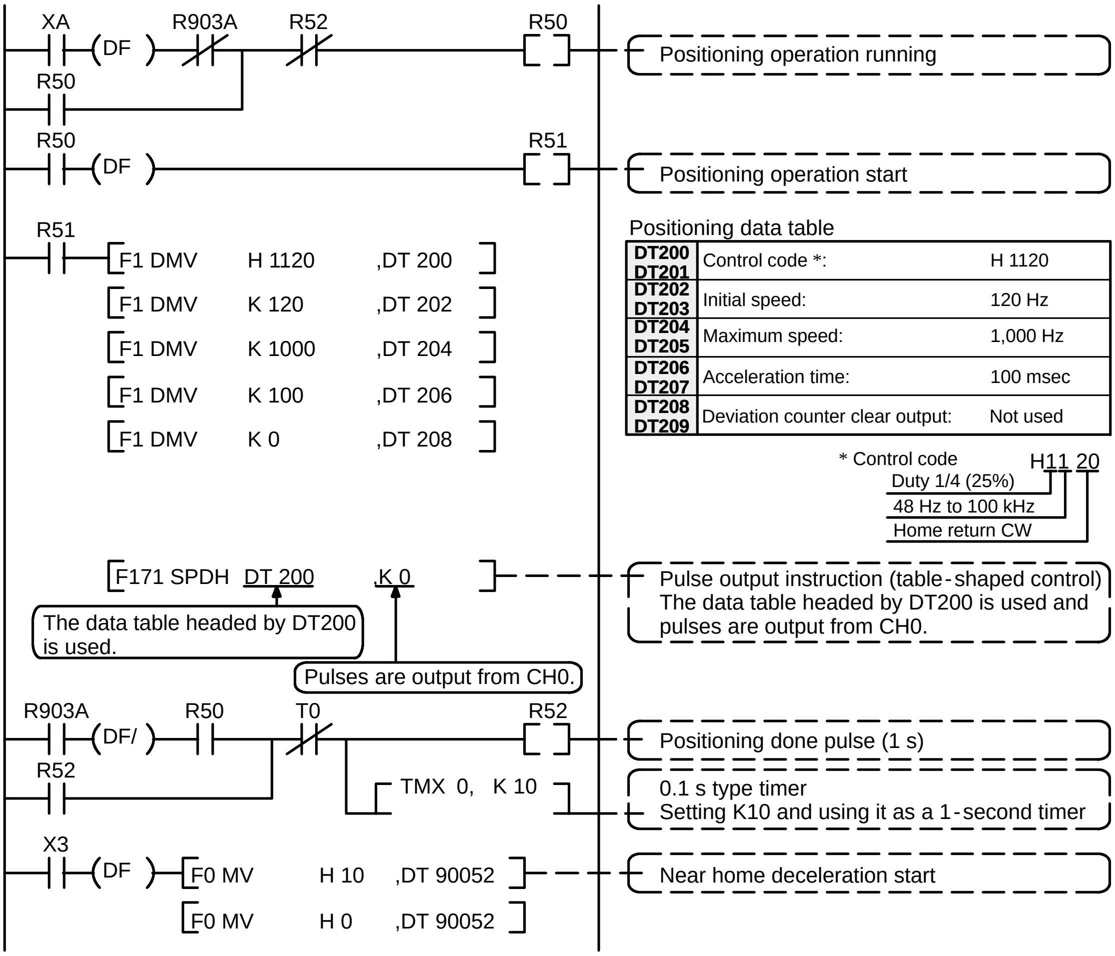


Figure 118: FPΣ Sample program - home return operation (+ direction)

Program


XA
DF
R903A
R52
R50
Positioning operation running
R50
R50
DF
R51
Positioning operation start
R51
F1 DMV H 1120 ,DT 200
F1 DMV K 120 ,DT 202
F1 DMV K 1000 ,DT 204
F1 DMV K 100 ,DT 206
F1 DMV K 0 ,DT 208
Positioning data table
* Control code H11 20
Duty 1/4 (25%)
48 Hz to 100 kHz
Home return CW
F171 SPDH DT 200 ,K 0
The data table headed by DT200 is used.
Pulses are output from CH0.
Pulse output instruction (table-shaped control) The data table headed by DT200 is used and pulses are output from CH0.
R903A
DF/
R50
T0
R52
Positioning done pulse (1 s)
R52
TMX 0, K 10
0.1 s type timer Setting K10 and using it as a 1-second timer
X3
DF
F0 MV H 10 ,DT 90052
F0 MV H 0 ,DT 90052
Near home deceleration start

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 119: FPΣ Sample program - home return operation (program)

Pulse output diagram

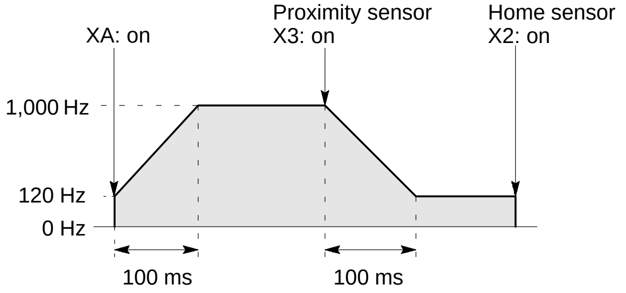
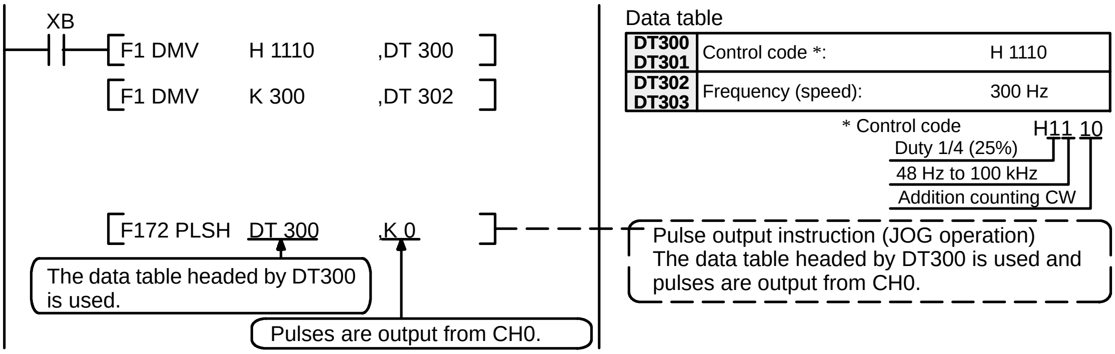


Figure 120: FPΣ Sample program - home return operation (pulse output diagram)

JOG operation (plus direction)

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

Program


XB
F1 DMV H 1110 ,DT 300
F1 DMV K 300 ,DT 302
F172 PLSH DT 300 ,K 0
The data table headed by DT300 is used.
Pulses are output from CH0.
Data table
* Control code H11 10
Duty 1/4 (25%)
48 Hz to 100 kHz
Addition counting CW
Pulse output instruction (JOG operation)
The data table headed by DT300 is used and pulses are output from CH0.

DT300 DT301	Control code *:	H 1110
DT302 DT303	Frequency (speed):	300 Hz

Figure 121: FPΣ Sample program - JOG operation (+ direction) (program)

Pulse output diagram

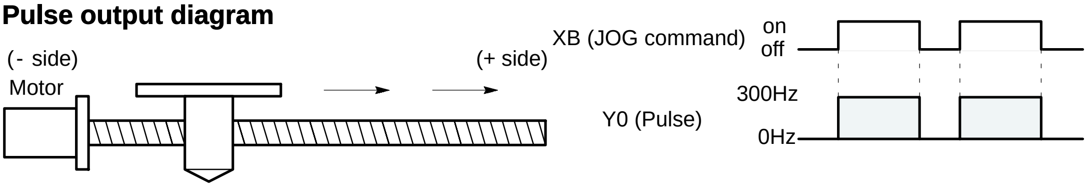
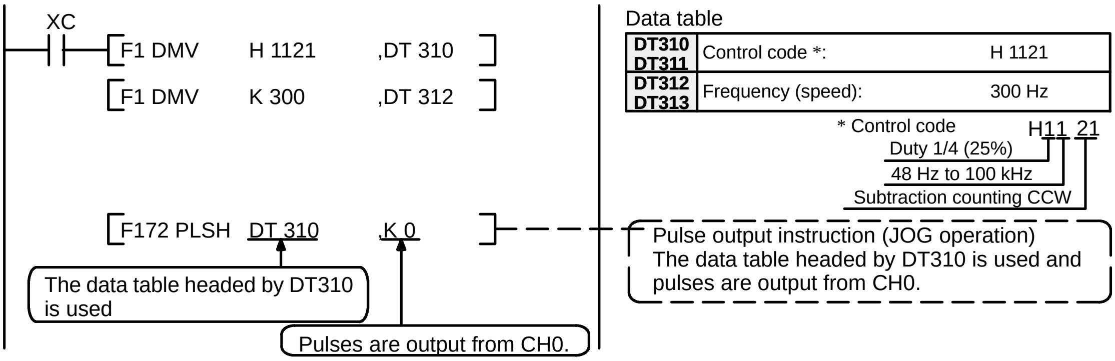


Figure 122: FPΣ Sample program - JOG operation (pulse output diagram)

JOG operation (minus direction)

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

Program


XC
F1 DMV H 1121 ,DT 310
F1 DMV K 300 ,DT 312
F172 PLSH DT 310 ,K 0
The data table headed by DT310 is used
Pulses are output from CH0.
Data table
* Control code H11 21
Duty 1/4 (25%)
48 Hz to 100 kHz
Subtraction counting CCW
Pulse output instruction (JOG operation)
The data table headed by DT310 is used and pulses are output from CH0.

DT310 DT311	Control code *:	H 1121
DT312 DT313	Frequency (speed):	300 Hz

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

Pulse output diagram

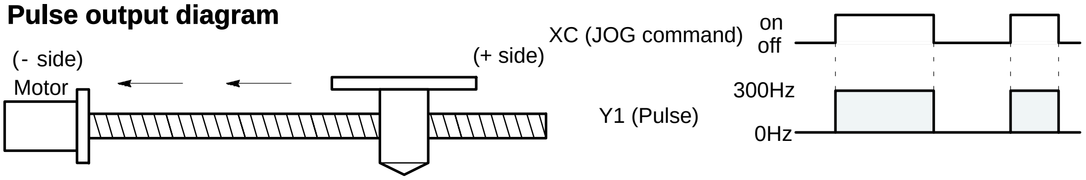


Figure 124: FPΣ Sample program - JOG operation (pulse output diagram)

Emergency stop (over limit)

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

Program

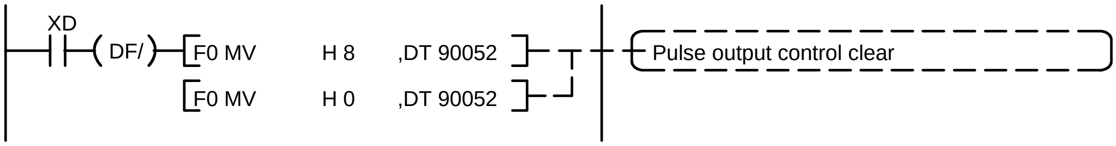


Figure 125: FPΣ Sample program - emergency stop (program)

6.5 PWM Output Function

This section explains about the PWM output function of FPΣ.

6.5.1 Overview of PWM Output Function

PWM output function

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

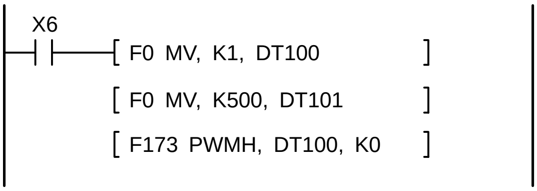
Setting the system register

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.”

6.5.2 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”.



```
[ F0  MV,  K1,  DT100        ]
[ F0  MV,  K500,  DT101      ]
[ F173  PWMH,  DT100,  K0    ]
```

Figure 126: 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 7

Communication Cassette

7.1 Communication Functions of FPΣ

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

7.1.1 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.

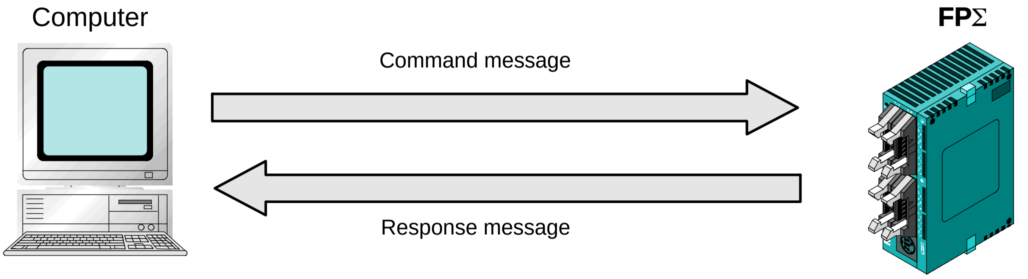


Figure 127: FPΣ Computer link function

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.

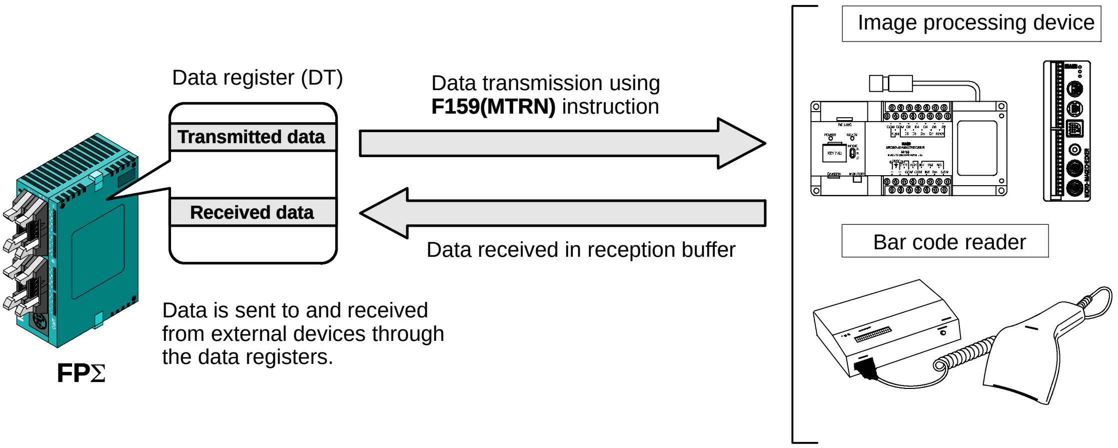

Data register (DT)
Transmitted data
Received data
Data transmission using **F159(MTRN)** instruction
Data received in reception buffer
Data is sent to and received from external devices through the data registers.
FPΣ
Image processing device
Bar code reader

Figure 128: FPΣ General-purpose serial communication function

Applicable communication cassette

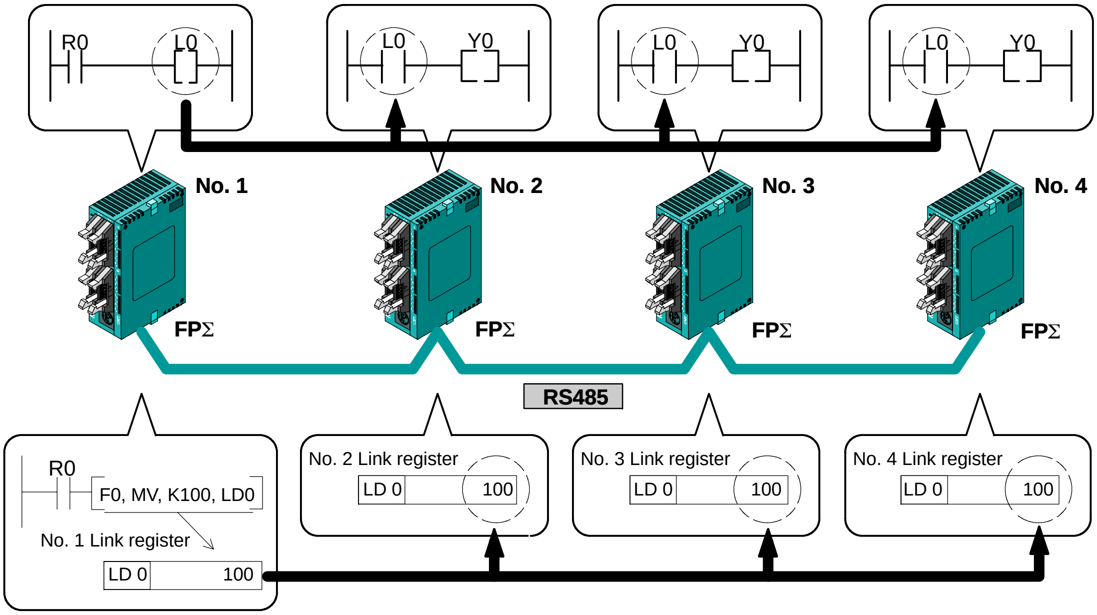
For 1:1 communication	1-channel RS232C type (Part No. FPG-COM1)
	2-channel RS232C type (Part No. FPG-COM2)
For 1:N communication . . .	1-channel RS485 type (Part No. FPG-COM3)

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 129: FPΣ PLC link function

Applicable communication cassette

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

7.2 Communication Cassette

This section explains about the optional communication cassette for FPΣ.

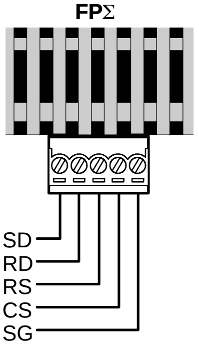
7.2.1 Type of Communication Cassette

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



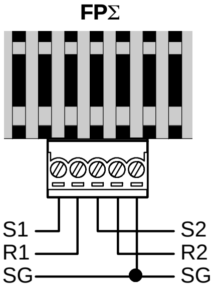
Abbreviation	Name	Signal direction
SD	Transmitted data	Unit → External device
RD	Received data	Unit ← External device
RS	Request to Send	Unit → External device
CS	Clear to Send	Unit ← External device
SG	Signal Ground	—

Figure 130: 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



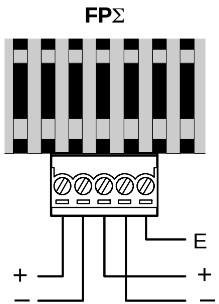
Abbreviation	Name	Signal direction
S1	Transmitted data 1	Unit → External device
R1	Received data 1	Unit ← External device
S2	Transmitted data 2	Unit → External device
R2	Received data 2	Unit ← External device
SG	Signal Ground	—

Figure 131: 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 links and general-purpose serial communication.

Terminal layout



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

Figure 132: FPΣ 1-channel RS485 type communication cassette

7.2.2 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	Computer link 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.**

7.2.3 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)	15m/49.21 ft.
Transmission speed (Baud rate)	2,400 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)

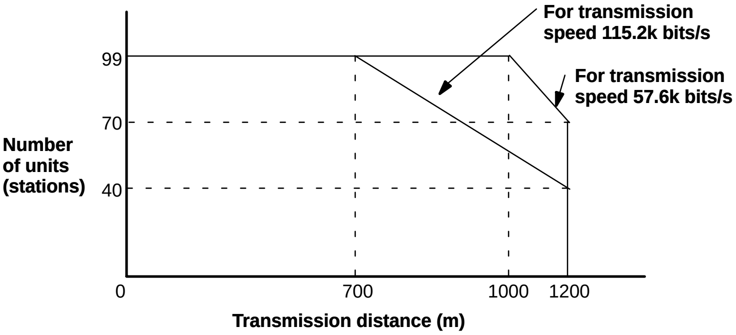
Item	Specification
Communication method	Two-wire half-duplex communication
Synchronous method	Start-stop synchronous system
Transmission line	Twisted pair cable or VCTF
Transmission distance (Total length)	Max. 1,200 m/3,937 ft. (*Notes 4 and 5)
Transmission speed (Baud rate)	2,400 bits/s to 115.2 k bits/s (19,200 bits/s when a C-NET adapter is connected.) (*Notes 2, 4 and 5)
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 units (stations)	Max. 99 units (stations) (32 units (stations) max. when a C-NET adapter is connected.) (*Notes 3, 4 and 5)
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 on the control unit.**
4) **When connecting a commercially available device that has an RS485 interface, please confirm operation using the actual device. In some cases, the number of units (stations), transmission distance, and transmission speed (baud rate) vary depending on the connected device.**
5) **The values for the transmission distance, transmission speed (baud rate), and number of units (stations) should be within the values noted in the graph below.**



When using a transmission speed of 2,400 bits/s to 38.4k bits/s, you can set up to a maximum of 99 units (stations) and a maximum transmission distance of 1,200 m.

PLC link function specifications (*Note 1)

Item	Specification
Communication method	Token bus
Transmission method	Floating master
Transmission line	Twisted pair cable or VCTF
Transmission distance (Total length)	1,200 m/3,937 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 on the control unit or the system registers.**

7.3 Attachment of Communication Cassette

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

7.3.1 Attachment Procedure

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

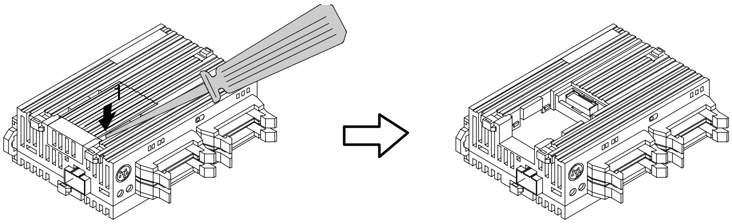


Figure 133: FPΣ Communication cassette attachment procedure 1

2. Install the communication cassette.

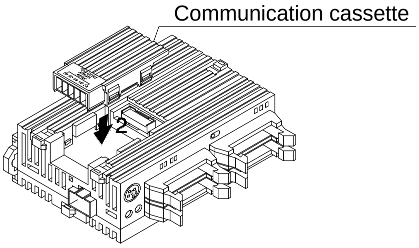


Figure 134: FPΣ Communication cassette attachment procedure 2

3. Plug in the communication connector.

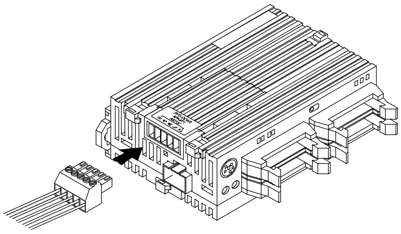


Figure 135: FPΣ Communication cassette attachment procedure 3

Note

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

7.4 Wiring of Communication Cassette

This section explains about the wiring of optional communication cassette.

7.4.1 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.

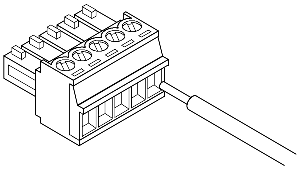


Figure 136: FPΣ Communication connector

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

7.4.2 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.

7.4.3 Wiring Method

Procedure:

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

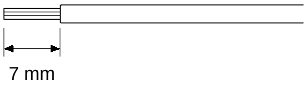


Figure 137: FPΣ Communication connector wiring method 1

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.**

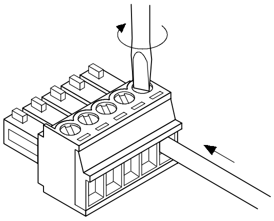


Figure 138: FPΣ Communication connector wiring method 2

7.4.4 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.

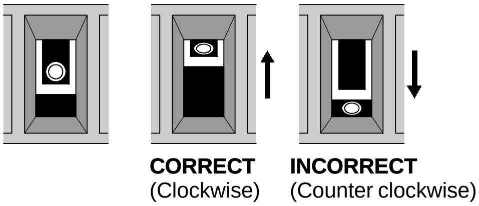


Figure 139: Cautions regarding wiring

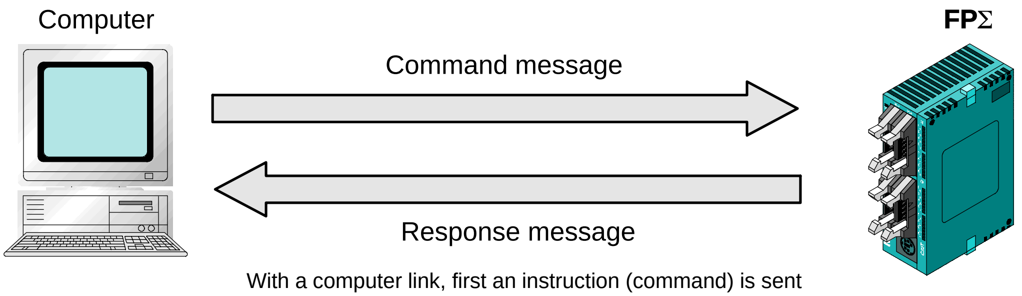
Chapter 8

Communication Function 1
Computer Link

8.1 Computer Link

This section explains about overview of computer link function.

8.1.1 Overview of Function



With a computer link, first an instruction (command) is sent from the computer to the PLC, and then the PLC sends a reply (response) back to the computer.

Figure 140: 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.

8.1.2 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.

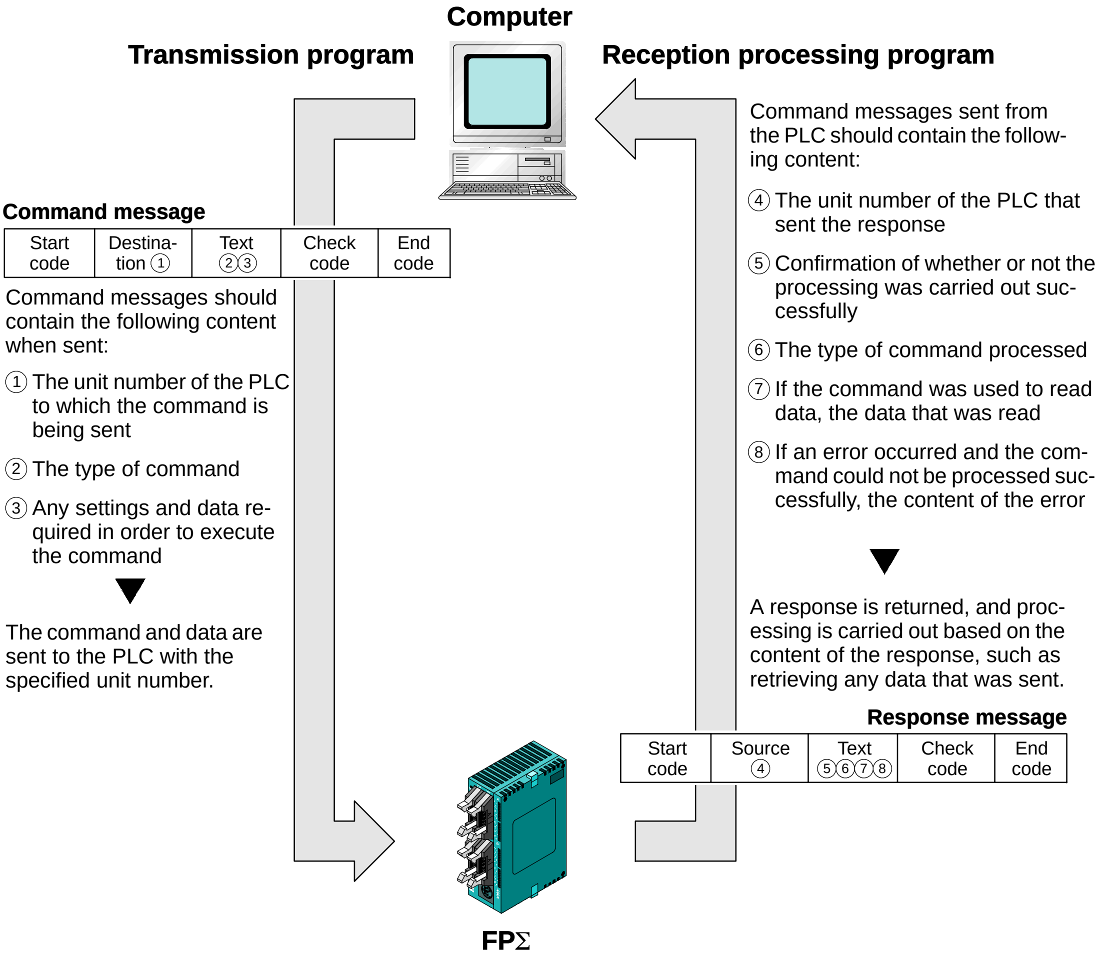
MEWTOCOL-COM sketch

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.



Command message

Start code	Destination ①	Text ②③	Check code	End code

Command messages should contain the following content when sent:

① The unit number of the PLC to which the command is being sent

② The type of command

③ Any settings and data required in order to execute the command

▼

The command and data are sent to the PLC with the specified unit number.

Command messages sent from the PLC should contain the following content:

④ The unit number of the PLC that sent the response

⑤ Confirmation of whether or not the processing was carried out successfully

⑥ The type of command processed

⑦ If the command was used to read data, the data that was read

⑧ If an error occurred and the command could not be processed successfully, the content of the error

▼

A response is returned, and processing is carried out based on the content of the response, such as retrieving any data that was sent.

Response message

Start code	Source ④	Text ⑤⑥⑦⑧	Check code	End code

Figure 141: FPΣ MEWTOCOL-COM

8.1.3 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.

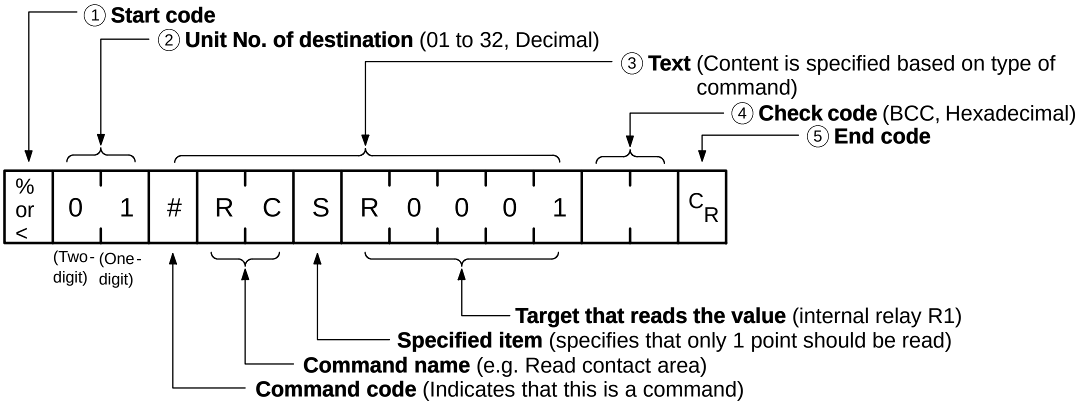

① Start code
② Unit No. of destination (01 to 32, Decimal)
③ Text (Content is specified based on type of command)
④ Check code (BCC, Hexadecimal)
⑤ End code
% or <
0
1
#
R
C
S
R
0
0
0
1
CR
(Two-digit)
(One-digit)
Target that reads the value (internal relay R1)
Specified item (specifies that only 1 point should be read)
Command name (e.g. Read contact area)
Command code (Indicates that this is a command)

Figure 142: 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.

The unit number of the PLC to which you want to send the command 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.

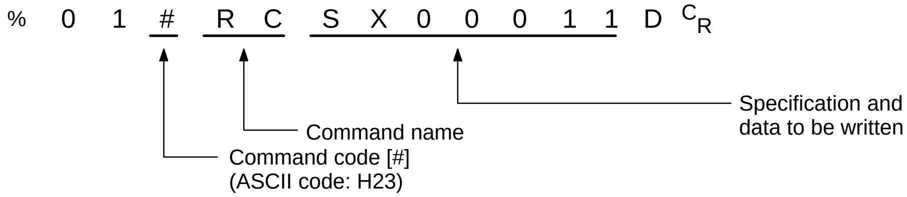

% 0 1 # R C S X 0 0 0 1 1 D CR
Specification and data to be written
Command name
Command code [#] (ASCII code: H23)

Figure 143: 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.

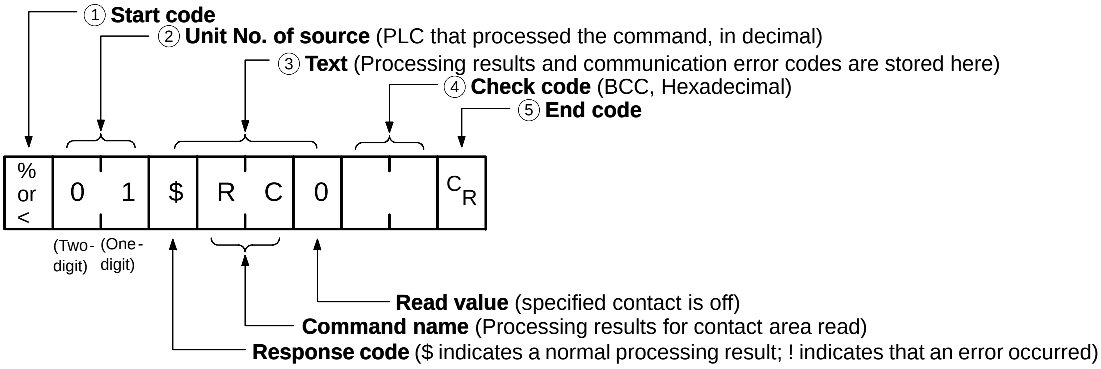

① Start code
② Unit No. of source (PLC that processed the command, in decimal)
③ Text (Processing results and communication error codes are stored here)
④ Check code (BCC, Hexadecimal)
⑤ End code
% or <
0
1
$
R
C
0
CR
(Two-digit)
(One-digit)
Read value (specified contact is off)
Command name (Processing results for contact area read)
Response code ($ indicates a normal processing result; ! indicates that an error occurred)

Figure 144: FPΣ Response message (format)

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.

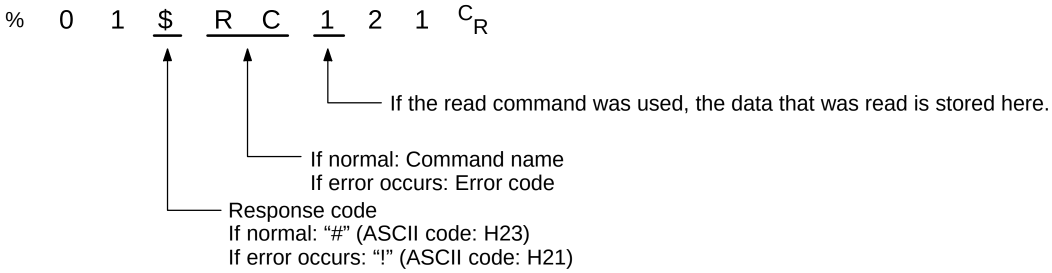

% 0 1 $ R C 1 2 1 CR
If the read command was used, the data that was read is stored here.
If normal: Command name
If error occurs: Error code
Response code
If normal: “#” (ASCII code: H23)
If error occurs: “!” (ASCII code: H21)

Figure 145: 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.**

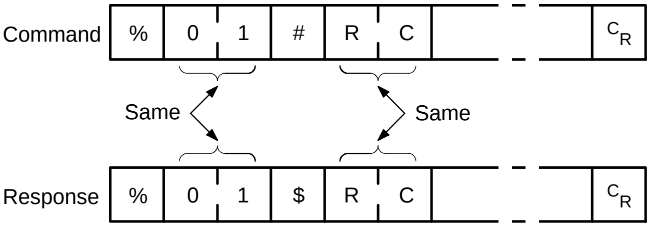


Figure 146: FPΣ Command & response message (note)

8.1.4 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 the code “MD or 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.
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

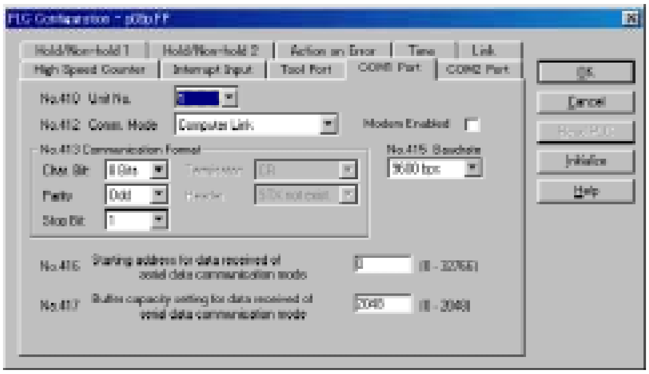
- The number of characters that can be sent is restricted by the type of header and the command.

8.1.5 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



No.410 Unit No.

No.412 Comm. Mode: Computer Link

Modem Enabled ☐

No.413 Communication Format

Char. Bit: 8 Bits

Parity: Odd

Stop Bit: 1

Terminator: CR

Header: STX not exist

No.415 Baudrate: 9600 bps

No.416 Starting address for data received of serial data communication mode: 0 (0 - 32765)

No.417 Buffer capacity setting for data received of serial data communication mode: 2048 (0 - 2048)

Figure 147: 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.

8.1.6 Restriction

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

There are no restrictions when multiple ports are used.

8.2 Connection Example with External Device

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

8.2.1 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.

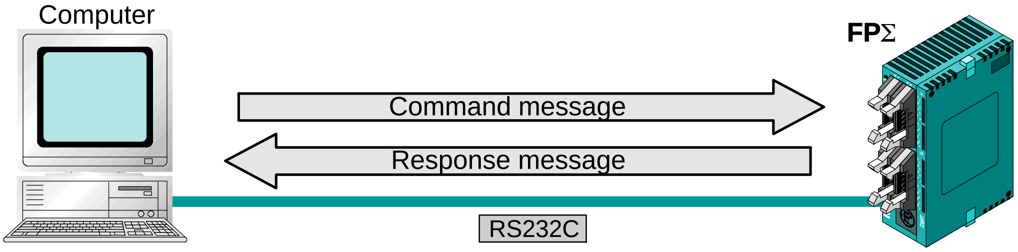


Figure 148: FPΣ Computer link-connection example (computer)

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 bps to 115200 bps

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 bps to 115200 bps

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

Connection example with computer

When using the 1-channel RS232C type of communication cassette

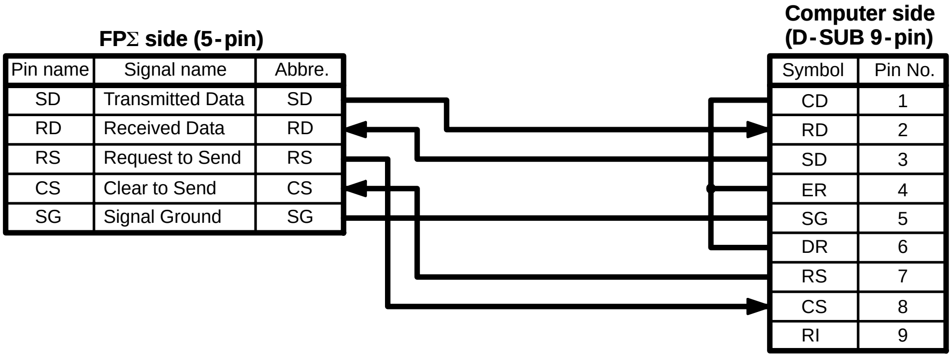


Figure 149: FPΣ Computer link - connection example 1 (computer)

When using the 2-channel RS232C type of communication cassette

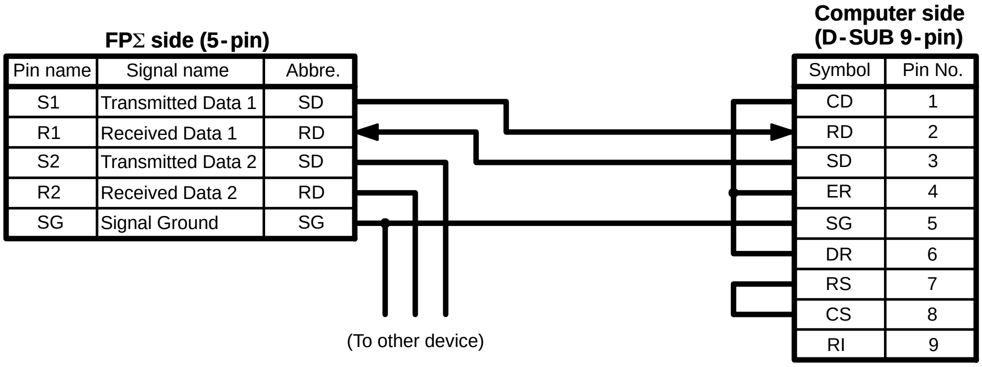


Figure 150: FPΣ Computer link - connection example 2 (computer)

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.

8.2.2 Connection Example with External Device (1:1 communication with programmable display “GT10/GT30”)

Outline

A 1:1 computer link with a programmable display “GT10/GT30” 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.

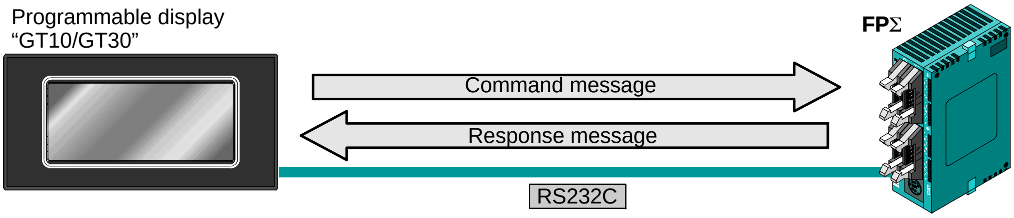


Figure 151: FPΣ Computer link - connection example (GT10)

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 bps

• 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 bps

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

Communication format setting for GT10/GT30

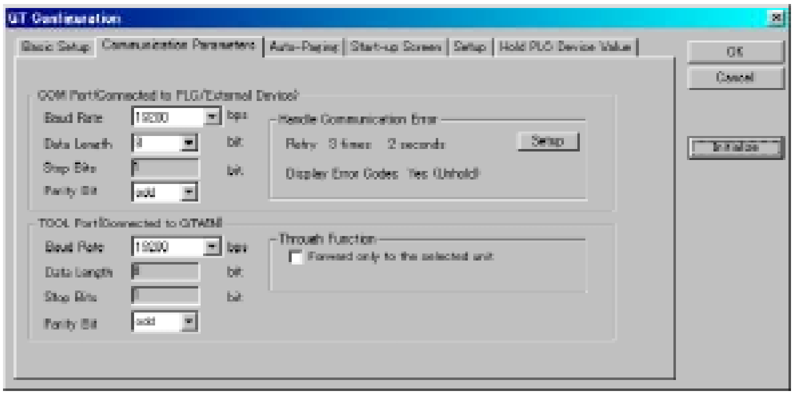
When the GT10/GT30 is shipped from the factory, the communication format for GT10/GT30 settings are as shown below. “GT Configuration” settings should be changed to match the application at hand.

Item	Description
Baud rate	19200 bps
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 programmable display and the “GT Configuration” item in the GTWIN screen creation tool. For detailed information, please see the technical manual for the GT10/GT30.

GTWIN GT Configuration settings “Communication Parameters” screen



COM Port(Connected to PLC/External Device)

Baud Rate: 19200 bps
Data Length: 8 bit
Stop Bits: 1 bit
Parity Bit: odd

Handle Communication Error

Retry 3 times 2 seconds
Display Error Codes Yes (Unhold)

TOOL Port(Connected to GTWIN)

Baud Rate: 19200 bps
Data Length: 8 bit
Stop Bits: 1 bit
Parity Bit: odd

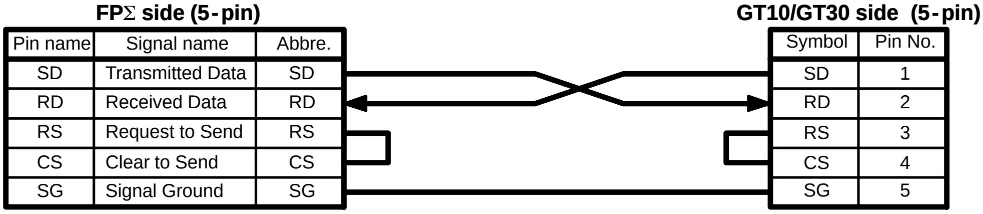
Through Function

☐ Forward only to the selected unit

Figure 152: GTWIN GT Configuration setting screen (communication prameters)

Connection example with programmable display “GT10/GT30”

When using the 1-channel RS232C type of communication cassette



FPΣ side (5-pin)

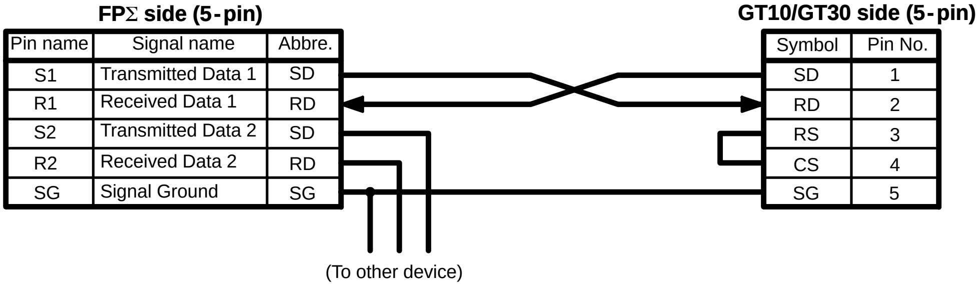
Pin name	Signal name	Abbre.
SD	Transmitted Data	SD
RD	Received Data	RD
RS	Request to Send	RS
CS	Clear to Send	CS
SG	Signal Ground	SG

GT10/GT30 side (5-pin)

Symbol	Pin No.
SD	1
RD	2
RS	3
CS	4
SG	5

Figure 153: FPΣ Computer link - connection example 1 (GT10)

When using the 2-channel RS232C type of communication cassette



FPΣ side (5-pin)

Pin name	Signal name	Abbre.
S1	Transmitted Data 1	SD
R1	Received Data 1	RD
S2	Transmitted Data 2	SD
R2	Received Data 2	RD
SG	Signal Ground	SG

GT10/GT30 side (5-pin)

Symbol	Pin No.
SD	1
RD	2
RS	3
CS	4
SG	5

(To other device)

Figure 154: FPΣ Computer link - connection example 2 (GT10)

Basic communication area setting for GT10/GT30

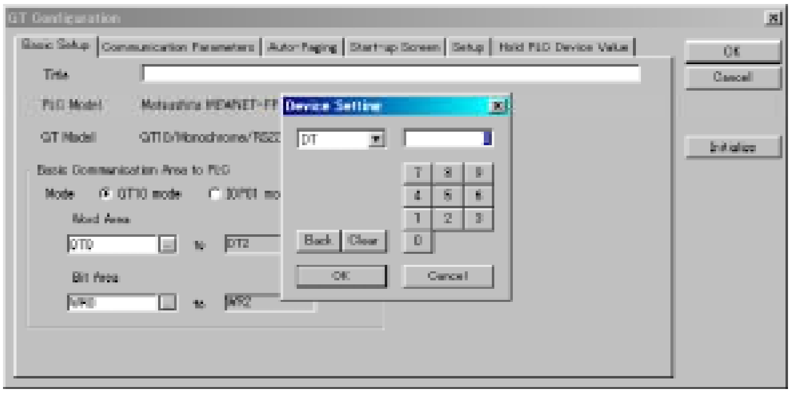
To carry out communication with a PLC, the “Basic Communication Area” setting for the internal device area in the PLC reserved by the programmable display in advance should be specified in the configuration settings.

When the GT10/GT30 is shipped from the factory, the basic communication area for GT10/GT30 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 configuration parameter settings for the programmable display and the “GT Configuration” item in the GTWIN screen creation tool.

GTWIN GT Configuration settings “Basic Setup” screen



GT Configuration

Title

PLC Model Matsushita MEWNET-FP

GT Model GT10/Monochrome/RS23

Basic Communication Area to PLC

Mode ● GT10 mode ○

Word Area DT0 to DT2

Bit Area WR0 to WR2

Device Setting

DT

Figure 155: GTWIN GT Configuration setting screen (basic setup)

8.3 Computer Link (1:N communication)

This section explains about the 1:N communication of computer link.

8.3.1 Overview of 1:N Communication

For a 1:N computer link, the computer and the FPΣ are connected through a commercially available RS232C-RS485 conversion 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.

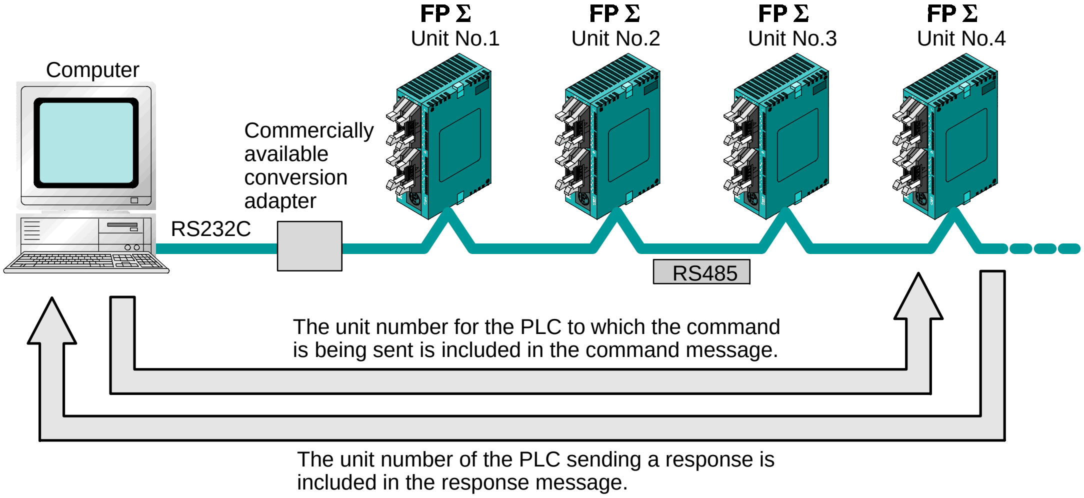

FP Σ
Unit No.1
FP Σ
Unit No.2
FP Σ
Unit No.3
FP Σ
Unit No.4
Computer
Commercially available conversion adapter
RS232C
RS485
The unit number for the PLC to which the command is being sent is included in the command message.
The unit number of the PLC sending a response is included in the response message.

Figure 156: 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.

8.3.2 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

8.3.3 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 99 (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 bps

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

Note

When a C-NET adapter is used, the number of unit (station) is max.32.

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.

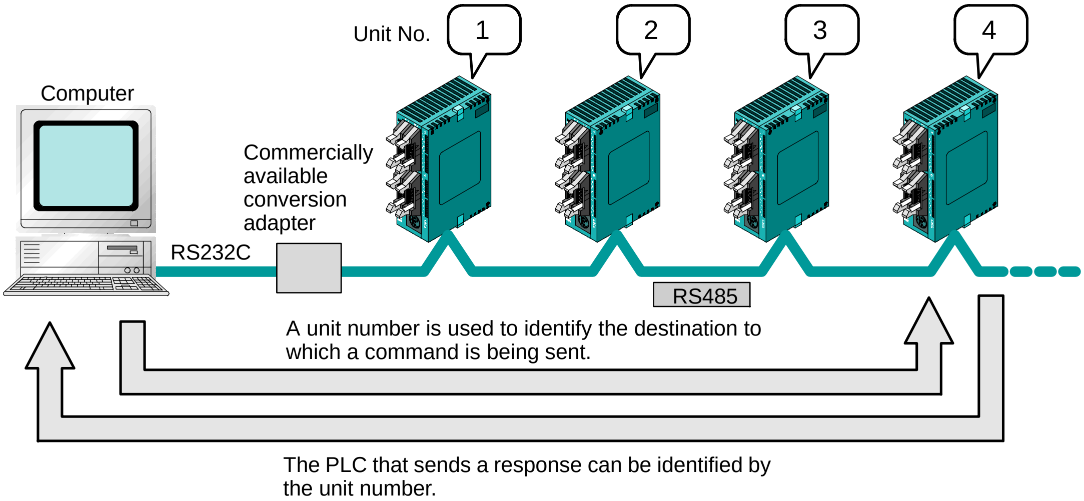

Unit No.
1
2
3
4
Computer
Commercially available conversion adapter
RS232C
RS485
A unit number is used to identify the destination to which a command is being sent.
The PLC that sends a response can be identified by the unit number.

Figure 157: FPΣ Computer link - setting of unit No. (station No.)

Unit No. setting using unit No. (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.

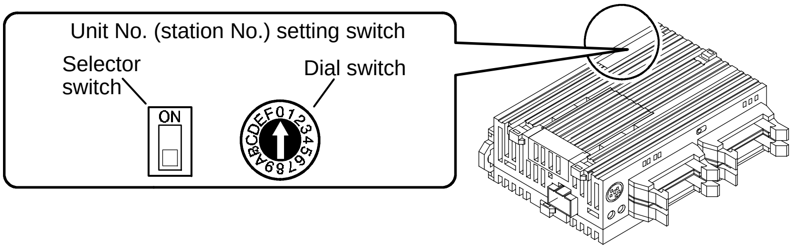


Figure 158: FPΣ Computer link - unit No. (station No.) setting switch

Relationship between unit No. 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

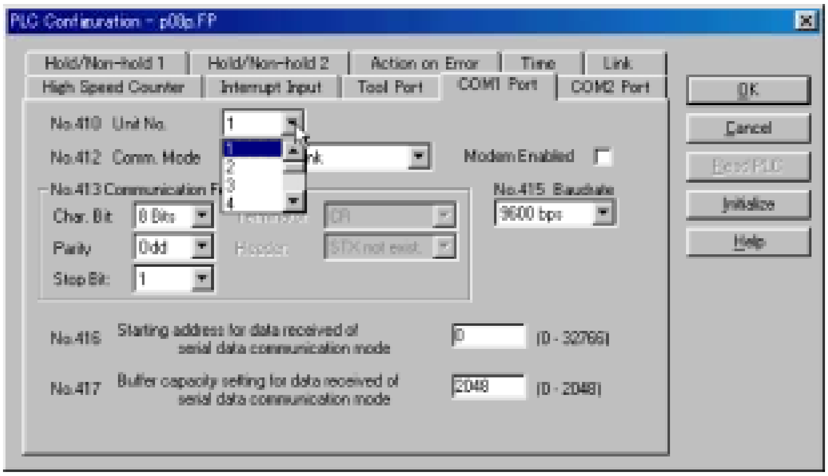
- The range of numbers that can be set using the unit No. setting switch is from 1 to 31.
- Setting the unit No. setting switch to “0” makes the system register setting valid, so that a unit number between 1 and 99 can be set.

Setting using the system register

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



No.410 Unit No. 1

No.412 Comm. Mode

Modem Enabled ☐

No.413 Communication F

Char. Bit 8 Bits

Parity Odd

Stop Bit 1

Terminator CR

Header STX not exist

No.415 Baudrate 9600 bps

No.416 Starting address for data received of serial data communication mode 0 (0 - 32765)

No.417 Buffer capacity setting for data received of serial data communication mode 2048 (0 - 2048)

Figure 159: FPWIN GR PLC Configuration setting dialog box

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

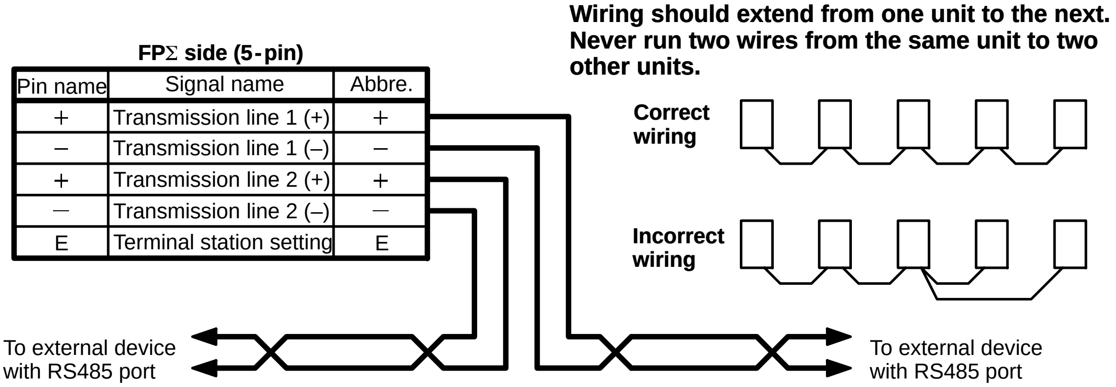
Click on the ▼ button, and select a unit number from among the numbers 1 to 99 displayed on the pull-down menu.

Notes

- **To make the unit number setting in the FPWIN GR valid, set the unit No. setting switch to “0”.**
- **The unit number setting using the station setting switch is valid only for the communication port of the communication cassette. The unit number for the tool port should be set using the system registers.**
- **When using the C-NET adapter, the maximum number of station numbers that can be specified is 32.**

8.3.4 Connection with External Device

Connection diagram



Wiring should extend from one unit to the next. Never run two wires from the same unit to two other units.

FPΣ side (5-pin)

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

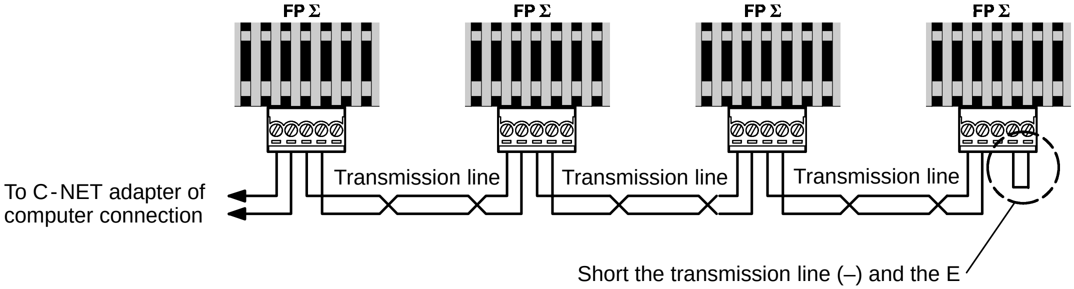
Correct wiring
Incorrect wiring
To external device with RS485 port
To external device with RS485 port

Figure 160: 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.



Short the transmission line (–) and the E terminal in the final unit (terminal station).

Figure 161: FPΣ Computer link - terminal station setting

Chapter 9

Communication Function 2
General-purpose Serial Communication

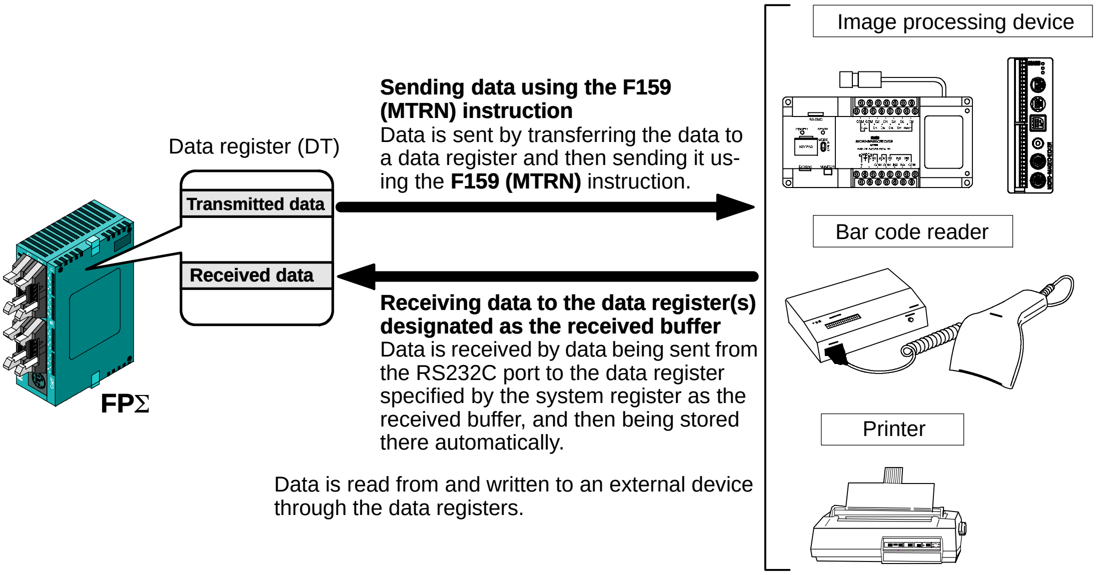
9.1 General-purpose Serial Communication

This section explains about overview of general-purpose serial communication.

9.1.1 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 device 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.



Sending data using the F159 (MTRN) instruction
Data is sent by transferring the data to a data register and then sending it using the **F159 (MTRN)** instruction.

Receiving data to the data register(s) designated as the received buffer
Data is received by data being sent from the RS232C port to the data register specified by the system register as the received buffer, and then being stored there automatically.

Data is read from and written to an external device through the data registers.

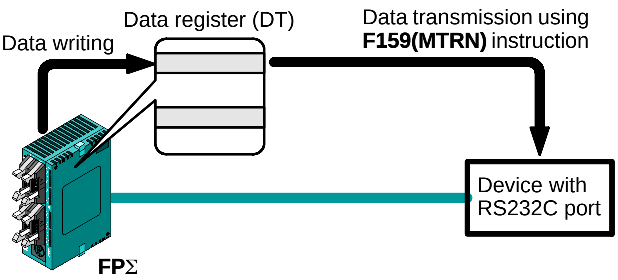
Figure 162: FPΣ General-purpose Serial Communication (overview)

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.



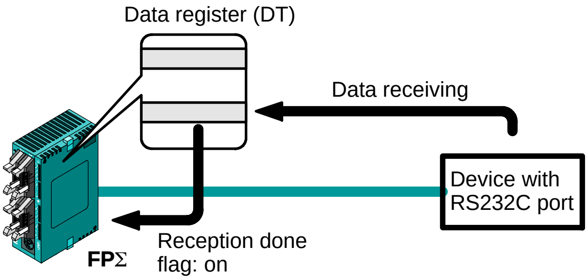
The end code specified by the system register is automatically added to the data that has been sent.

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

Figure 163: 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.

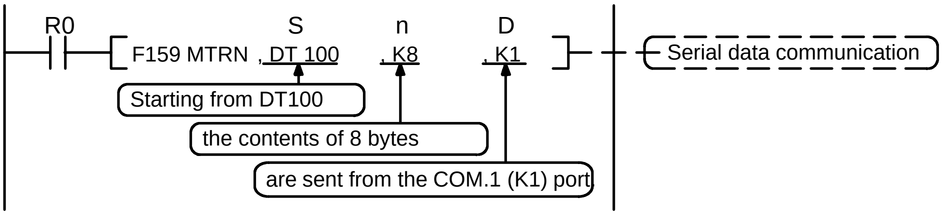
Figure 164: FPΣ Data reception

9.1.2 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.


R0
S
n
D
F159 MTRN , DT 100 , K8 , K1
Serial data communication
Starting from DT100
the contents of 8 bytes
are sent from the COM.1 (K1) 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 165: 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. 1 port.

Reception of data

Reception of data is controlled by turning the reception done flag “R9038 or R9048” 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.

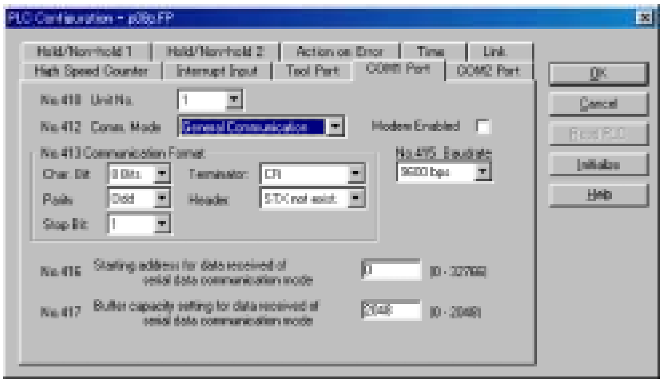
9.1.3 Communication Parameter Settings when Using General-purpose Serial Communications

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



No.410 Unit No. 1

No.412 Com. Mode General Communication

Modem Enabled ☐

No.413 Communication Format

Char. Bit 8 Bits

Parity Odd

Stop Bit 1

Terminator CR

Header STX not exist

No.415 Baudrate 9600 bps

No.416 Starting address for data received of serial data communication mode 0 (0 - 32766)

No.417 Buffer capacity setting for data received of serial data communication mode 2048 (0 - 2048)

Figure 166: 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

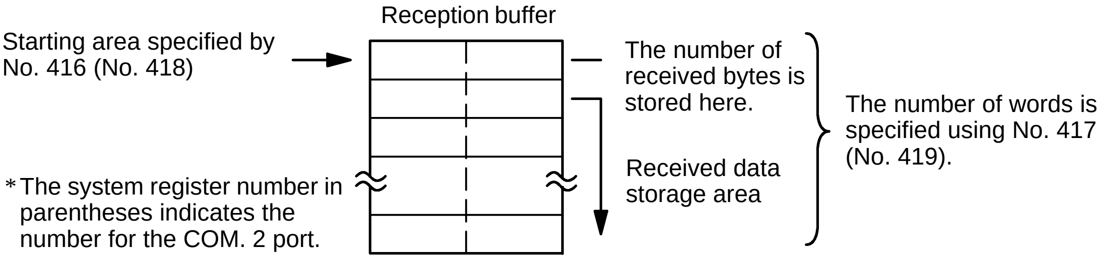
No. 415 Baud rate setting

The default setting for the baud rates for the ports is “9600 bps”. 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 bps, 4800 bps, 9600 bps, 19200 bps, 38400 bps, 57600 bps, 115200 bps” 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. 2 port) and the volume (number of words) using No. 417 (No. 419 for the COM. 2 port). The received buffer layout is as shown below.


Reception buffer
Starting area specified by No. 416 (No. 418)
The number of received bytes is stored here.
Received data storage area
The number of words is specified using No. 417 (No. 419).

* The system register number in parentheses indicates the number for the COM. 2 port.

Figure 167: FPΣ Reception buffer

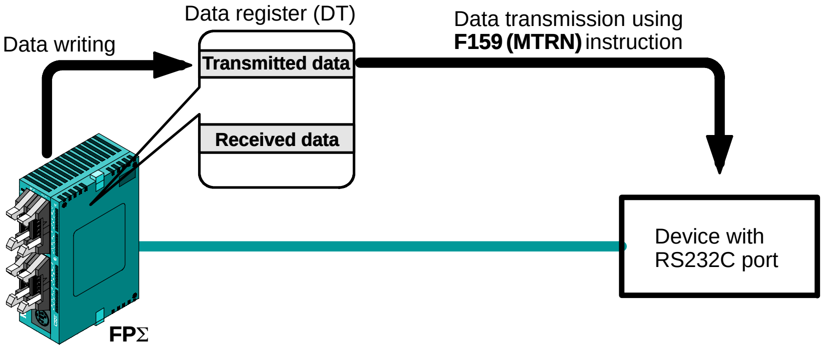
9.2 Overview of Communication with External Devices

This section explains about the communication “data transmission and data reception” with external devices.

Communication with external device is handled through the data register.

9.2.1 Data Transmission to External Device

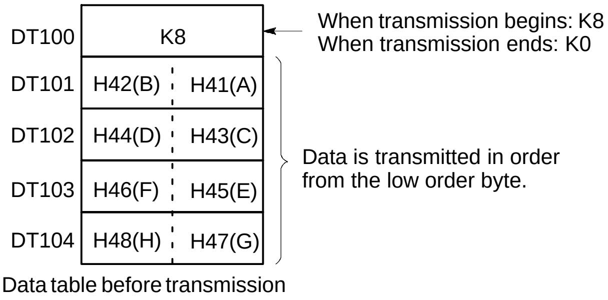
Overview of data transmission



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 168: FPΣ Overview of data transmission

Data table for transmission (transmission buffer)



DT100	K8	
DT101	H42(B)	H41(A)
DT102	H44(D)	H43(C)
DT103	H46(F)	H45(E)
DT104	H48(H)	H47(G)

When transmission begins: K8
When transmission ends: K0

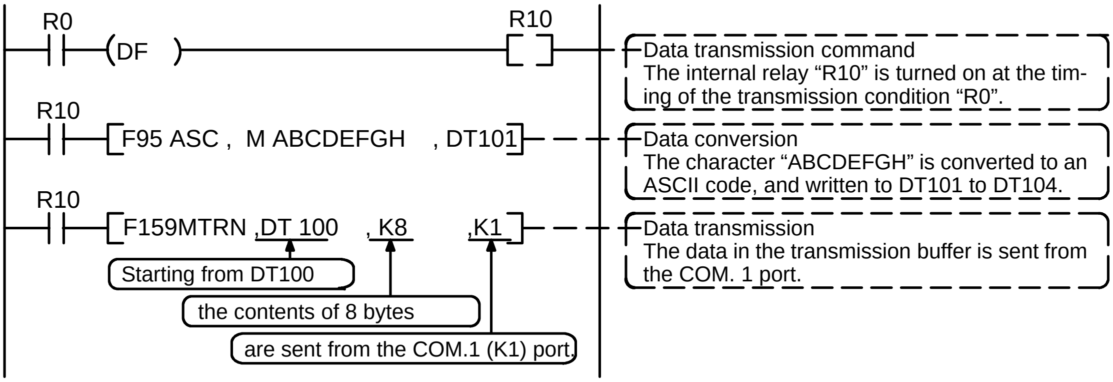
Data is transmitted in order from the low order byte.

Data table before transmission

Figure 169: 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.


R0
(DF)
R10
R10
F95 ASC , M ABCDEFGH , DT101
R10
F159MTRN ,DT 100 , K8 ,K1
Starting from DT100
the contents of 8 bytes
are sent from the COM.1 (K1) port.

Data transmission command
The internal relay “R10” is turned on at the timing of the transmission condition “R0”.

Data conversion
The character “ABCDEFGH” is converted to an ASCII code, and written to DT101 to DT104.

Data transmission
The data in the transmission buffer is sent from the COM. 1 port.

Figure 170: 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. 1 port using the **F159 (MTRN)** instruction.

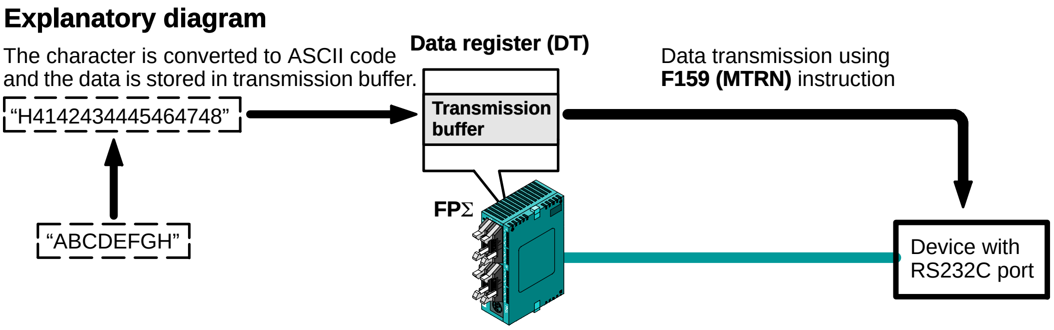

Explanatory diagram
The character is converted to ASCII code and the data is stored in transmission buffer.
Data register (DT)
Data transmission using F159 (MTRN) instruction
“H4142434445464748”
Transmission buffer
FPΣ
“ABCDEFGH”
Device with RS232C port

Figure 171: 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”.

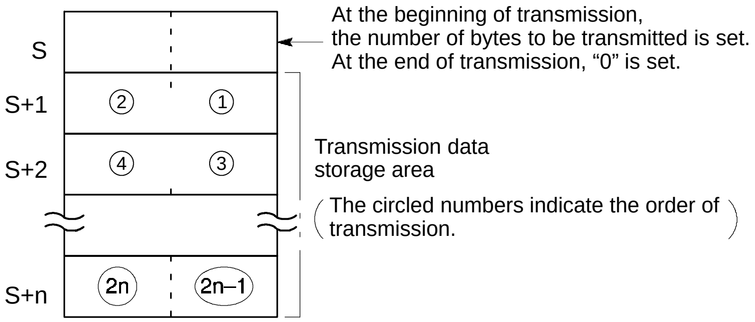

S
S+1
S+2
S+n
②
①
④
③
2n
2n–1
At the beginning of transmission, the number of bytes to be transmitted is set. At the end of transmission, “0” is set.
Transmission data storage area
The circled numbers indicate the order of transmission.

Figure 172: FPΣ Data table for transmission

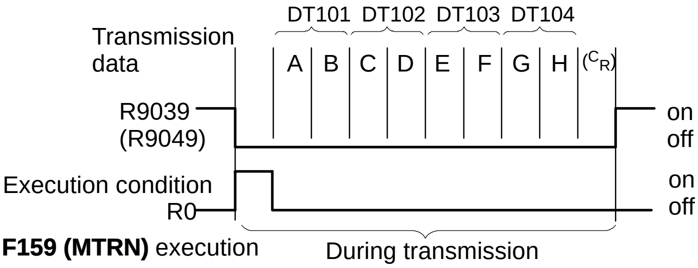
Use an **F0(MV)** or **F95(ASC)** instruction to write the data to be transmitted to the transmission data storage area specified in “S”.

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.



During this interval the **F159(MTRN)** instruction cannot be executed.

Figure 173: 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)

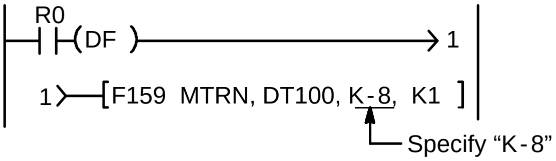


Figure 174: FPΣ Data transmission sample program

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-channel 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. 2 port contacts.

9.2.2 Receiving Data from External Device

Overview of data reception

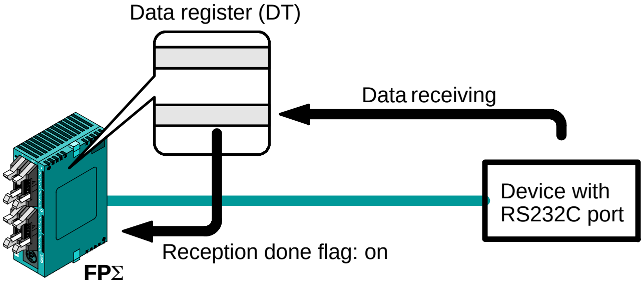
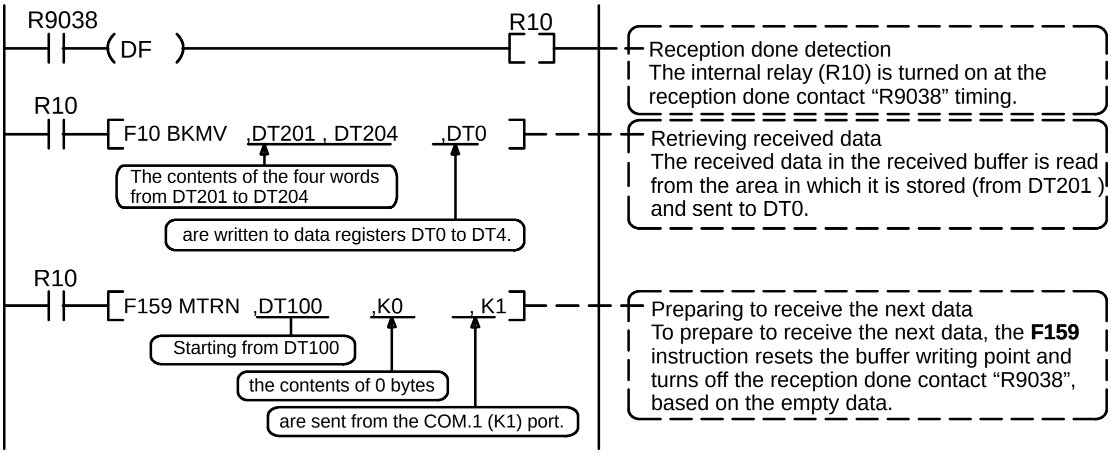


Figure 175: FPΣ Data reception

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.


R9038
DF
R10
R10
F10 BKMV ,DT201 , DT204 ,DT0
The contents of the four words from DT201 to DT204
are written to data registers DT0 to DT4.
R10
F159 MTRN ,DT100 ,K0 , K1
Starting from DT100
the contents of 0 bytes
are sent from the COM.1 (K1) port.

Reception done detection
The internal relay (R10) is turned on at the reception done contact “R9038” timing.

Retrieving received data
The received data in the received buffer is read from the area in which it is stored (from DT201) and sent to DT0.

Preparing to receive the next data
To prepare to receive the next data, the **F159** instruction resets the buffer writing point and turns off the reception done contact “R9038”, based on the empty data.

Figure 176: 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 contact “R9038 (R9048)” 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 contact “R9038 (R9048)”.
   The system is then ready to receive the next data.

Explanatory diagram

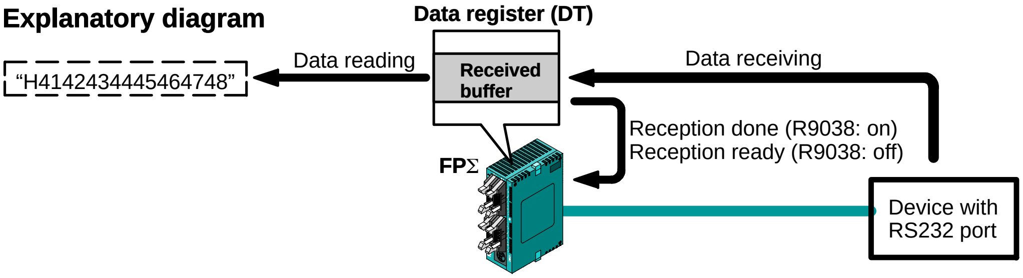


Figure 177: FPΣ Data reception explanatory diagram

Data table for reception (received buffer)

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

DT200	K8	
DT201	H42(B)	H41(A)
DT202	H44(D)	H43(C)
DT203	H46(F)	H45(E)
DT204	H48(H)	H47(G)

The received number of bytes is stored as data is stored.

Received data is stored in order from the lower-order byte.

Reception buffer when reception is completed.

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

- System register 416: K200
- System register 417: K5

Figure 178: 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.

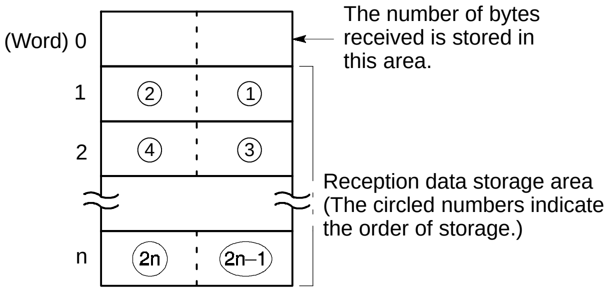

(Word) 0
1
2
n
②
①
④
③
2n
2n–1
The number of bytes received is stored in this area.
Reception data storage area (The circled numbers indicate the order of storage.)

Figure 179: 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.

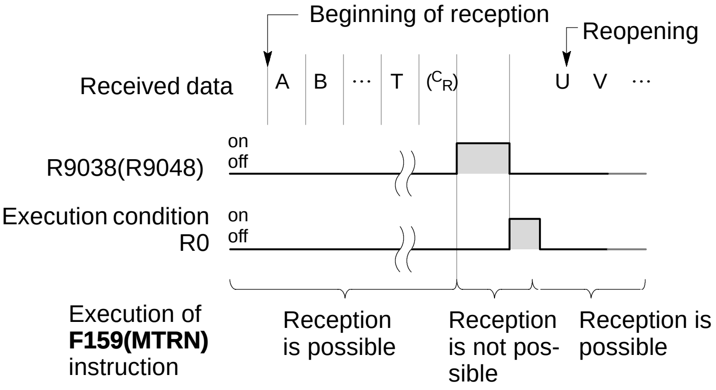


Figure 180: Explanation during reception

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

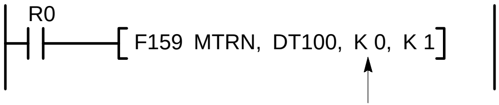
To perform repeated reception of data, refer to the following steps.

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)”.



To repeatedly perform only reception, specify K0.

R9038(R9048) also turns off when transmission is performed with a byte number specification.

* The contact numbers in parentheses indicate COM. 2 port contacts.

9.3 Connection Example with External Devices

This section explains about the connection example with external devices.

9.3.1 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.

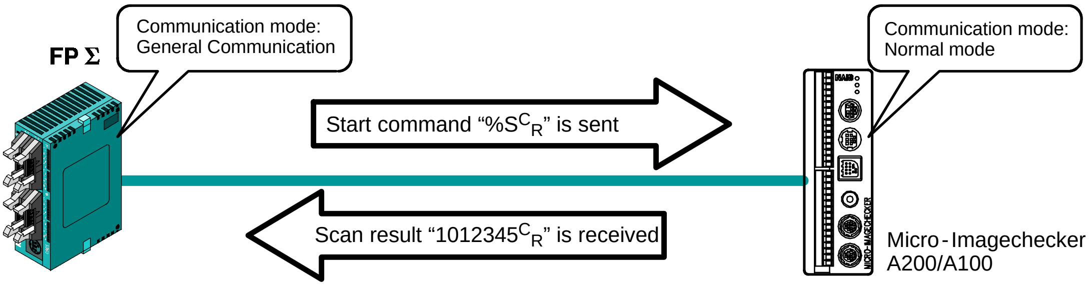

FP Σ
Communication mode: General Communication
Start command “%S$^{C}_{R}$” is sent
Scan result “1012345$^{C}_{R}$” is received
Communication mode: Normal mode
Micro-Imagechecker A200/A100

Figure 181: 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. 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	9600 bps
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	9600 bps
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” on the main menu, and set the following items.

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

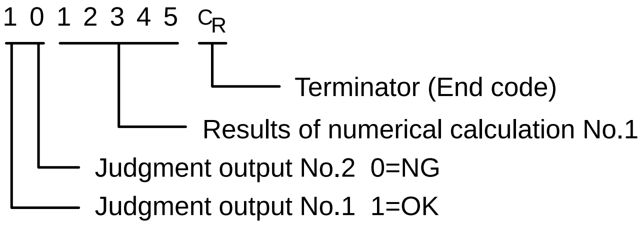
Serial communication setting for Micro-Imagechecker

To enter settings relating to serial communication for the Micro-Imagechecker, select “53: Serial Output” under “5: Communication” on “5: ENVIRONMENT” of the main menu, 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 1-channel RS232C type of communication cassette

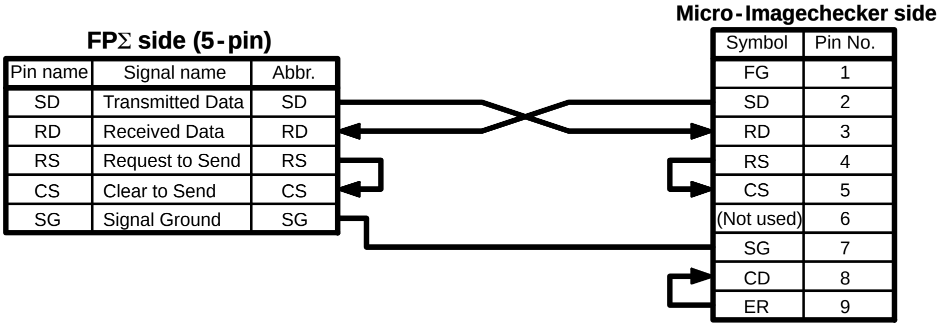


Figure 182: FPΣ Connection example with micro-imagechecker 1

- When using the 2-channel RS232C type of communication cassette

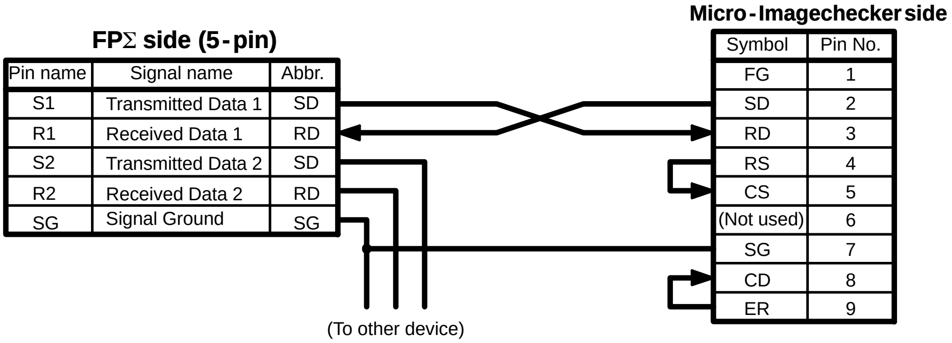


Figure 183: FPΣ Connection example with micro-imagechecker 2

Procedure of communication

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

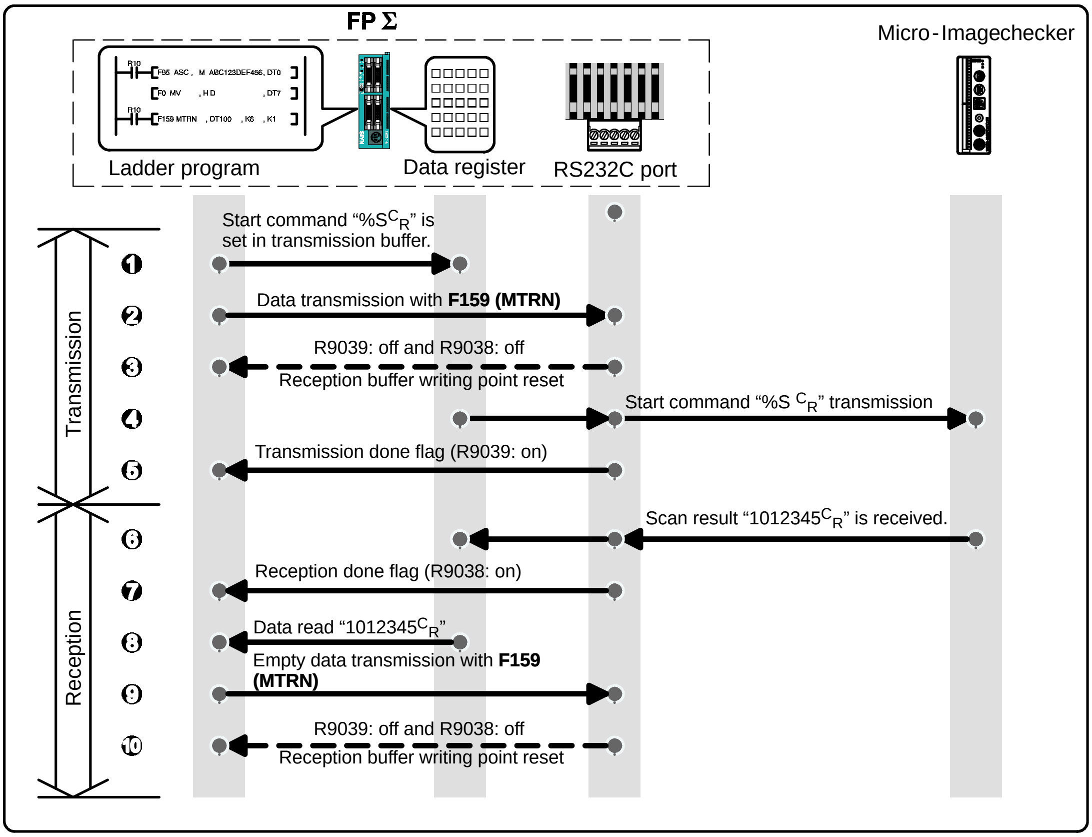
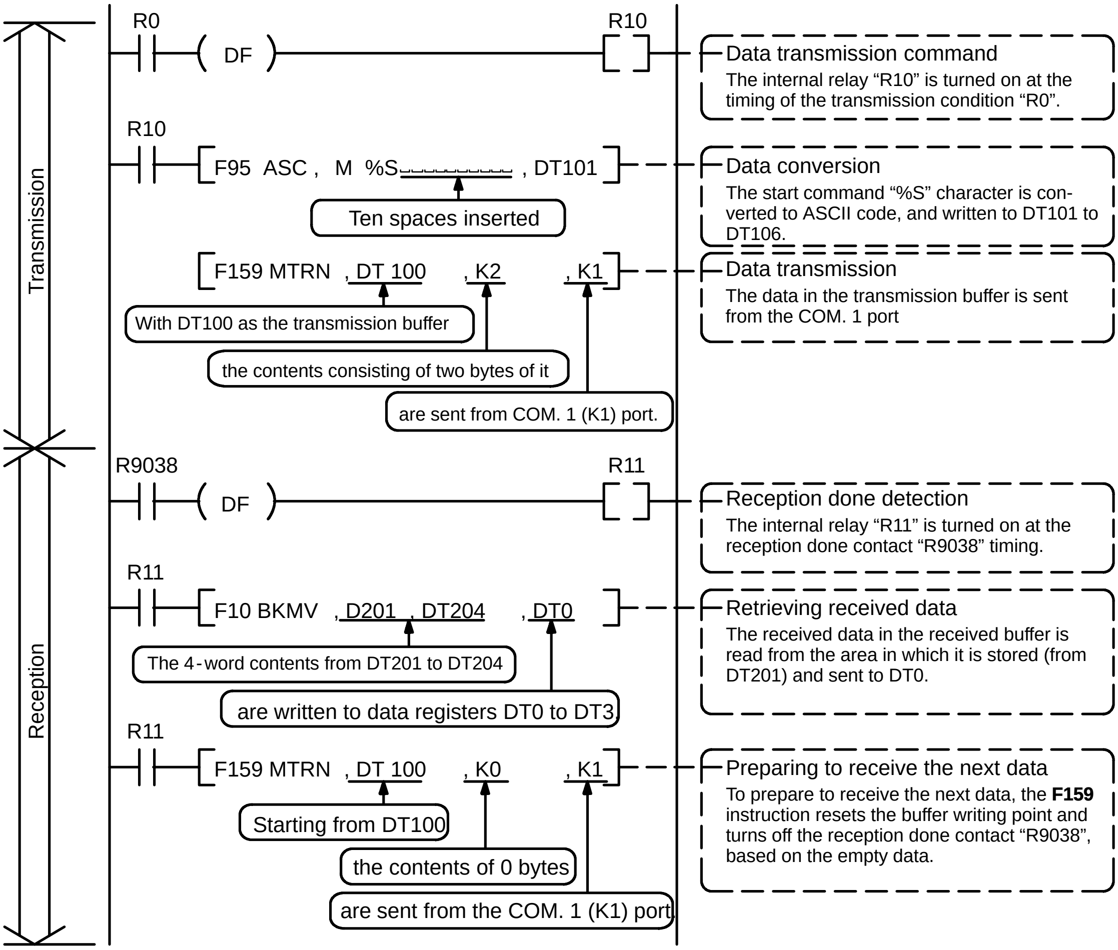

FP Σ
Micro-Imagechecker
R10
F95 ASC , M ABC123DEF456, DT0
F0 MV , H D , DT7
R10
F159 MTRN , DT100 , K8 , K1
Ladder program
Data register
RS232C port
Transmission
Reception
❶
Start command "%S^C$_R$" is set in transmission buffer.
❷
Data transmission with **F159 (MTRN)**
❸
R9039: off and R9038: off
Reception buffer writing point reset
❹
Start command "%S ^{C}$_R$" transmission
❺
Transmission done flag (R9039: on)
❻
Scan result "1012345^C$_R$" is received.
❼
Reception done flag (R9038: on)
❽
Data read "1012345^C$_R$"
❾
Empty data transmission with **F159 (MTRN)**
❿
R9039: off and R9038: off
Reception buffer writing point reset

Figure 184: FPΣ Procedure of communication (micro-imagechecker)

Sample program

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


Transmission
Reception
R0
DF
R10
R10
F95 ASC , M %S␣␣␣␣␣␣␣␣␣␣ , DT101
Ten spaces inserted
F159 MTRN , DT 100 , K2 , K1
With DT100 as the transmission buffer
the contents consisting of two bytes of it
are sent from COM. 1 (K1) port.
R9038
DF
R11
R11
F10 BKMV , D201 , DT204 , DT0
The 4-word contents from DT201 to DT204
are written to data registers DT0 to DT3
R11
F159 MTRN , DT 100 , K0 , K1
Starting from DT100
the contents of 0 bytes
are sent from the COM. 1 (K1) port

Data transmission command
The internal relay “R10” is turned on at the timing of the transmission condition “R0”.

Data conversion
The start command “%S” character is converted to ASCII code, and written to DT101 to DT106.

Data transmission
The data in the transmission buffer is sent from the COM. 1 port

Reception done detection
The internal relay “R11” is turned on at the reception done contact “R9038” timing.

Retrieving received data
The received data in the received buffer is read from the area in which it is stored (from DT201) and sent to DT0.

Preparing to receive the next data
To prepare to receive the next data, the **F159** instruction resets the buffer writing point and turns off the reception done contact “R9038”, based on the empty data.

Figure 185: 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.

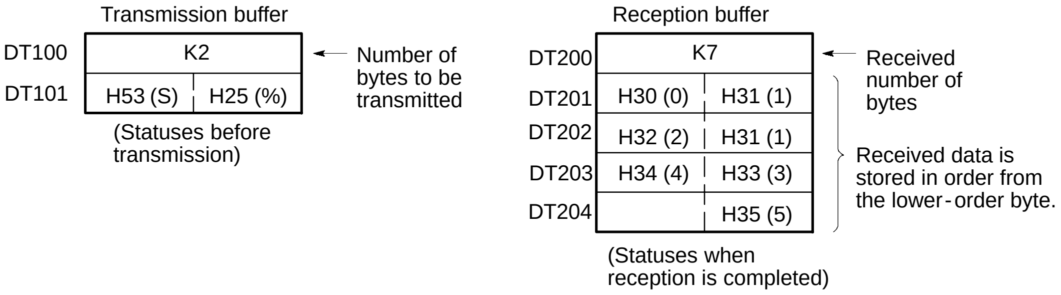


Figure 186: FPΣ Various buffer statuses

9.3.2 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.

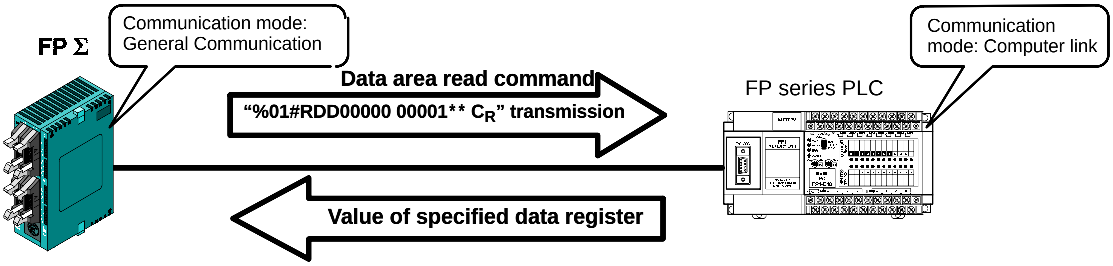

FP Σ
Communication mode: General Communication
Data area read command
"%01#RDD00000 00001** C_R" transmission
Value of specified data register
FP series PLC
Communication mode: Computer link

Figure 187: 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.

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	19200 bps
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	19200 bps
No. 418	Starting address for data received	DT200
No. 419	Buffer capacity setting for data received	100 byte

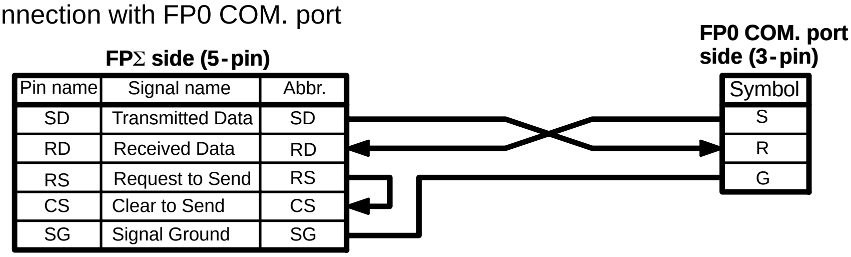
Communication format setting for FP series PLC (FP0, FP1)

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 bps

Connection example with FP series PLC (FP0, FP1)

- When using the 1-channel RS232C type of communication cassette

Connection with FP0 COM. port


FPΣ side (5-pin)
Pin name | Signal name | Abbr.
SD | Transmitted Data | SD
RD | Received Data | RD
RS | Request to Send | RS
CS | Clear to Send | CS
SG | Signal Ground | SG
FP0 COM. port side (3-pin)
Symbol
S
R
G

Connection with FP1 COM. port

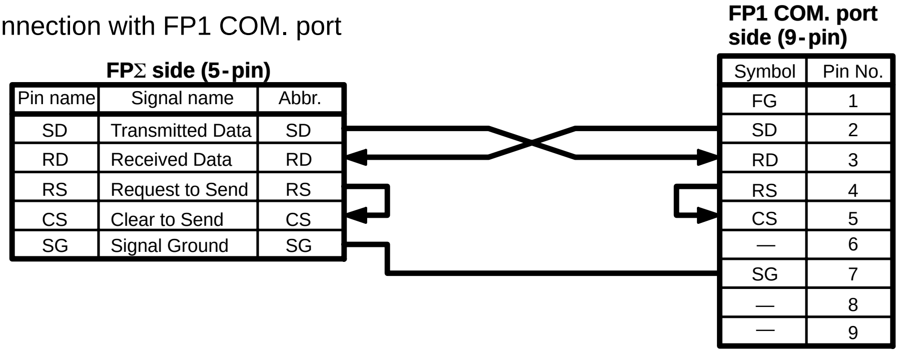
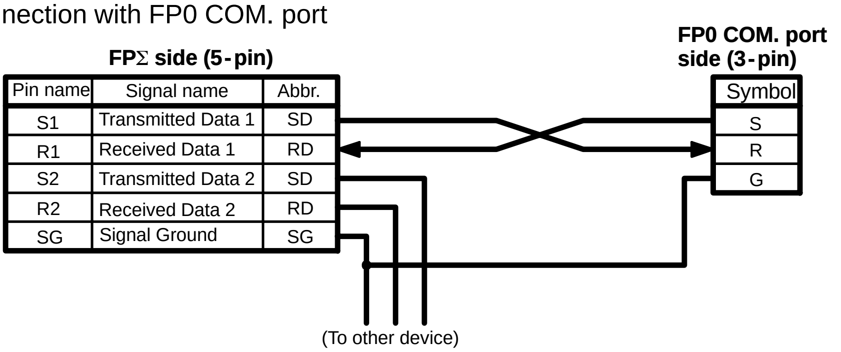


Figure 188: FPΣ Connection example with FP series PLC-1

- When using the 2-channel RS232C type of communication cassette

Connection with FP0 COM. port


FPΣ side (5-pin)
Pin name | Signal name | Abbr.
S1 | Transmitted Data 1 | SD
R1 | Received Data 1 | RD
S2 | Transmitted Data 2 | SD
R2 | Received Data 2 | RD
SG | Signal Ground | SG
FP0 COM. port side (3-pin)
Symbol
S
R
G
(To other device)

Connection with FP1 COM. port

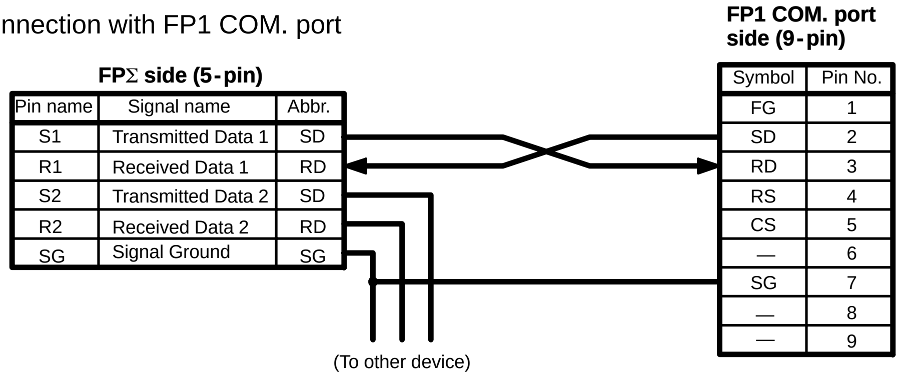

FPΣ side (5-pin)
Pin name | Signal name | Abbr.
S1 | Transmitted Data 1 | SD
R1 | Received Data 1 | RD
S2 | Transmitted Data 2 | SD
R2 | Received Data 2 | RD
SG | Signal Ground | SG
FP1 COM. port side (9-pin)
Symbol | Pin No.
FG | 1
SD | 2
RD | 3
RS | 4
CS | 5
— | 6
SG | 7
— | 8
— | 9
(To other device)

Figure 189: 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.

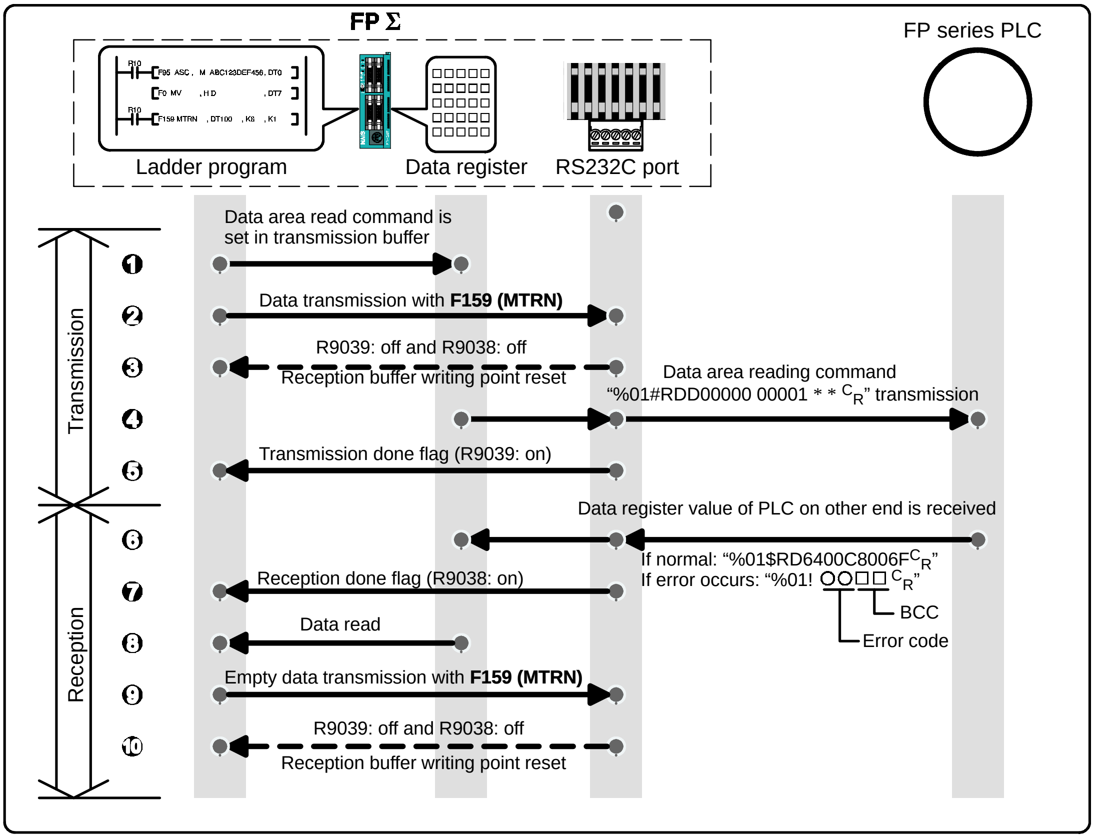

FP Σ
FP series PLC
R10 F95 ASC, M ABC123DEF456, DT0
F0 MV, H D, DT7
R10 F159 MTRN, DT100, K8, K1
Ladder program
Data register
RS232C port
Transmission
Reception
❶
❷
❸
❹
❺
❻
❼
❽
❾
❿
Data area read command is set in transmission buffer
Data transmission with F159 (MTRN)
R9039: off and R9038: off
Reception buffer writing point reset
Data area reading command
“%01#RDD00000 00001 * * CR” transmission
Transmission done flag (R9039: on)
Data register value of PLC on other end is received
If normal: “%01$RD6400C8006FCR”
If error occurs: “%01! ○○□□ CR”
BCC
Error code
Reception done flag (R9038: on)
Data read
Empty data transmission with F159 (MTRN)
R9039: off and R9038: off
Reception buffer writing point reset

Figure 190: 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.

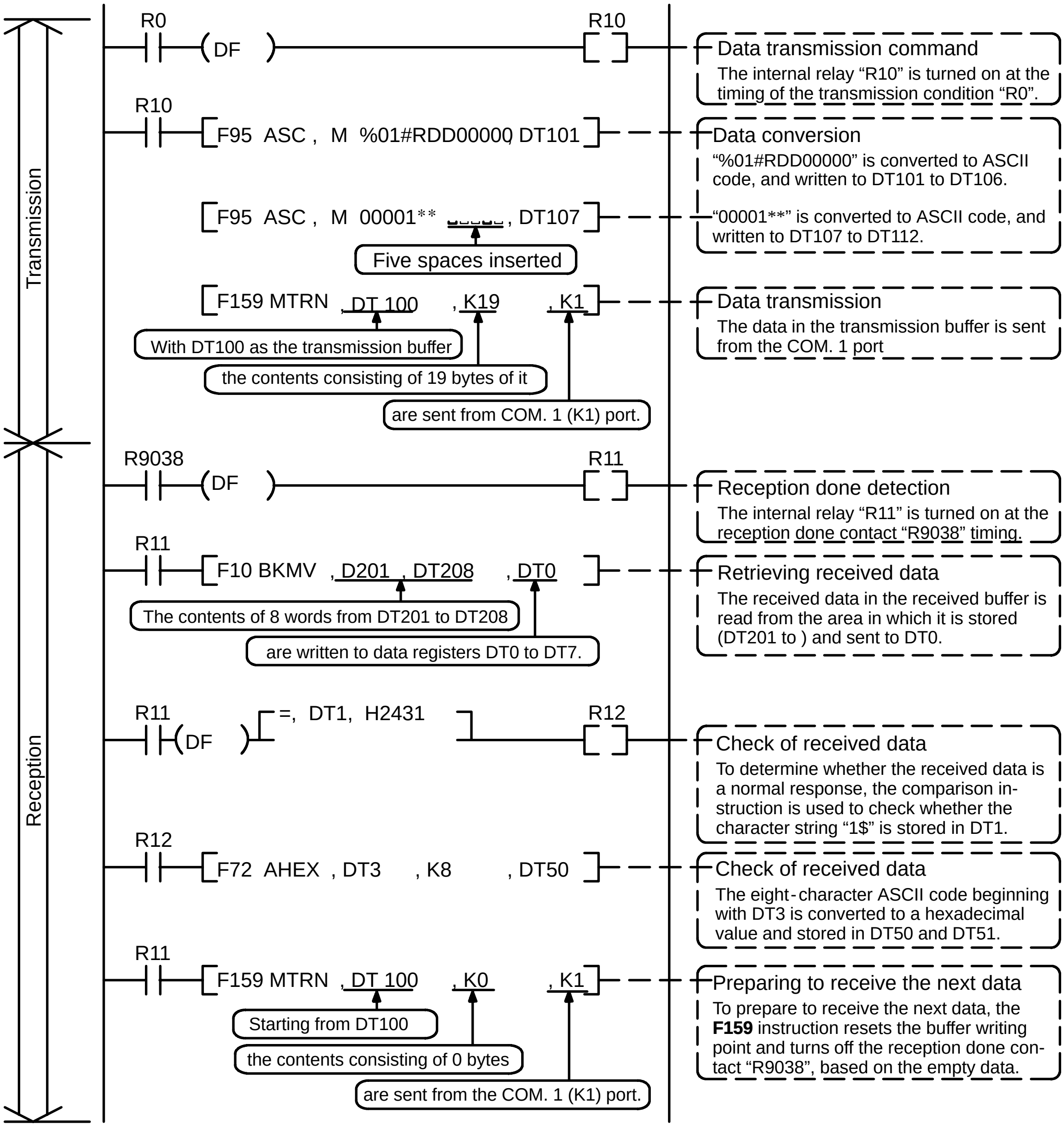
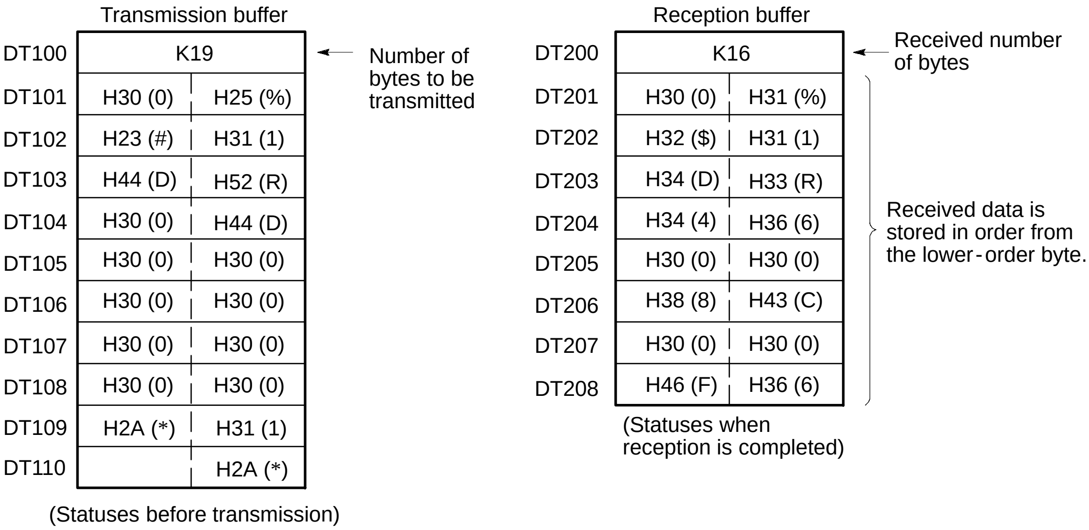

Transmission
R0
DF
R10
Data transmission command
The internal relay “R10” is turned on at the timing of the transmission condition “R0”.
R10
F95 ASC , M %01#RDD00000, DT101
Data conversion
“%01#RDD00000” is converted to ASCII code, and written to DT101 to DT106.
F95 ASC , M 00001** ␣␣␣␣␣ , DT107
“00001**” is converted to ASCII code, and written to DT107 to DT112.
Five spaces inserted
F159 MTRN , DT 100 , K19 , K1
Data transmission
The data in the transmission buffer is sent from the COM. 1 port
With DT100 as the transmission buffer
the contents consisting of 19 bytes of it
are sent from COM. 1 (K1) port.
Reception
R9038
DF
R11
Reception done detection
The internal relay “R11” is turned on at the reception done contact “R9038” timing.
R11
F10 BKMV , D201 , DT208 , DT0
Retrieving received data
The received data in the received buffer is read from the area in which it is stored (DT201 to) and sent to DT0.
The contents of 8 words from DT201 to DT208
are written to data registers DT0 to DT7.
R11
DF
=, DT1, H2431
R12
Check of received data
To determine whether the received data is a normal response, the comparison instruction is used to check whether the character string “1$” is stored in DT1.
R12
F72 AHEX , DT3 , K8 , DT50
Check of received data
The eight-character ASCII code beginning with DT3 is converted to a hexadecimal value and stored in DT50 and DT51.
R11
F159 MTRN , DT 100 , K0 , K1
Preparing to receive the next data
To prepare to receive the next data, the **F159** instruction resets the buffer writing point and turns off the reception done contact “R9038”, based on the empty data.
Starting from DT100
the contents consisting of 0 bytes
are sent from the COM. 1 (K1) port.

Figure 191: 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 (*)

Number of bytes to be transmitted

(Statuses 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)

Received number of bytes

Received data is stored in order from the lower-order byte.

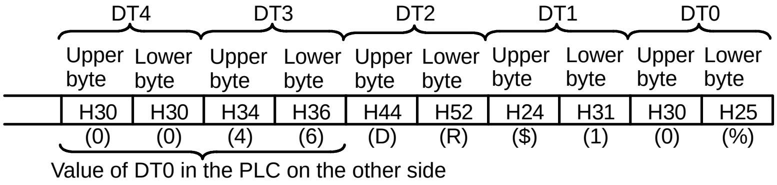
(Statuses when reception is completed)

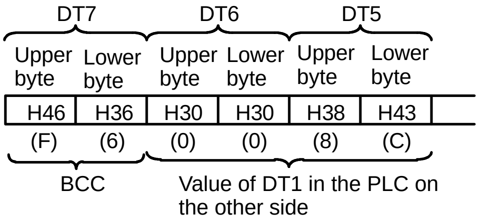
Figure 192: FPΣ Various buffer statuses

Tip

Contents of the response:

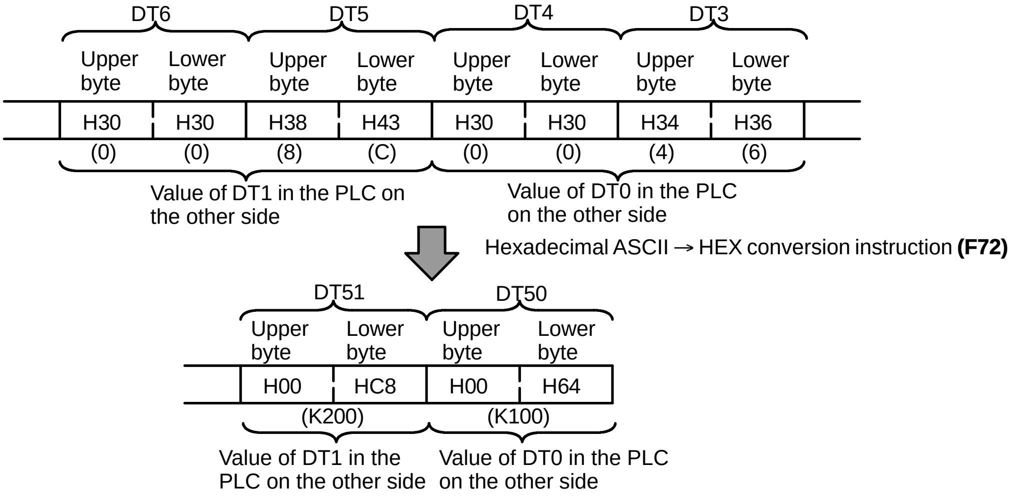
If K100 is stored in DT0 and K200 is stored in DT1 of the FP series PLC on the other side, “%01$RD6400C8006F$C_R$” is returned from the FP series PLC on the other side as the response when the program is executed. The received data is stored in the data registers as shown below.





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 → hexadecimal data conversion) instruction and stored in DT50 and DT51, only if the character string “$1” stored in DT1 detected as a comparison instruction.


DT6
DT5
DT4
DT3
Upper byte
Lower byte
Upper byte
Lower byte
Upper byte
Lower byte
Upper byte
Lower byte
H30
H30
H38
H43
H30
H30
H34
H36
(0)
(0)
(8)
(C)
(0)
(0)
(4)
(6)
Value of DT1 in the PLC on the other side
Value of DT0 in the PLC on the other side
Hexadecimal ASCII → HEX conversion instruction **(F72)**
DT51
DT50
Upper byte
Lower byte
Upper byte
Lower byte
H00
HC8
H00
H64
(K200)
(K100)
Value of DT1 in the PLC on the other side
Value of DT0 in the PLC on the other side

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

9.4 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.

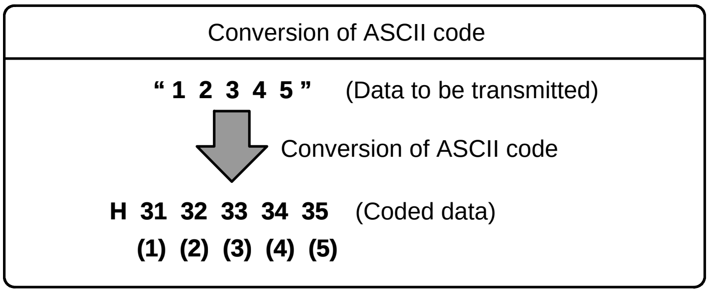

Conversion of ASCII code
“ 1 2 3 4 5 ” (Data to be transmitted)
Conversion of ASCII code
H 31 32 33 34 35 (Coded data)
(1) (2) (3) (4) (5)

Figure 193: 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.

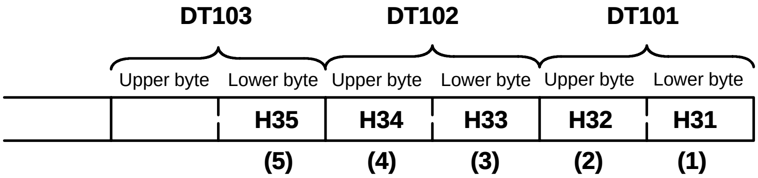


Figure 194: FPΣ Example (transmission buffer)

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.

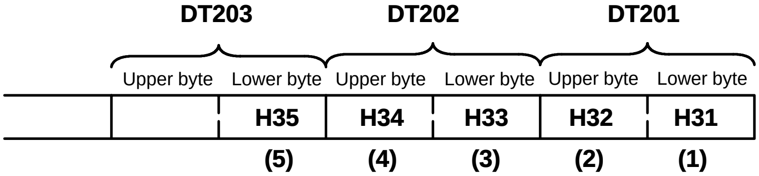


Figure 195: FPΣ Example (received buffer)

9.5 1:N Communication

This section explains about the 1:N communication of general-purpose serial communication.

9.5.1 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.

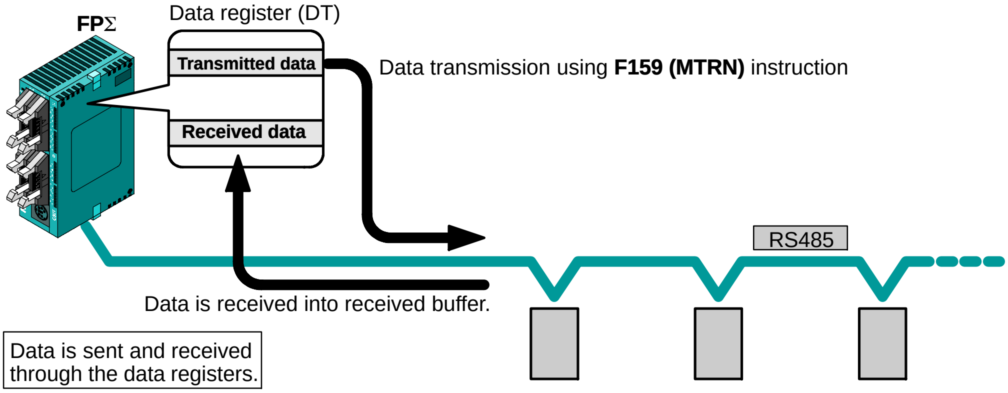

FPΣ
Data register (DT)
Transmitted data
Received data
Data transmission using F159 (MTRN) instruction
RS485
Data is received into received buffer.
Data is sent and received through the data registers.

Figure 196: FPΣ General-purpose serial communication (1:N communication)

9.5.2 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

9.5.3 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 bps
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 bps
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)

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

9.6 Flag Operations When Using Serial Communication

This section explains about the operation of “reception done flag” and “transmission done flag” when using serial communication.

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

When receiving data:

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

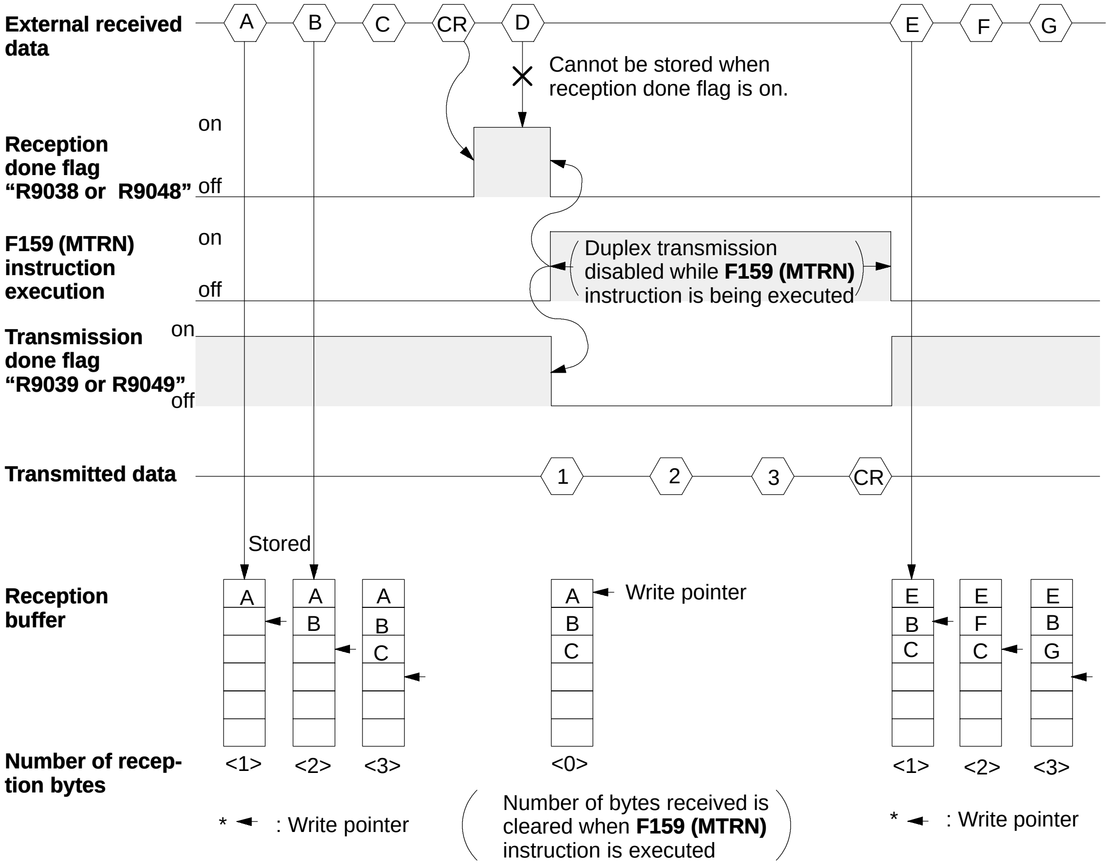

External received data
A
B
C
CR
D
E
F
G
Cannot be stored when reception done flag is on.
on
off
Reception done flag “R9038 or R9048”
F159 (MTRN) instruction execution
Duplex transmission disabled while F159 (MTRN) instruction is being executed
Transmission done flag “R9039 or R9049”
Transmitted data
1
2
3
CR
Stored
Reception buffer
Write pointer
Number of reception bytes
<1>
<2>
<3>
<0>
* : Write pointer
Number of bytes received is cleared when F159 (MTRN) instruction is executed

Figure 197: 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 or R9048” is on.

☛ next page

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 or R9047”, reception done flag “R9038 or R9048” and transmission done flag “R9039 or R9049” go off.

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

Reception stops if the error flag “R9037 or 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 or 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.

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

When receiving data:

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

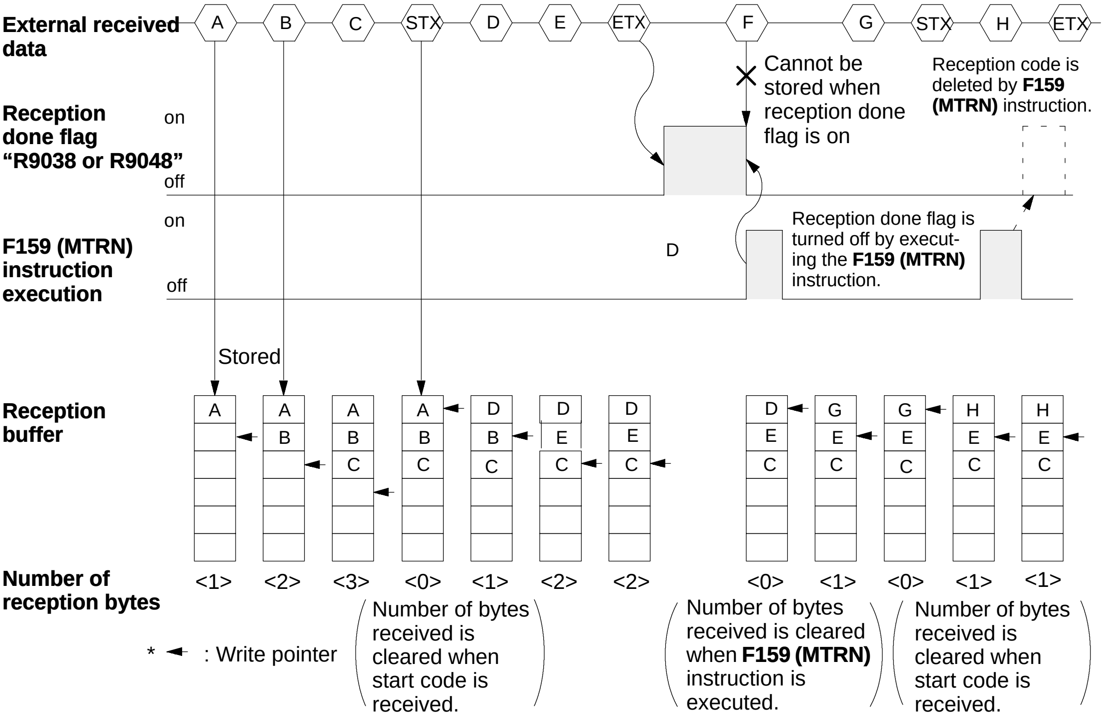

External received data
A
B
C
STX
D
E
ETX
F
G
STX
H
ETX
Cannot be stored when reception done flag is on
Reception code is deleted by F159 (MTRN) instruction.
Reception done flag “R9038 or R9048”
on
off
F159 (MTRN) instruction execution
on
off
D
Reception done flag is turned off by executing the F159 (MTRN) instruction.
Stored
Reception buffer
Number of reception bytes
<1> <2> <3> <0> <1> <2> <2> <0> <1> <0> <1> <1>
Number of bytes received is cleared when start code is received.
Number of bytes received is cleared when F159 (MTRN) instruction is executed.
Number of bytes received is cleared when start code is received.
* : Write pointer

Figure 198: 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 or 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 or 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:

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

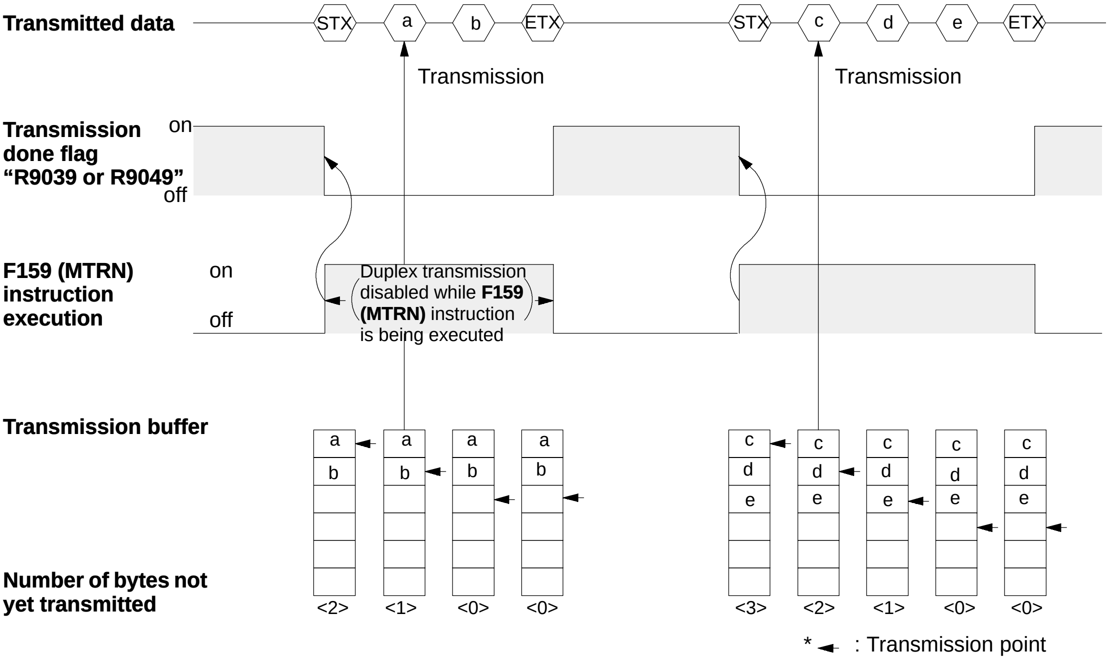

Transmitted data
STX
a
b
ETX
STX
c
d
e
ETX
Transmission
Transmission
Transmission done flag “R9039 or R9049”
on
off
F159 (MTRN) instruction execution
on
off
Duplex transmission disabled while F159 (MTRN) instruction is being executed
Transmission buffer
Number of bytes not yet transmitted
<2>
<1>
<0>
<0>
<3>
<2>
<1>
<0>
<0>
* : Transmission point

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

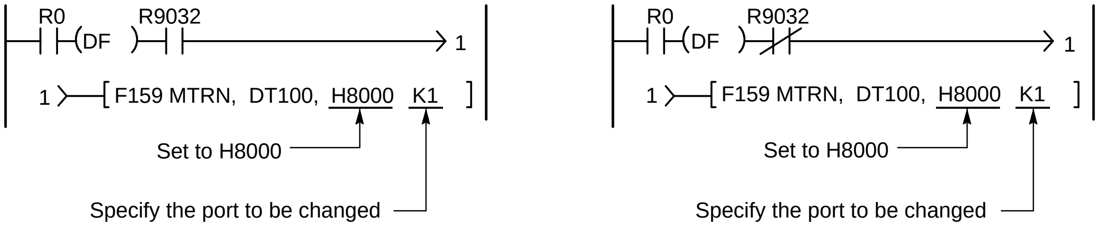
Start code (STX) and end code (ETX) are automatically added to the data being transmitted, and the data is transmitted to an external device.

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

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

9.7 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.


Changing from “general port” to “computer link”

Changing from “computer link” to “general port”

Figure 200: 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 10

Communication Function 3
PLC Link Function

10.1 PLC Link

This section explains about the overview of PLC link function.

10.1.1 Overview of Function

What is the PLC Link?

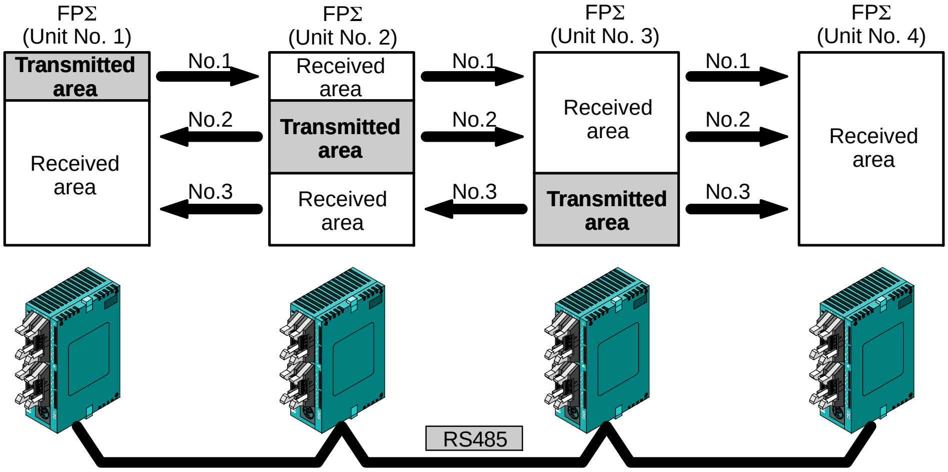
The PLC link is an economic way of linking two PLCs, using a twisted-pair cable.

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.

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 10 - 5, “Communication Parameter Settings”.



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 201: FPΣ PLC link function (overview)

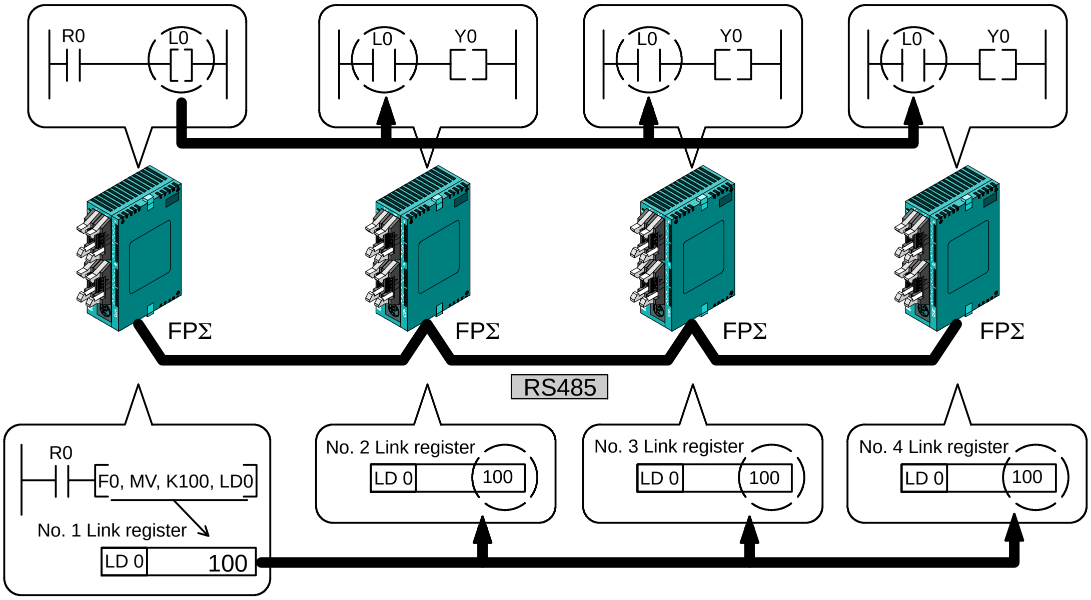
Overview of PLC link operation

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 202: FPΣ Overview of PLC link operation

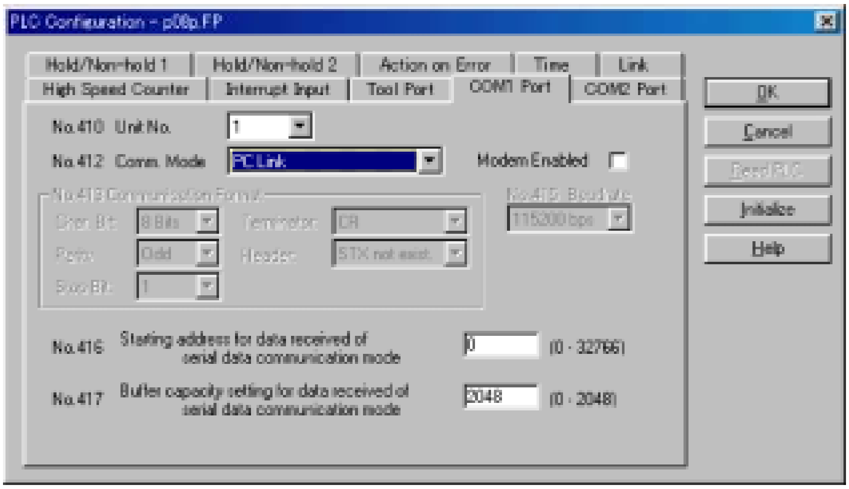
10.2 Communication Parameter Settings

This section explains about communication parameter settings when using PLC link function.

10.2.1 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. 1 Port” tab.

PLC Configuration setting dialog box



No.410 Unit No. 1

No.412 Comm. Mode PC Link

Modem Enabled ☐

No.413 Communication Format

Char. Bit: 8 Bits

Terminator: CR

Parity: Odd

Header: STX not exist

Stop Bit: 1

No.415 Baud rate 115200 bps

No.416 Starting address for data received of serial data communication mode 0 (0 - 32766)

No.417 Buffer capacity setting for data received of serial data communication mode 2048 (0 - 2048)

Figure 203: FPWIN GR - PLC Configuration setting dialog box

No. 412 Communication Mode (Comm. Mode)

Select the communication mode of COM. port.
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

10.2.2 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.

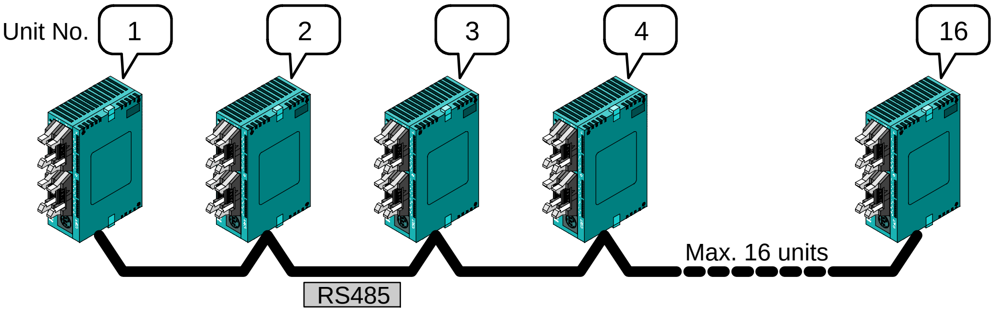


Figure 204: FPΣ Unit No. for PLC link

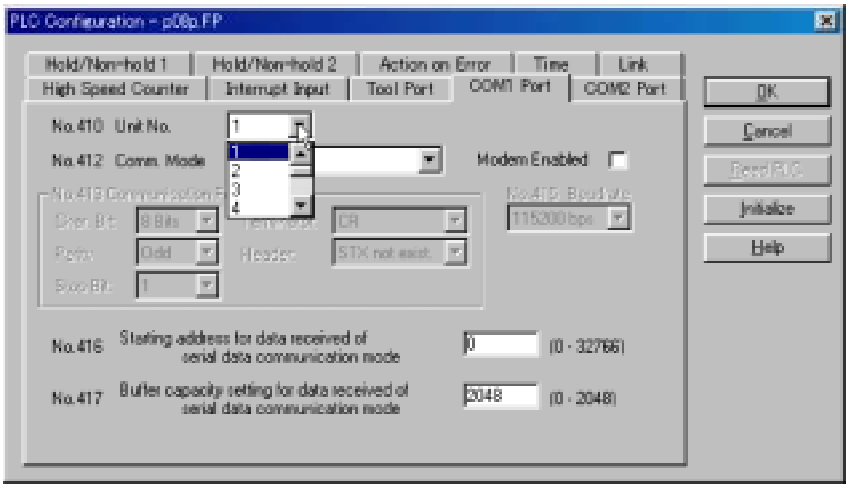
The unit number is a number assigned to a given PLC in order to identify that particular PLC. Unit numbers should be specified in such a way that the same number is not used for more than one PLC on the same network.

Setting method

The unit number is specified using the system registers settings in the FPWIN GR programming tool, and the unit No. setting switch on the side of the FPΣ control unit. Setting the unit No. 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. 1 Port” tab.

PLC Configuration setting dialog box



No.410 Unit No. 1

No.412 Comm. Mode

Modem Enabled ☐

No.413 Communication F

Char. Bit: 8 Bits

Parity: Odd

Stop Bit: 1

Terminator: CR

Header: STX not exist

No.415 Baudrate 115200 bps

No.416 Starting address for data received of serial data communication mode 0 (0 - 32766)

No.417 Buffer capacity setting for data received of serial data communication mode 2048 (0 - 2048)

Figure 205: FPWIN GR - PLC Configuration setting dialog box

No. 410 Unit No. setting (for COM.1 port)

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

Unit number setting using unit No. setting switch

The unit No. 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 16.

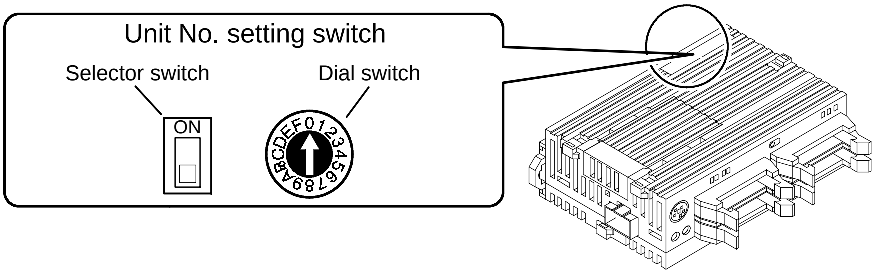


Figure 206: FPΣ Unit No. setting switch

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 No. setting switch is from 1 to 16.
- Setting the unit No. setting switch to “0” makes the system register settings valid.

Notes

- **To make the unit number setting in the FPWIN GR valid, set the unit No. setting switch to “0”.**
  If the station number setting switch has been set to 0, the system register settings and SYS1 instruction setting become valid.
- **When using the PLC link function, set the range of unit numbers as 1 to 16.**
- **Station numbers should be set sequentially and consecutively, starting from 1, with no breaks between them. If there is a missing station number, the transmission time will be that much longer.**
- **If fewer than 16 units are linked, the transmission time can be shortened by setting the largest station number in system register no. 47.**
- **Station numbers can also be set using the SYS1 instruction.**
- **The priority order for station number settings is the station number setting switch > system registers > SYS1 instruction.**

10.2.3 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

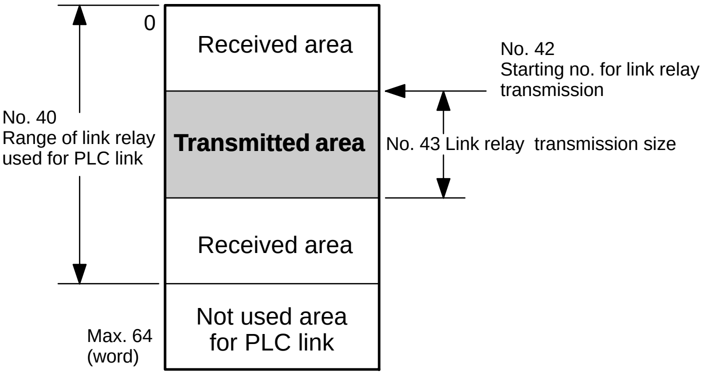

0
Received area
No. 42
Starting no. for link relay transmission
No. 40
Range of link relay used for PLC link
Transmitted area
No. 43 Link relay transmission size
Received area
Max. 64 (word)
Not used area for PLC link

Figure 207: FPΣ Link relay allocation

Link register

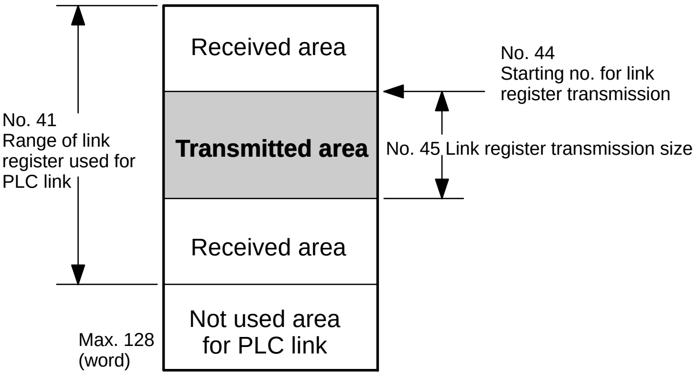

Received area
No. 44
Starting no. for link register transmission
No. 41
Range of link register used for PLC link
Transmitted area
No. 45 Link register transmission size
Received area
Max. 128 (word)
Not used area for PLC link

Figure 208: 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

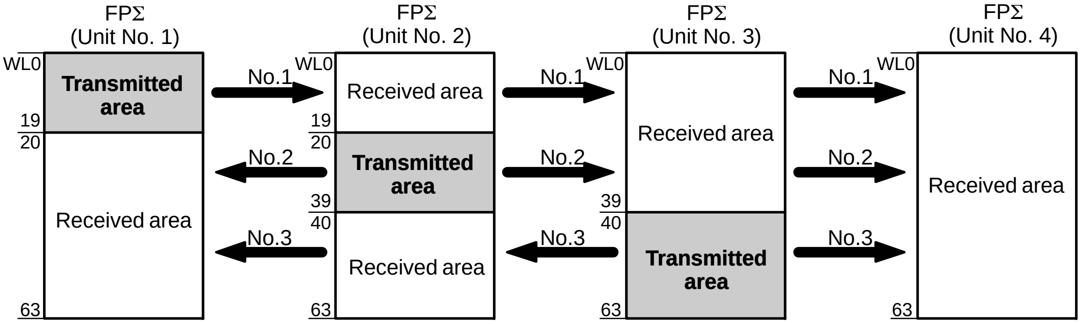


Figure 209: Example of link area allocation

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

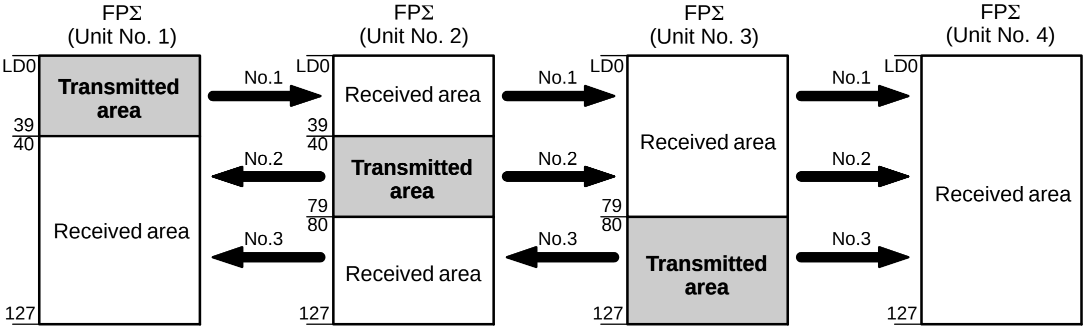


Figure 210: Example of link register allocation

System register

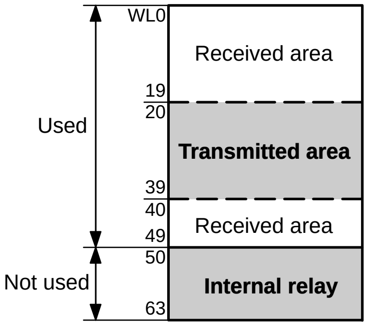
No.	Name	Set value of various control unit			
		No. 1	**No. 2**	**No. 3**	**No. 4**
No. 41	Range of link register used for PLC link	128	128	128	128
No. 44	Starting no. for link register transmission	0	40	80	0
No. 45	Link register transmission size	40	40	48	0

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

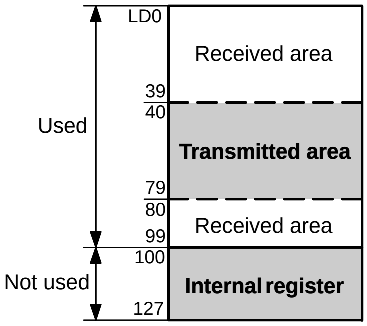


No.	Name	No. 1
No. 40	Range of link relay used for PLC link	50
No. 42	Starting no. for link relay transmission	20
No. 43	Link relay transmission size	20

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

Figure 211: 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 212: 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

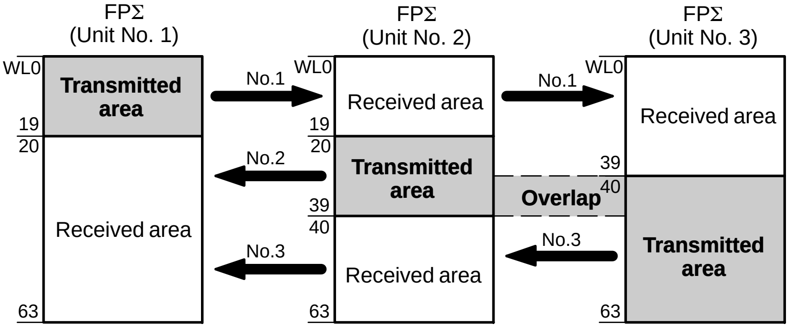


Figure 213: Precautions when allocating link relay area

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

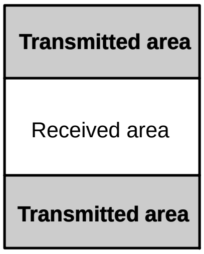


Figure 214: Unallowable allocation example 1

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

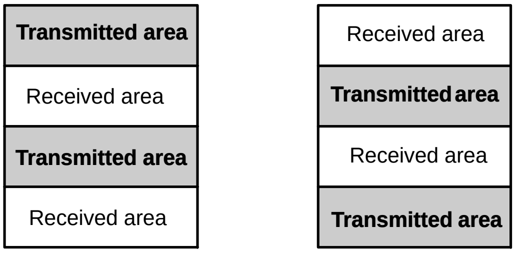


Figure 215: Unallowable allocation example 2

10.2.4 Setting the Largest Station Number for a PLC Link

The largest station number can be set using system register no. 47.

Sample settings

No. of units linked	Setting contents
When linked with 2 units	1st unit: station no. 1 is set 2nd unit: station no. 2 is set A largest station no. of 2 is set for each.
When linked with 4 units	1st unit: station no. 1 is set 2nd unit: station no. 2 is set 3rd unit: station no. 3 is set 4th unit: station no. 4 is set A largest station no. of 4 is set for each.
When linked with n units	Nth unit: station no. n is set A largest station no. of N is set for each.

Notes

- **Station numbers should be set sequentially and consecutively, starting from 1, with no breaks between them. If there is a missing station number, the transmission time will be that much longer.**
- **If fewer than 16 units are linked, the transmission time can be shortened by setting the largest station number in system register no. 47.**
- **The same value should be set for the largest station numbers of all of the PLCs that are linked.**
- **If there are fewer than 16 units linked and the largest station number has not been set (default = 16), or the largest station number has been set but the station number settings are not consecutive, or the station number settings are consecutive but there is a station for which the power supply has not been turned on, the response time for the PLC Link (the link transmission cycle) will be longer. For further information, please refer to page 10 - 22, “PLC Link Response Time”.**

10.3 Monitoring When a PLC Link is Being Used

10.3.1 Monitoring Using Relays

When using a PLC link, the operation status of the links can be monitored using the following relays.

Transmission assurance relay R9060 to R906F (correspond to station No.1 to 16)

If the transmission data from a different station is being used with the various PLCs, check to make sure the transmission assurance relay for the target station is on before using the data.

Relay No.	R9060	R9061	R9062	R9063	R9064	R9065	R9066	R9067	R9068	R9069	R906A	R906B	R906C	R906D	R906E	R906F
Station No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Conditions for on/off	ON: When the PLC link is normal OFF: If transmission is stopped, a problem has occurred, or a PLC link is not being used															

Operation mode relay R9070 to R907F (correspond to station No.1 to 16)

The PLC operation modes (RUN/PROG.) of other stations can be ascertained for any given PLC.

Relay No.	R9070	R9071	R9072	R9073	R9074	R9075	R9076	R9077	R9078	R9079	R907A	R907B	R907C	R907D	R907E	R907F
Station No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Conditions for on/off	ON: When the unit is in the RUN mode OFF: When the unit is in the PROG. mode															

PLC link transmission error relay R9050

This goes on if a problem is detected during transmission.

Relay No.	R9050															
Station No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Conditions for on/off	ON: When a transmission error has occurred in the PLC link, or when there is an error in the setting for the PLC link area OFF: When there are no transmission errors															

Tip

Monitoring the PLC link status

The PLC link status items, such as the transmission cycle time and the number of times that errors have occurred, can be monitored by pressing down the PLC link switch on the FPWIN GR Status Monitor screen.

Note

It is not possible to carry out remote programming of other linked PLCs using the programming tool.

10.4 Connection Example of PLC Link

This section explains about the connection example of PLC link.

10.4.1 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, Y0 of the control unit of unit No. 2 goes on. When X2 of the control unit of unit No. 1 goes on, Y0 of the control unit of unit No. 3 goes on.

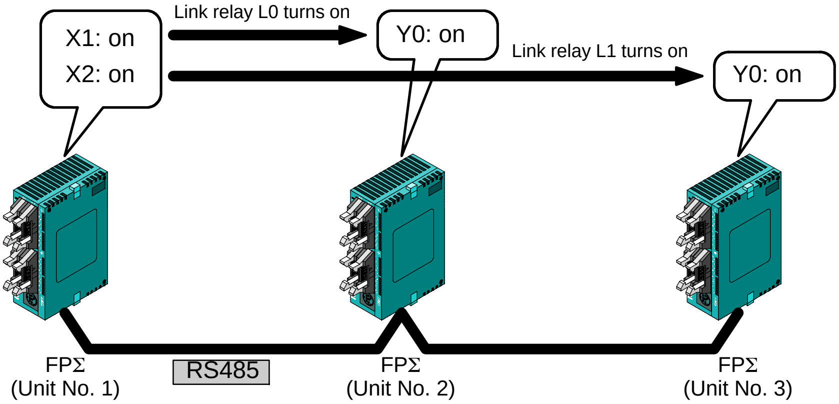


Figure 216: FPΣ Connection when using a PLC link with three FPΣ units

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 No. using the system registers.

Setting of unit No. and communication mode

Setting of FPΣ “unit No. 1”

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

Setting of FPΣ “unit No. 2”

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

Setting of FPΣ “unit No. 3”

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

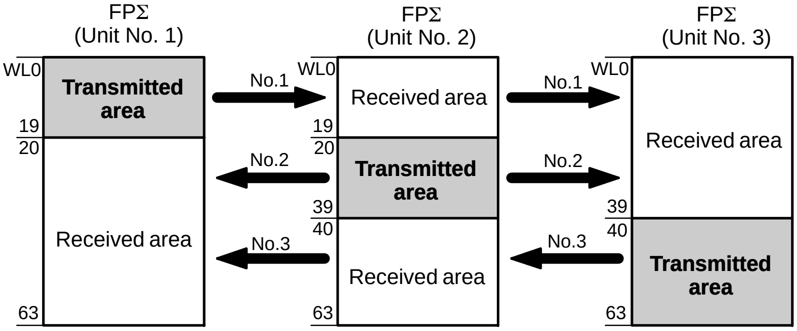


Figure 217: FPΣ Link relay allocation when using a PLC link with three FPΣ units

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

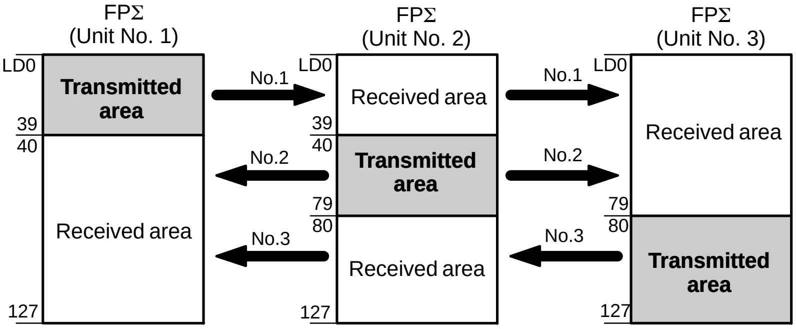


Figure 218: FPΣ Link register allocation when using a PLC link with three FPΣ units

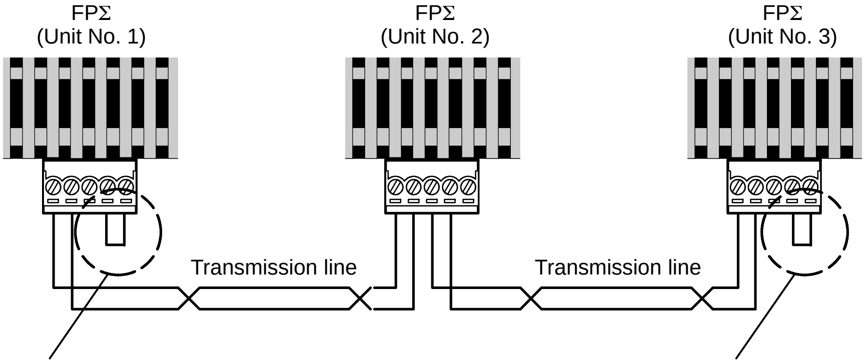
System register

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

Setting the largest station number

No.	**Name**	**Set value of various control unit**		
		No. 1	**No. 2**	**No. 3**
No. 47	Largest station number setting for PLC link	3	3	3

Connection diagram



The final unit (terminal station) should be shorted between the transmission line (–) and the E terminal.

The final unit (terminal station) should be shorted between the transmission line (–) and the E terminal.

Figure 219: FPΣ Connection diagram when using a PLC link with three FPΣ units

10.4.2 Sample Programs

Program of “unit No. 1” FPΣ contorl 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.

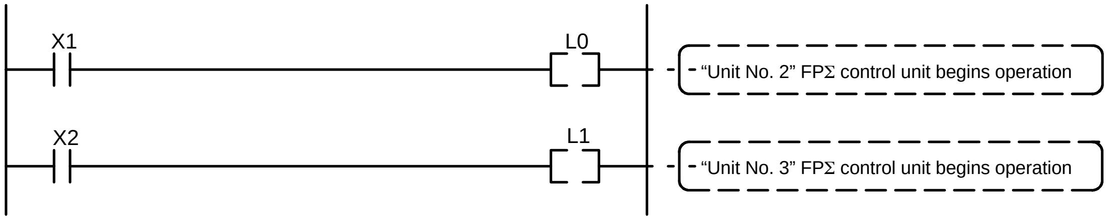

X1
L0
“Unit No. 2” FPΣ control unit begins operation
X2
L1
“Unit No. 3” FPΣ control unit begins operation

Figure 220: Sample program - unit No. 1

Program of “unit No. 2” FPΣ contorl unit

When the L0 of the link relay goes on, Y0 is output.

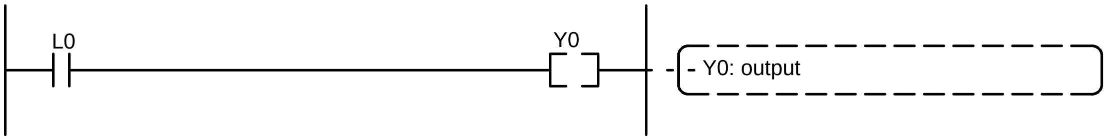


Figure 221: Sample program - unit No. 2

Program of “unit No. 3” FPΣ contorl unit

When the L1 of the link relay goes on, Y0 is output.

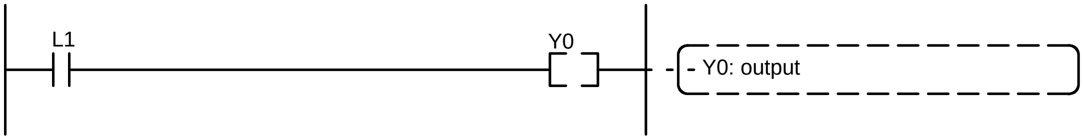


Figure 222: Sample program - unit No. 3

10.5 PLC Link Response Time

10.5.1 PLC Link Response Time

The maximum value for the transmission time (T) of one cycle can be calculated using the following formula.

$$\text{T max.} = \underbrace{\text{Ts1} + \text{Ts2} + - - - - + \text{Tsn}}_{\text{① Ts (transmission time per station)}} + \underline{\text{Tlt}} + \underline{\text{Tso}} + \underline{\text{Tlk}}$$

④ Tlk (link addition processing time)
③ Tso (master station scan time)
② Tlt (link table sending time)

The various items in the formula are calculated as described below.

① Ts (transmission time per station)

Ts = scan time + Tpc (PLC link sending time)
Tpc = Ttx (sending time per byte) x Pcm (PLC link sending size)
Ttx = 1 / transmission speed x 1000 x 11 ms - - - approx. 0.096 ms at 115.2 kbps
Pcm = 23 + (number of relay words + number of register words) x 4

② Tlt (link table sending time)

Tlt = Ttx (sending time per byte) x Ltm (link table sending size)
Ttx = 1 / transmission speed x 1000 x 11 ms - - - approx. 0.096 ms at 115.2 kbps
Ltm = 13 + 2 x n (n = number of stations being added)

③ Tso (master station scan time)

This should be confirmed using the programming tool.

④ Tlk (link addition processing time) - - - If no stations are being added, Tlk = 0.

Tlk = Tlc (link addition command sending time) + Twt (addition waiting time) + Tls (sending time for command to stop transmission if link error occurs) + Tso (master station scan time)
Tlc = 10 x Ttx (sending time per byte)
Ttx = 1 / transmission speed x 1000 x 11 ms - - - approx. 0.096 ms at 115.2 kbps
Twt = Initial value 400 ms (can be changed using SYS2 system register instruction)
Tls = 7 x Ttx (sending time per byte)
Ttx = 1 / transmission speed x 1000 x 11 ms - - - approx. 0.096 ms at 115.2 kbps
Tso = Master station scan time

Calculation example 1

When there are no stations that have not been added to a 16-unit link, the largest station number is 16, relays and registers have been evenly allocated, and the scan time for each PLC is 1 ms

Ttx = 0.096   Each Pcm = 23 + (4 + 8) x 4 = 71   Tpc = Ttx x Pcm = 0.096 x 71 ≒ 6.82 ms
Each Ts = 1 + 6.82 = 7.82 ms   Tlt = 0.096 x (13 + 2 x 16) = 4.32 ms
Given the above conditions, the maximum value for the transmission time (T) of one cycle will be:
T max. = 7.82 x 16 + 4.32 + 1 = 130.44 ms

Calculation example 2

When there are no stations that have not been added to a 16-unit link, the largest station number is 16, relays and registers have been evenly allocated, and the scan time for each PLC is 5 ms

Ttx = 0.096 Each Pcm = 23 + (4 + 8) x 4 = 71 Tpc = Ttx x Pcm = 0.096 x 71 ≒ 6.82 ms

Each Ts = 5 + 6.82 = 11.82 ms Tlt = 0.096 x (13 + 2 x 16) = 4.32 ms

Given the above conditions, the maximum value for the transmission time (T) of one cycle will be:

T max. = 11.82 x 16 + 4.32 + 5 = 198.44 ms

Calculation example 3

When there is one station that has not been added to a 16-unit link, the largest station number is 16, relays and registers have been allocated evenly, and the scan time for each PLC is 5 ms

Ttx = 0.096 Each Ts = 5 + 6.82 = 11.82 ms Tlt = 0.096 x (13 + 2 x 15) ≒ 4.31 ms

Tlk = 0.96 + 400 + 0.67 + 5 ≒ 407 ms

Note: The default value for the addition waiting time is 400 ms.

Given the above conditions, the maximum value for the transmission time (T) of one cycle will be:

T max. = 11.82 x 15 + 4.13 + 5 + 407 = 593.43 ms

Calculation example 4

When there are no stations that have not been added to an 8-unit link, the largest station number is 9, relays and registers have been evenly allocated, and the scan time for each PLC is 5 ms

Ttx = 0.096 Each Pcm = 23 + (8 + 16) x 4 = 119 Tpc = Ttx x Pcm = 0.096 x 119 ≒ 11.43 ms

Each Ts = 5 + 11.43 = 16.43 ms Tlt = 0.096 x (13 + 2 x 8) ≒ 2.79 ms

Given the above conditions, the maximum value for the transmission time (T) of one cycle will be:

T max. = 16.43 x 8 + 2.79 + 5 = 139.23 ms

Calculation example 5

When there are no stations that have not been added to a 2-unit link, the largest station number is 2, relays and registers have been evenly allocated, and the scan time for each PLC is 5 ms

Ttx = 0.096 Each Pcm = 23 + (32 + 64) x 4 = 407 Tpc = Ttx x Pcm = 0.096 x 407 ≒ 39.072 ms

Each Ts = 5 + 39.072 = 44.072 ms Tlt = 0.096 x (13 + 2 x 2) ≒ 1.632 ms

Given the above conditions, the maximum value for the transmission time (T) of one cycle will be:

T max. = 44.072 x 2 + 1.632 + 5 = 94.776 ms

Calculation example 6

When there are no stations that have not been added to a 2-unit link, the largest station number is 2, 32 relays and register 2 words have been evenly allocated, and the scan time for each PLC is 1 ms

Ttx = 0.096 Each Pcm = 23 + (1 + 1) x 4 = 31 Tpc = Ttx x Pcm = 0.096 x 31 ≒ 2.976 ms

Each Ts = 1 + 2.976 = 3.976 ms Tlt = 0.096 x (13 + 2 x 2) ≒ 1.632 ms

Given the above conditions, the maximum value for the transmission time (T) of one cycle will be:

T max. = 3.976 x 2 + 1.632 + 1 = 10.584 ms

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Notes

- **In the description, “stations that have not been added” refers to stations that are not connected between the No. 1 station and the largest station number, or stations that are connected but for which the power supply has not been turned on.**
- **When calculation examples 2 and 3 are compared, the transmission cycle time is longer if there is one station that has not been added to the link, and as a result the PLC link response time is longer.**
- **The SYS1 instruction can be used to minimize the transmission cycle time even if there is a station or stations that have not been added to the link.**

10.5.2 Shortening the Transmission Cycle Time When There are Stations That Have not been Added to the Link

If there are stations that have not been added to the link, the Tlk time (link addition processing time) will be longer, which causes the transmission cycle time to be longer.

T max. = Ts1 + Ts2 + - - - - + Tsn + Tlt + Tso + Tlk

Tlk = Tlc (link addition command sending time) + Twt (addition waiting time) + Tls (link error stop command sending time) + Tso (master station scan time)

If the SYS1 instruction is used to shorten Twt in the above formula, the increase in the transmission cycle time can be minimized.

Example of setting the SYS1 instruction

SYS1 MPCLK1T0, 100

Function description: Changes the waiting time for a link to be added to the PLC link (default value = 400 ms)

In the above, the waiting time is set to 100 ms.

Key words: Setting for the No. 1 key word: PCLK1T0

Allowable setting range for the No. 2 key word: 10 to 400 (10 ms to 400 ms)

Notes

Precautions concerning settings:

- **The above instruction should be set so that it is executed at the beginning of the program, at the rise of R9014, and the same value should be set for all of the PLCs being linked.**
- **Executing the above instruction does not change any of the system registers.**
- **The SYS1 instruction should be set to a value at least twice that of the maximum scan time for any of the PLCs connected to the link.**
- **If a short value has been set, there may be PLCs that cannot be added to the link even if the power supply to that PLC is on. However, the shortest time that can be set is 10 ms.**
- **If there are any stations that have not been added to the link, the setting should not be changed as long as a longer link transmission cycle time does not cause any particular problems.**

10.5.3 Error Detection Time for Transmission Assurance Relays

If the power supply for the PLC of any given station fails or is turned off, it takes (as a default value) 6.4 seconds for the transmission assurance relay of that PLC to be turned off at the other stations. This time period can be shortened using the SYS1 instruction.

Example of SYS1 instruction setting

SYS1 MPCLK1T1, 100

Function description: This changes the time that the PLC link transmission assurance relay is off (default value = 6400 ms).

The above example shows the time being set to 100 ms.

Key words: Specification of No. 1 key word: PCLK1T1

Allowable setting range for No. 2 key word: 100 to 6400 (100 ms to 6400 ms)

Notes

Precautions concerning settings

- **The above instruction should be set up at the beginning of the program, so that it is executed at the rise of R9014, and the same value should be set for all of the PLCs in the link.**
- **Executing the above instruction does not change any of the system registers.**
- **The SYS1 instruction should be set to a value at least twice that of the maximum transmission cycle time when all of the PLCs are connected to the link.**
- **If a short value has been set, there is a possibility of the transmission assurance relay malfunctioning. However, the shortest time that can be set is 100 ms.**
- **The setting should not be changed as long as a longer transmission assurance relay detection time does not cause any particular problems.**

Chapter 11

Other Functions

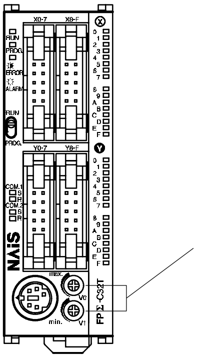
11.1 Analog Potentiometer

This section explains about the analog potentiometer.

11.1.1 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.



Analog potentiometer
V0 (potentiometer 0) . Changes the value of DT90040 within a range of K0 to K1000.
V1 (potentiometer 1) . Changes the value of DT90041 within a range of K0 to K1000.

Figure 223: FPΣ Analog potentiometer

Applicable special data register

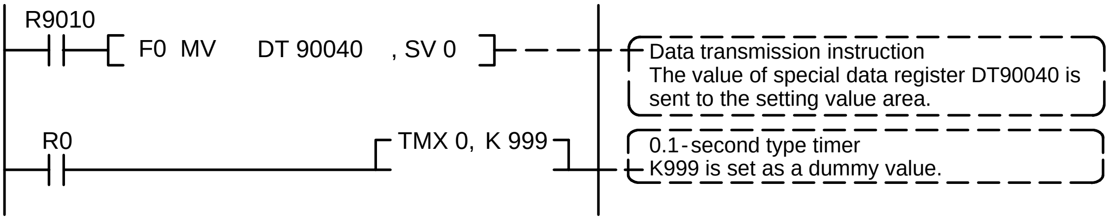
Symbol	Potentiometer No.	Special data register	Range of change
V0	Volume 0	DT90040	K0 to K1000
V1	Volume 1	DT90041	

11.1.2 Example Showing How the Analog Potentiometers are Used

The FPΣ is provided with special data 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 data 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.



Data transmission instruction
The value of special data register DT90040 is sent to the setting value area.

0.1-second type timer
K999 is set as a dummy value.

Figure 224: Program example of analog potentiometer

11.2 Clock/Calendar Function

This section explains about the clock/calendar function.

11.2.1 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

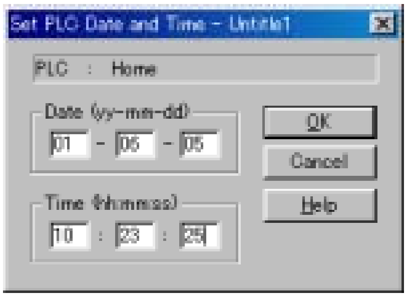
11.2.2 Setting of Clock/Calendar Function

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 and Time” under “Tool” on the menu bar.

Set PLC Date and Time dialog box



PLC : Home

Date (yy-mm-dd) 01 - 06 - 05

Time (hh:mm:ss) 10 : 23 : 25

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 225: 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.

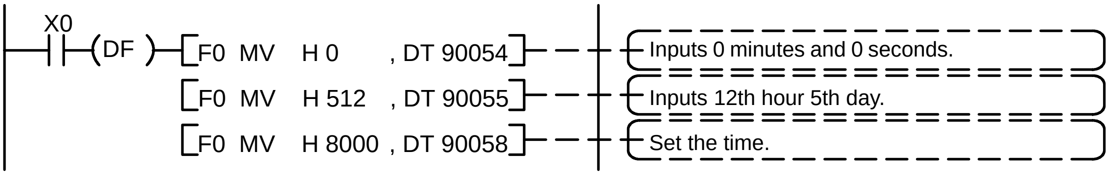


Figure 226: FPΣ Sample program of clock/calendar function

11.2.3 Precautions Concerning Backup of Clock/Calendar Data

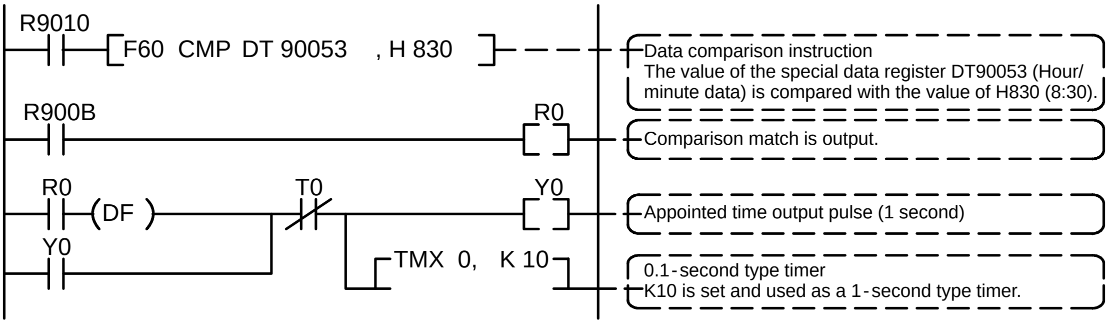
The clock/calendar values are backed up using a battery. Please be aware that these values cannot be used unless a battery has been installed in the FPΣ.

No values have been set in the default settings, so the programming tool or another means must be used to specify the values.

11.2.4 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.



Data comparison instruction
The value of the special data register DT90053 (Hour/minute data) is compared with the value of H830 (8:30).

Comparison match is output.

Appointed time output pulse (1 second)

0.1-second type timer
K10 is set and used as a 1-second type timer.

Figure 227: 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 12

Self-Diagnostic and Troubleshooting

12.1 Self-Diagnostic Function

This section explains about the self-diagnostic function of FPΣ.

12.1.1 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.

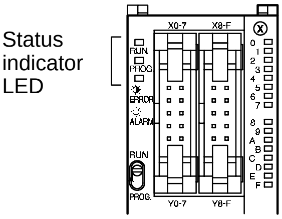


Figure 228: FPΣ Status indicator LED

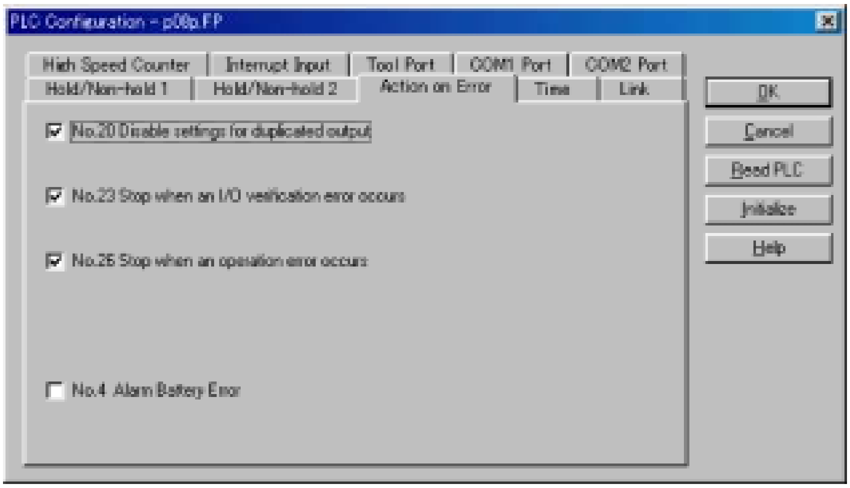
12.1.2 Operation on Error

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.



☑ No.20 Disable settings for duplicated output

☑ No.23 Stop when an I/O verification error occurs

☑ No.26 Stop when an operation error occurs

☐ No.4 Alarm Battery Error

Figure 229: 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.

12.2 Troubleshooting

This section explains about what to do if an error occurs.

12.2.1 If the ERROR/ALARM LED Flashes

Condition: The self-diagnostic error occurs.

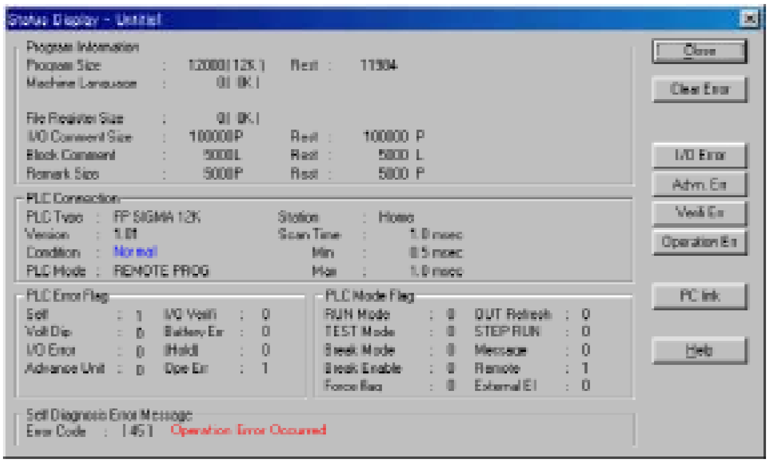
Procedure 1

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



Program Information
Program Size : 12000 (12K) Rest : 11904
Machine Language : 0 (0K)
File Register Size : 0 (0K)
I/O Comment Size : 100000P Rest : 100000 P
Block Comment : 5000L Rest : 5000 L
Remark Size : 5000P Rest : 5000 P

PLC Connection
PLC Type : FP SIGMA 12K Station : Home
Version : 1.01 Scan Time : 1.0 msec
Condition : Normal Min : 0.5 msec
PLC Mode : REMOTE PROG Max : 1.0 msec

PLC Error Flag
Self : 1 I/O Verifi : 0
Volt Dip : 0 Battery Er : 0
I/O Error : 0 Hold : 0
Advance Unit : 0 Ope Er : 1

PLC Mode Flag
RUN Mode : 0 OUT Refresh : 0
TEST Mode : 0 STEP RUN : 0
Break Mode : 0 Message : 0
Break Enable : 0 Remote : 1
Force Req : 0 External EI : 0

Self Diagnosis Error Message
Error Code : [45] Operation Error Occurred

Figure 230: FPWIN GR - 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.

Tip

To display the status display dialog box, select “Status Display” under “Online” on the menu bar.

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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.

12.2.2 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 12 - 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.

12.2.3 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.

12.2.4 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.

12.2.5 If a Protect Error Message Appears

When a Password Function is Used

Procedure

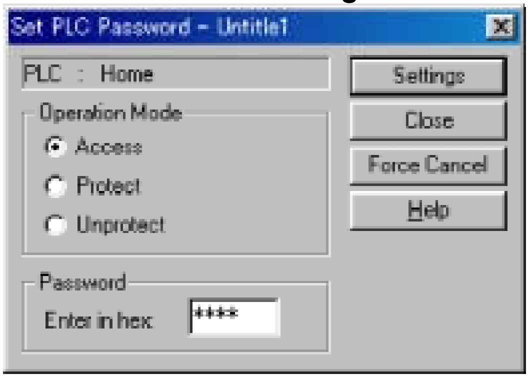
Enter a password in the “Set PLC Password” menu in FPWIN GR and turn on the “Access” radio button.

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



PLC : Home

Operation Mode

● Access

○ Protect

○ Unprotect

Password

Enter in hex: ****

Figure 231: FPWIN GR - Set PLC Password dialog box

12.2.6 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 12 - 5.

Procedure 2

Execute a total-check function to determine the location of the syntax error.

12.2.7 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 7 - 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 13

Specifications

13.1 Table of Specifications

This section contains the general and performance specifications for the FPΣ.

13.1.1 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	**C32**	4 ms at 21.6 V, 7 ms at 24 V, 10 ms at 26.4 V	
	C24	3 ms at 21.6 V, 5 ms at 24 V, 8 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	**C32**	Between input/output terminals and power supply terminal/ function earth	500 VAC for 1 minute
		Between input terminal and output terminal	
	C24	Between input terminals (X0 to X7)/input terminals (X8 to XF) and power supply terminal/function earth	500 VAC for 1 minute
		Between output terminals and power supply terminal/function earth	1500 VAC for 1 minute
		Between input terminals (X0 to X7) and input terminals (X8 to XF)	500 VAC for 1 minute
		Between input terminals (X0 to X7)/input terminals (X8 to XF) and output terminals	1500 VAC for 1 minute
Insulation resistance	**C32**	Between input/output terminals and power supply terminal/ function earth	Min. 100Ω (measured with a 500 V DC megger)
		Between input terminal and output terminal	
	C24	Between input terminals (X0 to X7)/input terminals (X8 to XF) and power supply terminal/function earth	
		Between output terminals and power supply terminal/function earth	
		Between input terminals (X0 to X7) and input terminals (X8 to XF)	
		Between input terminals (X0 to X7)/input terminals (X8 to XF) 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
FPΣ control unit	FPG-C32T/C32T2	Approx. 120 g/4.24 oz
	FPG-C24R2	Approx. 140 g/4.94 oz
FPΣ expansion unit	FPG-XY64D2T	Approx. 100 g/3.53 oz
FP0 expansion unit	FPG-E8X	Approx. 65 g/2.29 oz
	FPG-E8R/E8YR	Approx. 90 g/3.17 oz
	FPG-E8YT/E8YP	Approx. 65 g/2.29 oz
	FPG-E16R	Approx. 105 g/3.70 oz
	FPG-E16T/E16P/E16X/E16YT/E16YP	Approx. 70 g/2.47 oz
	FPG-E32T/E32P	Approx. 85 g/3.00 oz

Unit’s current consumption table

Type of unit		Control unit current consumption	Expansion unit current consumption	Input circuit current consumption	Output circuit current consumption
		This is the current consumed from the control unit power supply connector. If expansion units or intelligent units are added, the current is increased by the value indicated below.	**This is the current consumed from the expansion unit power supply connector. If a unit is not listed below, it means that it has no power supply connector.**	**This is the current consumed by the input circuits of the various units. This value indicates the current that flows into the input circuit. “n” indicates the number of points that are on.**	**This is the current consumed by the output circuits of the various units. This value indicates the current used to drive the output circuits. “n” indicates the number of points that are on. This value does not include the load current value.**
FPΣ control unit	FPG-C32T	90 mA or less	—	77.2 mA or less	70 mA or less
	FPG-C32T2	90 mA or less	—	77.2 mA or less	70 mA or less
	FPG-C24R2	160 mA or less	—	77.2 mA or less	—
FPΣ expansion unit	FPG-XY64D2T	35 mA or less	—	3.5 x n mA or less	15 mA or less
FP0 expansion unit	FP0-E8X	10 mA or less	—	4.3 x n mA or less	—
	FP0-E8R	15 mA or less	50 mA or less	4.3 x n mA or less	—
	FP0-E8YR	10 mA or less	100 mA or less	—	—
	FP0-E8YT	15 mA or less	—	—	3 x n mA or less
	FP0-E16X	20 mA or less	—	4.3 x n mA or less	—
	FP0-E16R	20 mA or less	100 mA or less	4.3 x n mA or less	—
	FP0-E16T	25 mA or less	—	4.3 x n mA or less	3 x n mA or less
	FP0-E16YT	25 mA or less	—	—	3 x n mA or less
	FP0-E32T	40 mA or less	—	4.3 x n mA or less	3 x n mA or less
FP0 intelligent unit	FP0-A21	20 mA or less	100 mA or less	—	—
	FP0-A80	20 mA or less	60 mA or less	—	—
	FP0-IOL	30 mA or less	40 mA or less	—	—
Communication cassette	FPG-COM1 FPG-COM2	20 mA or less	—	—	—
	FPG-COM3	25 mA or less	—	—	—

13.1.2 Performance Specifications

Item			Descriptions		
			FPG-C32T	**FPG-C32T2**	**FPG-C24R2**
Number of controllable I/O points	**Control unit**		32 points (DC input: 16, Transistor output: 16)	32 points (DC input: 16, Transistor output: 16)	24 points (DC input: 16, Relay output: 8)
	When using FP0 expansion units		Max. 128 points (up to 3 units)	Max. 128 points (up to 3 units)	Max. 120 points (up to 3 units) *When using transistor output type expansion units
	When using FPΣ expansion units		Not possible	Max. 288 points (up to 4 units)	Max. 280 points (up to 4 units) *When using transistor output type expansion units
	When using FP0 and FPΣ expansion units		—	Max. 384 points (up to FP0 3 units and FPΣ 4 units)	Max. 376 points (up to FP0 3 units and FPΣ 4 units) *When using transistor output type expansion units
Programming method/Control method			Relay symbol/Cyclic operation		
Program memory			Built-in Flash ROM (without backup battery) (By using exclusive instructions it is possible to write and read data.)		
Program capacity			12,000 steps		
Number of instruction	**Basic**		85		
	High-level		220		
Operation speed			0.4 μs/step (by basic instruction)		
Operation memory points	**Relay**	**External input relay (X)**	512 points (* Note 7)	1,184 points (* Note 7)	1,184 points (* Note 7)
		External output relay (Y)	512 points (* Note 7)	1,184 points (* Note 7)	1,184 points (* Note 7)
		Internal relay (R)	1,568 points (R0 to R97F) (* Note 1)		
		Timer/Counter (T/C)	1,024 points (* Note 1 and 2) (for initial setting, Timer: 1,008 points (T0 to T1007), Counter: 16 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		

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Item	Descriptions
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 storage	All kinds of comments, including I/O comments, remarks, and block comments, can be stored. (Without backup battery)
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, password, floating-point operation, and PID processing

Notes

1) **If no battery is used, only the fixed area is backed up (counters 16 points: C1008 to C1023, internal relays 128 points: R900 to R97F, data registers 55 words: DT32710 to DT32764). When the optional battery is used, all area 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.**
7) **The number of points actually available for use is determined by the hardware configuration.**

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 mode	When using single-phase: Addition input, Subtraction input	When using 2-phase: Two-phase input, One input, Direction distinction input
	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)	(When using linear interpolation function: Max. 100 kHz When using circular interpolation function: Max. 20 kHz)
	High-speed counter used (* Note 2)	Two-phase ch0 or ch2	
	Input/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	15 m/49.21 ft.
Transmission speed (Baud rate)	2,400 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), RS232C type communication cassette is required.

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

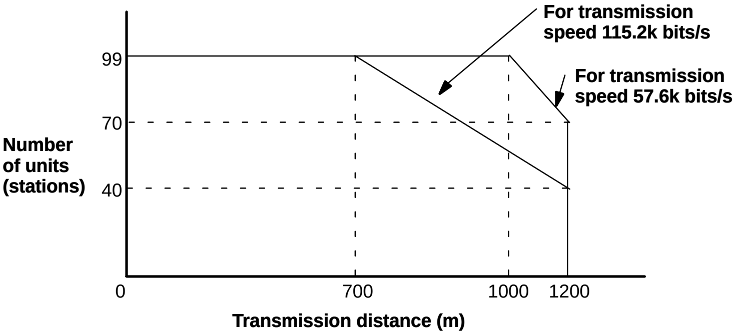
Serial communication specifications (1:N communication) (* Note 1)

Item	Description
Communication method	Two-wire, half duplex transmission
Synchronous method	Start stop synchronous system
Transmission line	Twisted-pair cable or VCTF
Transmission distance (Total distance)	Maximum 1,200 m/3,937 ft. (* Notes 4 and 5)
Transmission speed (Baud rate)	2,400 bits/s to 115.2k bits/s (19,200 bits/s when a C-NET adapter is connected) (* Notes 2, 4 and 5)
Transmission code	ASCII
Transmission format	Stop bit: 1 bit/2 bits, Parity: none/even/odd, Data length: 7 bits/8 bits (* Notes 2)
Number of units (stations)	Maximum 99 units (stations) (32 units (stations) max. when a C-NET adapter is connected) (* Notes 3, 4 and 5)
Interface	Conforming to RS485 (connected via the terminal block)

Notes

1) In order to use the serial communication function (1:N communication), RS485 type communication cassette is required.

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 set, using the switches on the control unit.**
4) **When connecting a commercially available device that has an RS485 interface, please confirm operation using the actual device. In some cases, the number of units (stations), transmission distance, and transmission speed (baud rate) vary depending on the connected device.**
5) **The values for the transmission distance, transmission speed (baud rate), and number of units (stations) should be within the values noted in the graph below.**



When using a transmission speed of 2,400 bits/s to 38.4k bits/s, you can set up to a maximum of 99 units (stations) and a maximum transmission distance of 1,200 m.

PLC link function specification (* Note 1)

Item	Description
Communication method	Token bus
Transmission method	Floating master method
Transmission line	Twisted-pair cable or VCTF
Transmission distance (Total distance)	1,200 m/3,937 ft.
Transmission speed (Baud rate)	115.2k bits/s
Number of units (stations)	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) **RS485 type communication cassette is required in order to use the PLC link function.**
2) **Unit (Station) numbers are specified using the switches on the control unit or the system registers.**

13.2 I/O No. Allocation

FPΣ Control unit

The allocation of the FPΣ control unit is fixed.

Control unit		I/O No.
FPG-C32T **FPG-C32T2**	**Input: 16 points**	X0 to XF
	Output: 16 points	Y0 to YF
FPG-C24R2	**Input: 16 points**	X0 to XF
	Output: 8 points	Y0 to Y7

I/O No. of 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.

FPΣ expansion unit (for left side expansion)		First expansion	Second expansion	Third expansion	Fourth expansion
FPG-XY64D2T	**Input: 32 points**	X100 to X11F	X180 to X19F	X260 to X27F	X340 to X35F
	Output: 32 points	Y100 to Y11F	Y180 to Y19F	Y260 to Y27F	Y340 to Y35F

FP0 expansion unit (for right side expansion)		First expansion	Second expansion	Third expansion
FP0-E8X	**Input: 8 points**	X20 to X27	X40 to X47	X60 to X67
FP0-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
FP0-E8YT/E8YR/E8YP	**Output: 8 points**	Y20 to Y27	Y40 to Y47	Y60 to Y67
FP0-E16X	**Input: 16 points**	X20 to X2F	X40 to X4F	X60 to X6F
FP0-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
FP0-E16YT/E16YP	**Output: 16 points**	Y20 to Y2F	Y40 to Y4F	Y60 to Y6F
FP0-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 (for right side expansion)

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 (for right side expansion)

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.

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

I/O No. of FP0 I/O link unit (for right side expansion)

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

13.3 Relays, Memory Areas and Constants

Item			Number of points and range of memory area available for use		Function
			FPG-C32T	FPG-C24R2 FPG-C32T2	
Relay	**External input relay (* Note 1)**	**(X)**	512 points (X0 to X31F)	1,184 points (X0 to X73F)	Turn on or off based on external input.
	External output relay (* Note 1)	**(Y)**	512 points (Y0 to Y31F)	1,184 points (Y0 to Y73F)	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 (* Note 1)**	**(WX)**	32 words (WX0 to WX31)	74 words (WX0 to WX73)	Code for specifying 16 external input points as one word (16 bits) of data.
	External output relay (* Note 1)	**(WY)**	32 words (WY0 to WY31)	74 words (WY0 to WY73)	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 PLC 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 × 10^{-38} to F-3.402823 × 10^{38}
			F1.175494 × 10^{-38} to F3.402823 × 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 16 points: C1008 to C1023, internal relays 128 points: R900 to R97F, data registers 55 words: DT32710 to DT32764). When the optional battery is used, all area 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.**

13.4 Table of System Registers

This section explains about system registers for FPΣ.

13.4.1 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

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 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.

13.4.2 Table of System Registers

Item	No.	Name	Default value	Descriptions	
Hold/ Non-hold 1	**5**	Starting number setting for counter	1008	0 to 1024	§ In case of using back-up battery (option), the setting value will be effective. § In case of not using back-up battery (option), please keep the default value. Otherwise we can't guarantee the function of hold/non-hold value.
	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 flash. Enabled: When a battery error occurs, a self-diagnostic error is issued and the ERROR/ALARM LED flashes.	
Time setting	**31**	Wait time setting for multi-frame communication	6500.0 ms	10 to 81900 ms	
	34	Constant value settings for scan time	Normal scan	0: Normal scan 0 to 350 ms: Scans once each specified time interval. 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 counter	**400**	High-speed counter operation mode settings (X0 to X2)	CH0: Do not set input 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) Addition input (X0) Addition input (X0), Reset input (X2) Subtraction input (X0) Subtraction input (X0), Reset input (X2) One input (X0, X1) One input (X0, X1), Reset input (X2) Direction decision (X0, X1) Direction decision (X0, X1), Reset input (X2)
			CH1: Do not set input X1 as high-speed counter	CH1	Do not set input X1 as high-speed counter. Addition input (X1) Addition input (X1), Reset input (X2) Subtraction input (X1) Subtraction input (X1), Reset input (X2)
	401	High-speed counter operation mode settings (X3 to X5)	CH2: Do not set input 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) Addition input (X3) Addition input (X3), Reset input (X5) Subtraction input (X3) Subtraction input (X3), Reset input (X5) One input (X3, X4) One input (X3, X4), Reset input (X5) Direction decision (X3, X4) Direction decision (X3, X4), Reset input (X5)
			CH3: Do not set input X4 as high-speed counter	CH3	Do not set input X4 as high-speed counter. Addition input (X4) Addition input (X4), Reset input (X5) Subtraction input (X4) Subtraction input (X4), Reset input (X5)

Item	No.	Name	Default value	Descriptions
Interrupt 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 system register 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 set-ting	**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 set-ting	**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, stop bit is 1.
The communication speed (baud rate) is fixed at 115,200 bps.

Item	No.	Name	Default value	Descriptions
COM. 2 port setting	**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

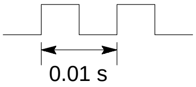
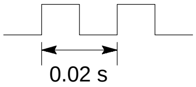
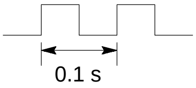
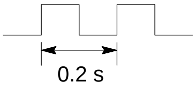
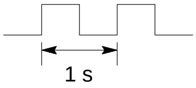
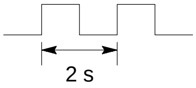
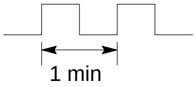
Note

The communication format when using the PLC link is fixed at the following settings:
the data length is 8 bits, odd parity, stop bit is 1.
The communication speed (baud rate) is fixed at 115,200 bps.

13.5 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 **F176 (SPCH)**” 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 **F176 (SPCH)**” 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 **F176 (SPCH)**” 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 **F176 (SPCH)**” 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.

13.6 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	Not used	————	N/A	N/A
DT90002	Position of abnormal I/O unit for FPΣ left side expansion	When an error occurs at FPΣ expansion I/O unit, the bit corresponding to the unit No. will be set on “1”. Monitor using binary display. 15 11 7 3 2 1 0 (Bit No.) 3 2 1 0 (Unit No.) on “1”: error, off “0”: normal	A	N/A
DT90003	Not used	————	N/A	N/A
DT90004	Not used	————	N/A	N/A
DT90005	Not used	————	N/A	N/A
DT90006	Position of abnormal intelligent unit for FPΣ left side expansion	When an error condition is detected in an intelligent unit, the bit corresponding to the unit No. will be set on “1”. Monitor using binary display. 15 11 7 3 2 1 0 (Bit No.) 3 2 1 0 (Unit No.) on “1”: error, off “0”: normal	A	N/A
DT90007	Not used	————	N/A	N/A
DT90008	Not used	————		
DT90009	Communication error flag for COM2	Stores the error contents when using COM.2 port.	A	N/A
DT90010	Position of I/O verify error unit for FP0 right side expansion	When the state of installation of FP0 expansion I/O unit has changed since the power was turned on, the bit corresponding to the unit No. will be set on ”1”. Monitor using binary display. 15 11 7 3 2 1 0 (Bit No.) 2 1 0 (Unit No.) on “1”: error, off “0”: normal	A	N/A
DT90011	Position of I/O verify error unit for FPΣ left side expansion	When the state of installation of FPΣ expansion I/O unit has changed since the power was turned on, the bit corresponding to the unit No. will be set on ”1”. Monitor using binary display. 15 11 7 3 2 1 0 (Bit No.) 3 2 1 0 (Unit No.) on “1”: error, off “0”: normal	A	N/A
DT90012	Not used	————	N/A	N/A

(A: Available, N/A: Not available)

Address	Name	Description	Reading	Writing
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. The value can be read and written by executing **F0 (MV)** instruction.	A	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	A
DT90016			A	A
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
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

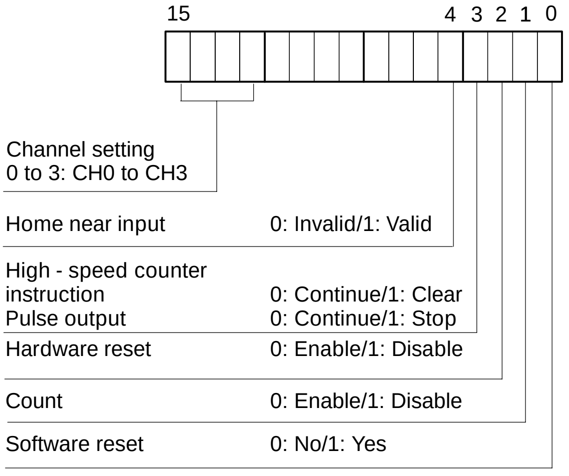
Note

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.

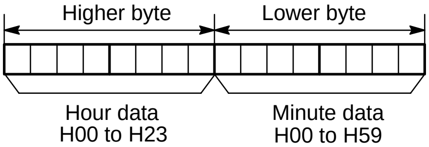
(A: Available, N/A: Not available)

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 search 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

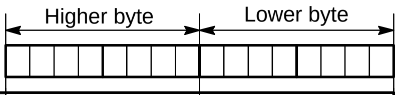
(A: Available, N/A: Not available)

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, F171, F175** or **F176**” 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** or **F167**” 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  15 4 3 2 1 0 Channel setting 0 to 3: CH0 to CH3 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	N/A	A

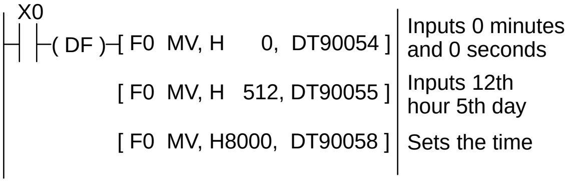
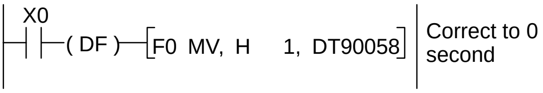
(A: Available, N/A: Not available)

<table>
<tr><th>Address</th><th>Name</th><th>Description</th><th>Reading</th><th>Writing</th></tr>
<tr><td><b>DT90053</b></td><td>Clock/calendar monitor (hour/minute)</td><td>Hour and minute data of the clock/calendar are stored here. This data is read-only data; it cannot be overwritten.


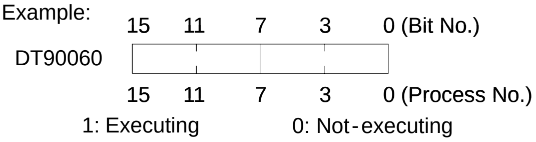
Higher byte
Lower byte
Hour data
H00 to H23
Minute data
H00 to H59

</td><td>A</td><td>N/A</td></tr>
<tr><td><b>DT90054</b></td><td>Clock/calendar setting (minute/second)</td><td rowspan="4">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 <b>F0 (MV)</b> instruction.

<table>
<tr><td><b>DT90054</b></td><td>Minute data
H00 to H59</td><td>Second data
H00 to H59</td></tr>
<tr><td><b>DT90055</b></td><td>Day data
H01 to H31</td><td>Hour data
H00 to H23</td></tr>
<tr><td><b>DT90056</b></td><td>Year data
H00 to H99</td><td>Month data
H01 to H12</td></tr>
<tr><td><b>DT90057</b></td><td>———</td><td>Day-of-the-week data
H00 to H06</td></tr>
</table></td><td rowspan="4">A</td><td rowspan="4">A</td></tr>
<tr><td><b>DT90055</b></td><td>Clock/calendar setting (day/hour)</td></tr>
<tr><td><b>DT90056</b></td><td>Clock/calendar setting (year/month)</td></tr>
<tr><td><b>DT90057</b></td><td>Clock/calendar setting (day-of-the-week)</td></tr>
</table>

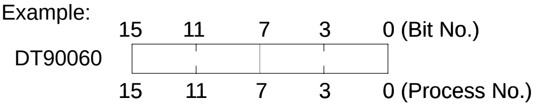
(A: Available, N/A: Not available)

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

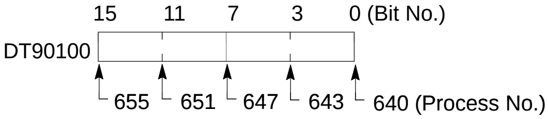
(A: Available, N/A: Not available)

Address	Name	Description	Reading	Writing
DT90059	Serial communication error code	Error code is stored here when a communication error occurs.	N/A	N/A
DT90060	Step ladder process (0 to 15)	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.	A	A
DT90061	Step ladder process (16 to 31)			
DT90062	Step ladder process (32 to 47)			
DT90063	Step ladder process (48 to 63)			
DT90064	Step ladder process (64 to 79)			
DT90065	Step ladder process (80 to 95)			
DT90066	Step ladder process (96 to 111)			
DT90067	Step ladder process (112 to 127)			
DT90068	Step ladder process (128 to 143)			
DT90069	Step ladder process (144 to 159)			
DT90070	Step ladder process (160 to 175)			
DT90071	Step ladder process (176 to 191)			
DT90072	Step ladder process (192 to 207)			
DT90073	Step ladder process (208 to 223)			
DT90074	Step ladder process (224 to 239)			
DT90075	Step ladder process (240 to 255)			
DT90076	Step ladder process (256 to 271)			

(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:  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.	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)			

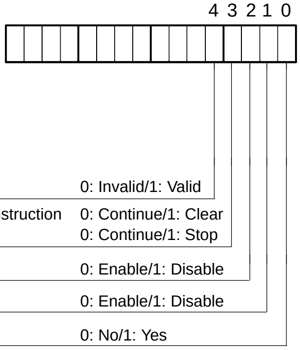
(A: Available, N/A: Not available)

Address	Name	Description	Reading	Writing
DT90098	Step ladder process (608 to 623)	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.) DT90100 655 651 647 643 640 (Process No.) 1: Executing 0: Not-executing A programming tool software can be used to write data.	A	A
DT90099	Step ladder process (624 to 639)			
DT90100	Step ladder process (640 to 655)			
DT90101	Step ladder process (656 to 671)			
DT90102	Step ladder process (672 to 687)			
DT90103	Step ladder process (688 to 703)			
DT90104	Step ladder process (704 to 719)			
DT90105	Step ladder process (720 to 735)			
DT90106	Step ladder process (736 to 751)			
DT90107	Step ladder process (752 to 767)			
DT90108	Step ladder process (768 to 783)			
DT90109	Step ladder process (784 to 799)			
DT90110	Step ladder process (800 to 815)			
DT90111	Step ladder process (816 to 831)			
DT90112	Step ladder process (832 to 847)			
DT90113	Step ladder process (848 to 863)			
DT90114	Step ladder process (864 to 879)			
DT90115	Step ladder process (880 to 895)			
DT90116	Step ladder process (896 to 911)			
DT90117	Step ladder process (912 to 927)			
DT90118	Step ladder process (928 to 943)			
DT90119	Step ladder process (944 to 959)			
DT90120	Step ladder process (960 to 975)			
DT90121	Step ladder process (976 to 991)			
DT90122	Step ladder process (992 to 999) (Higher byte: not used)			

(A: Available, N/A: Not available)

Address	Name	Description	Reading	Writing
DT90123 to DT90125	Not used	———	N/A	N/A
DT90126	Forced Input/ Output unit No.	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

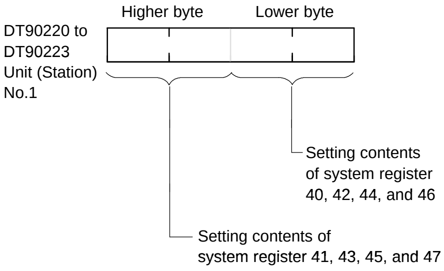
(A: Available, N/A: Not available)

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.  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, F171 , F175** or **F176**" 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					

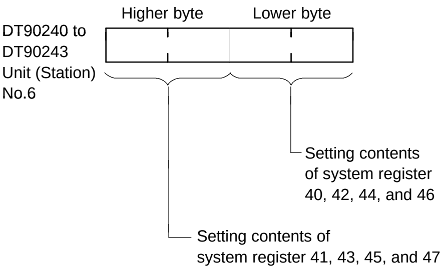
(A: Available, N/A: Not available)

Address	Name		Description	Reading	Writing
DT90206	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** or **F167**” is executed. The value can be read by executing **F1 (DMV)** instruction.	A	N/A
DT90207					
DT90208 to DT90218	Not used		—	N/A	N/A

(A: Available, N/A: Not available)

Address	Name		Description	Reading	Writing
DT90219	Unit No. (Station No.) selection for DT90220 to DT90251		0: Unit No. (Station No.) 1 to 8, 1: Unit No. (Station No.) 9 to 16	A	N/A
DT90220	PLC link unit (station) No.1 or 9	System register 40 and 41	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  Higher byte Lower byte DT90220 to DT90223 Unit (Station) No.1 Setting contents of system register 40, 42, 44, and 46 Setting contents of system register 41, 43, 45, and 47	A	N/A
DT90221		System register 42 and 43			
DT90222		System register 44 and 45			
DT90223		System register 46 and 47			
DT90224	PLC link unit (station) No.2 or 10	System register 40 and 41			
DT90225		System register 42 and 43			
DT90226		System register 44 and 45			
DT90227		System register 46 and 47			
DT90228	PLC link unit (station) No.3 or 11	System register 40 and 41			
DT90229		System register 42 and 43			
DT90230		System register 44 and 45			
DT90231		System register 46 and 47			
DT90232	PLC link unit (station) No.4 or 12	System register 40 and 41			
DT90233		System register 42 and 43			
DT90234		System register 44 and 45			
DT90235		System register 46 and 47			
DT90236	PLC link unit (station) No.5 or 13	System register 40 and 41			
DT90237		System register 42 and 43			
DT90238		System register 44 and 45			
DT90239		System register 46 and 47			

(A: Available, N/A: Not available)

Address	Name	Name	Description	Reading	Writing
DT90240	PLC link unit (station) No.6 or 14	System register 40 and 41	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  Higher byte Lower byte DT90240 to DT90243 Unit (Station) No.6 Setting contents of system register 40, 42, 44, and 46 Setting contents of system register 41, 43, 45, and 47	A	N/A
DT90241		System register 42 and 43			
DT90242		System register 44 and 45			
DT90243		System register 46 and 47			
DT90244	PLC link unit (station) No.7 or 15	System register 40 and 41		A	N/A
DT90245		System register 42 and 43			
DT90246		System register 44 and 45			
DT90247		System register 46 and 47			
DT90248	PLC link unit (station) No.8 or 16	System register 40 and 41			
DT90249		System register 42 and 43			
DT90250		System register 44 and 45			
DT90251		System register 46 and 47			
DT90252 to DT90255	Not used		———	N/A	N/A
DT90256	Unit No. (Station No.) switch monitor for COM port		Used by the system.	N/A	N/A

13.7 Table of Error Cords

This section contains the syntax check error and self-diagnostic error for the FPΣ.

13.7.1 Table of Syntax Check Error

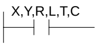
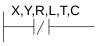
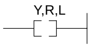
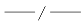
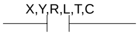
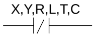
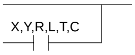
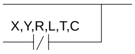
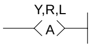
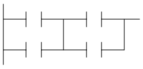
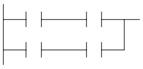
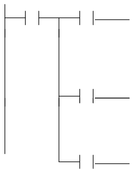
Error code	Name	Operation status	Description and steps to take
E1	Syntax error	Stops	A program with a syntax error has been written. **Change to PROG. mode and correct the error.**
E2	Duplicated output error	Stops	Two or more **OT(Out)** instructions and **KP(Keep)** instructions are programmed using 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.**
E6	Compile memory full error	Stops	The program stored in the FPΣ is too large to compile in the program memory. **Change to PROG. mode and reduce the total number of steps for the program.**
E7	High-level instruction type error	Stops	In the program, high-level instructions, which execute in every scan and at the leading edge of the trigger, are programmed to be triggered by one contact. (e.g., **F0 (MV)** and **P0 (PMV)** are programmed using the same trigger continuously.) **Correct the program so that the high-level instructions executed in every scan and at the leading edge are triggered separately.**
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.**

13.7.2 Table of Self-Diagnostic Error

Error code	Name	Opera-tion status	Description and steps to take
E26	User’s ROM error	Stops	Probably a hardware abnormality. **Please contact your dealer.**
E27	Unit installation error	Stops	The number of installed units exceed the limitations. **Turn off the power supply and check the restrictions on unit combinations.**
E28	System register error	Stops	Probably an abnormality in the system register. **Check the system register setting.**
E30	Interrupt error 0	Stops	Probably a hardware abnormality. **Please contact your dealer.**
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.**
E34	I/O status error	Stops	An abnormal unit is installed. **Replace the unit with a new one.**
E40	Position of abnormal I/O unit	Stops	An abnormality in an I/O unit is occurred. **Check the contents of special data register “DT90002” and locate the abnormal FPΣ expansion I/O unit. Then check the unit.**
E41	Intelligent unit error	Stops	An abnormality in an intelligent unit. **Check the contents of special data register “DT90006” and locate the abnormal FPΣ intelligent unit.**
E42	I/O unit verify error	Selectable	The connection condition of I/O unit has changed compared to that at time of power-up. **Check the contents of special data register (FP0 expansion I/O unit: “DT90010”, FPΣ expansion I/O unit: “DT90011”) and locate the erroneous I/O unit.** **Set the operation status using system register 23 to continue operation.**
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.**
E50	Battery error	Selectable	The voltage of the backup battery lowered or the battery is not connected to the control unit. **Check the connection of the backup battery and then replace battery if necessary.** **By setting the system register 4, you can issued this self-diagnostic error. (In that case, the ERROR/ALARM LED flashes.)**
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	

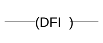
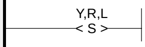
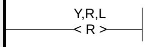
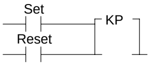
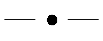
13.8 Table of Instructions

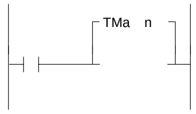
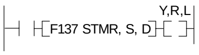
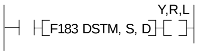
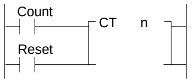
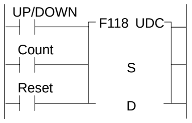
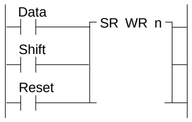
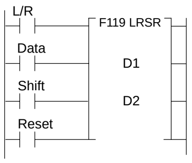
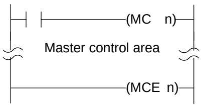
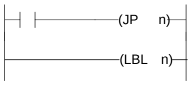
Table of Basic Instructions

Name	Boolean	Symbol	Description	Steps (* Note)
Sequence basic instructions				
Start	**ST**		Begins a logic operation with a Form A (normally open) contact.	1 (2)
Start Not	**ST/**		Begins a logic operation with a Form B (normally closed) contact.	1 (2)
Out	**OT**		Outputs the operated result to the specified output.	1
Not	**/**		Inverts the operated result up to this instruction.	1
AND	**AN**		Connects a Form A (normally open) contact serially.	1 (2)
AND Not	**AN/**		Connects a Form B (normally closed) contact serially.	1 (2)
OR	**OR**		Connects a Form A (normally open) contact in parallel.	1 (2)
OR Not	**OR/**		Connects a Form B (normally closed) contact in parallel.	1 (2)
Alternative out	**ALT**		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**		Turns on the contact for only one scan when the leading edge of the trigger is detected.	1
Trailing edge differential	**DF/**		Turns on the contact for only one scan when the trailing edge of the trigger is detected.	1

Note

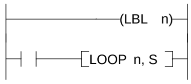
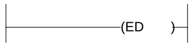
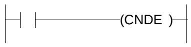
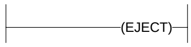
When T256/C256 or higher, R9000 or higher is used, the number of steps is the number in parentheses.

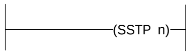
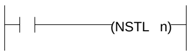
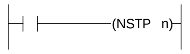
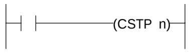
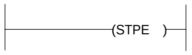
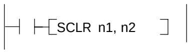
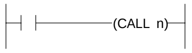
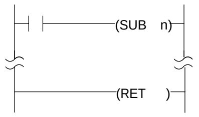
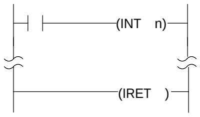
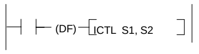
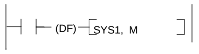
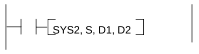
Name	**Boolean**	**Symbol**	**Description**	**Steps** (*** Note**)
Leading edge differential (initial execution type)	**DFI**		Turns on the contact for only one scan when the leading edge of the trigger is detected. The leading edge detection is possible on the first scan.	1
Set	**SET**		Output is set 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

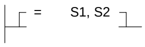
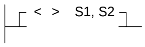
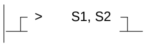
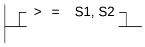
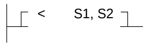
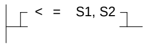
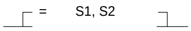
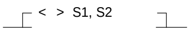
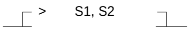
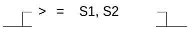
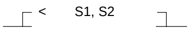
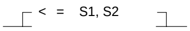
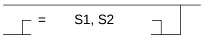
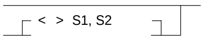
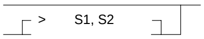
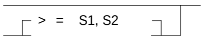
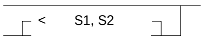
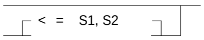
Name	**Boolean**	**Symbol**	**Description**	**Steps (* Note)**
Basic function instructions				
On-delay timer	**TML**		After set value “n” × 0.001 seconds, timer contact “a” is set to on.	3 (4)
	TMR		After set value “n” × 0.01 seconds, timer contact “a” is set to on.	3 (4)
	TMX		After set value “n” × 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	**JP**		The program jumps to the label instruction and continues from there.	2
Label	**LBL**			1

Note

When TM256 or higher or CT256 or higher is set, the number of steps is the number in parentheses.

Name	**Boolean**	**Symbol**	**Description**	**Steps** (*** Note**)
Loop	**LOOP**		The program jumps to the label instruction and continues from there (the number of jumps is set in “S”).	4
Label	**LBL**			1
End	**ED**		The operation of program is ended. Indicates the end of a main program.	1
Conditional end	**CNDE**		The operation of program is ended when the trigger turns on.	1
Eject	**EJECT**		Adds page break for use when printing.	1

Name	**Boolean**	**Symbol**	**Description**	**Steps**
Step ladder instructions				
Start step	**SSTP**		The start of program “n” for process control	3
Next step	**NSTL**		Start the specified process “n” and clear the process currently operated. (Scan execution type)	3
	NSTP		Start the specified process “n” and clear the process currently operated. (Pulse execution type)	3
Clear step	**CSTP**		Resets the currently operated process “n”.	3
Step end	**STPE**		End of step ladder area	1
Clear multiple steps	**SCLR**		Resets the currently operated processes “n1” to “n2”.	5
Subroutine instructions				
Subroutine call	**CALL**		Executes the specified subroutine. When returning to the main program, outputs in the subroutine program are maintained.	2
Subroutine entry	**SUB**		Indicates the start of the subroutine program “n”.	1
Subroutine return	**RET**		Ends the subroutine program.	1
Interrupt instructions				
Interrupt	**INT**		Indicates the start of the interrupt program “n”.	1
Interrupt return	**IRET**		Ends the interrupt program.	1
Interrupt control	**ICTL**		Select interrupt enable/disable or clear in “S1” and “S2” and execute.	5
Special setting instructions				
Communication conditions setting	**SYS1**		Change the communication conditions for the COM port or tool port based on the contents specified by the character constant.	13
Password setting			Change the password specified by the PLC based on the contents specified by the character constant.	
Interrupt setting			Set the interrupt input based on the contents specified by the character constant.	
PLC link time setting			Set the system setting time when a PLC link is used, based on the contents specified by the character constant.	
RS485 response time control			Change the communication conditions of the COM. port or tool port for RS485 based on the contents specified by the character constant.	
System registers “No. 40 to No. 47” changing	**SYS2**		Change the setting value of the system register for the PLC link function.	7

Name	Boolean	Symbol	Description	Steps
Data comparison instructions				
16-bit data comparison (Start)	**ST=**		Begins a logic operation by comparing two 16-bit data in the comparative condition “S1=S2”.	5
	ST<>		Begins a logic operation by comparing two 16-bit data in the comparative condition “S1≠ S2”.	5
	ST>		Begins a logic operation by comparing two 16-bit data in the comparative condition “S1>S2”.	5
	ST>=		Begins a logic operation by comparing two 16-bit data in the comparative condition “S1≧ S2”.	5
	ST<		Begins a logic operation by comparing two 16-bit data in the comparative condition “S1<S2”.	5
	ST<=		Begins a logic operation by comparing two 16-bit data in the comparative condition “S1≦ S2”.	5
16-bit data comparison (AND)	**AN=**		Connects a contact serially by comparing two 16-bit data in the comparative condition “S1=S2”.	5
	AN<>		Connects a contact serially by comparing two 16-bit data in the comparative condition “S1≠ S2”.	5
	AN>		Connects a contact serially by comparing two 16-bit data in the comparative condition “S1>S2”.	5
	AN>=		Connects a contact serially by comparing two 16-bit data in the comparative condition “S1≧ S2”.	5
	AN<		Connects a contact serially by comparing two 16-bit data in the comparative condition “S1<S2”.	5
	AN<=		Connects a contact serially by comparing two 16-bit data in the comparative condition “S1≦ S2”.	5
16-bit data comparison (OR)	**OR=**		Connects a contact in parallel by comparing two 16-bit data in the comparative condition “S1=S2”.	5
	OR<>		Connects a contact in parallel by comparing two 16-bit data in the comparative condition “S1≠ S2”.	5
	OR>		Connects a contact in parallel by comparing two 16-bit data in the comparative condition “S1>S2”.	5
	OR>=		Connects a contact in parallel by comparing two 16-bit data in the comparative condition “S1≧ S2”.	5
	OR<		Connects a contact in parallel by comparing two 16-bit data in the comparative condition “S1<S2”.	5
	OR<=		Connects a contact in parallel by comparing two 16-bit data in the comparative condition “S1≦ S2”.	5

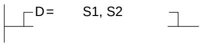
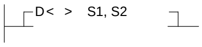
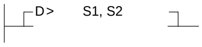
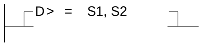
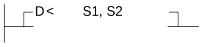
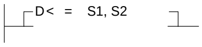
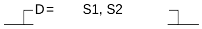
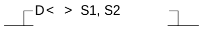
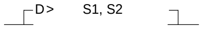
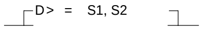
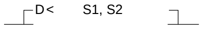
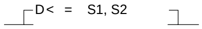
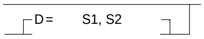
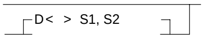
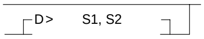
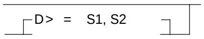
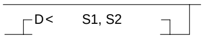
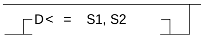
Name	Boolean	Symbol	Description	Steps
32-bit data comparison (Start)	**STD=**		Begins a logic operation by comparing two 32-bit data in the comparative condition “(S1+1, S1) = (S2+1, S2)”.	9
	STD<>		Begins a logic operation by comparing two 32-bit data in the comparative condition “(S1+1, S1)≠ (S2+1, S2)”.	9
	STD>		Begins a logic operation by comparing two 32-bit data in the comparative condition “(S1+1, S1) > (S2+1, S2)”.	9
	STD>=		Begins a logic operation by comparing two 32-bit data in the comparative condition “(S1+1, S1)≧ (S2+1, S2)”.	9
	STD<		Begins a logic operation by comparing two 32-bit data in the comparative condition “(S1+1, S1) < (S2+1, S2)”.	9
	STD<=		Begins a logic operation by comparing two 32-bit data in the comparative condition “(S1+1, S1)≦ (S2+1, S2)”.	9
32-bit data comparison (AND)	**AND=**		Connects a contact serially by comparing two 32-bit data in the comparative condition “(S1+1, S1)=(S2+1, S2)”.	9
	AND<>		Connects a contact serially by comparing two 32-bit data in the comparative condition “(S1+1, S1) ≠ (S2+1, S2)”.	9
	AND>		Connects a contact serially by comparing two 32-bit data in the comparative condition “(S1+1, S1)>(S2+1, S2)”.	9
	AND>=		Connects a contact serially by comparing two 32-bit data in the comparative condition “(S1+1, S1) ≧ (S2+1, S2)”.	9
	AND<		Connects a contact serially by comparing two 32-bit data in the comparative condition “(S1+1, S1)<(S2+1, S2)”.	9
	AND<=		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=**		Connects a contact in parallel by comparing two 32-bit data in the comparative condition “(S1+1, S1)=(S2+1, S2)”.	9
	ORD<>		Connects a contact in parallel by comparing two 32-bit data in the comparative condition “(S1+1, S1)≠ (S2+1, S2)”.	9
	ORD>		Connects a contact in parallel by comparing two 32-bit data in the comparative condition “(S1+1, S1)>(S2+1, S2)”.	9
	ORD>=		Connects a contact in parallel by comparing two 32-bit data in the comparative condition “(S1+1, S1)≧ (S2+1, S2)”.	9
	ORD<		Connects a contact in parallel by comparing two 32-bit data in the comparative condition “(S1+1, S1)<(S2+1, S2)”.	9
	ORD<=		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 F-ROM**	**ICRD**	S1, S2, D	The data stored in the F-ROM specified by “S1” and “S2” are transferred to the area starting at “D”.	11
P13	**Data write to F-ROM**	**PICWT**	S1, S2, D	The data specified by “S1” and “S2” are transferred to the 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 (Destination setting)**	**+**	S1, S2, D	(S1) + (S2) → (D)	7
F23	**32-bit data addition (Destination setting)**	**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 (Destination setting)**	**-**	S1, S2, D	(S1) - (S2) → (D)	7
F28	**32-bit data subtraction (Destination setting)**	**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 (Destination setting)**	**B+**	S1, S2, D	(S1) + (S2) → (D)	7
F43	**8-digit BCD data addition (Destination setting)**	**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 (Destination setting)**	**B-**	S1, S2, D	(S1) - (S2) → (D)	7
F48	**8-digit BCD data subtraction (Destination setting)**	**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

No.	Name	Boolean	Operand	Description	Steps
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
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	**Word (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 → $H\ \underset{B}{\underline{42}}\ \underset{A}{\underline{41}}\ \underset{D}{\underline{44}}\ \underset{C}{\underline{43}}$	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: $H\ \underset{D}{\underline{44}}\ \underset{C}{\underline{43}}\ \underset{B}{\underline{42}}\ \underset{A}{\underline{41}}$ → HCDAB	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 → $H\ \underset{2}{\underline{32}}\ \underset{1}{\underline{31}}\ \underset{4}{\underline{34}}\ \underset{3}{\underline{33}}$	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: $H\ \underset{4}{\underline{34}}\ \underset{3}{\underline{33}}\ \underset{2}{\underline{32}}\ \underset{1}{\underline{31}}$ → H3412	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 → $H\ \underset{0}{\underline{30}}\ \underset{0}{\underline{30}}\ \underset{1}{\underline{31}}\ \underset{-}{\underline{2D}}\ \underline{20}\ \underline{20}$	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: $H\ \underset{0}{\underline{30}}\ \underset{0}{\underline{30}}\ \underset{1}{\underline{31}}\ \underset{-}{\underline{2D}}\ \underline{20}\ \underline{20}$ → K-100	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

No.	Name	Boolean	Operand	Description	Steps
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
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**	**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
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
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.	9

No.	Name	Boolean	Operand	Description	Steps
Data shift 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
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 COM., RS232C or RS485 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 (DT90045, DT90044). (* Note)	7
			DT90044, D	Transfers value in high-speed counter elapsed value area (DT90045, DT90044) to (D+1, D). (* Note)	7

Note

The elapsed value area varies depending on the channel being used.

No.	Name	Boolean	Operand	Description	Steps
F166	**Target value much on (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 (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
F171	**Pulse output (with channel specification)** **(Trapezoidal control and home return)**	**SPDH**	S, n	Positioning pulses are output from the specified channel, in accordance with the contents of the data table that starts with S.	5
F172	**Pulse output (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	**PWM output (with channel specification)**	**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
F174	**Pulse output (with channel specification) (Selectable data table control operation)**	**SP0H**	S, n	Outputs the pulses from the specified channel according to the data table specified by S.	5
F175	**Pulse output (Linear interpolation)**	**SPSH**	S, n	Pulses are output from channel, in accordance with the designated data table, so that the path to the target position forms a straight line.	5
F176	**Pulse output (Circular interpolation)**	**SPCH**	S, n	Pulses are output from channel, in accordance with the designated data table, so that the path to the target position forms an arc.	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	$(S1+1, S1) \wedge (S2+1, S2) \rightarrow (D+1, D)$	12
F216	**32-bit data OR**	**DOR**	S1, S2, D	$(S1+1, S1) \vee (S2+1, S2) \rightarrow (D+1, D)$	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

No.	Name	Boolean	Operand	Description	Steps
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
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	The output value “Y” is found for the input value “X” by performing scaling for the given data table.	8
F283	**Scaling of 32-bit data**	**DSCAL**	S1, S2, D	The output value “Y” is found for the input value “X” by performing scaling for the given data table.	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 cosine operation**	**COS**	S, D	COS (S+1, S) → (D+1, D)	10
F316	**Floating-point type datatangent operation**	**TAN**	S, D	TAN (S+1, S) → (D+1, D)	10
F317	**Floating-point type data arcsine 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 natural 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

13.9 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 using the code “MC or MD”.
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.

13.10 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
D	D	D	D
D	D	D	D
D	D	D	D
63	003F	0000 0000 0011 1111	0000 0000 0110 0011
D	D	D	D
D	D	D	D
D	D	D	D
255	00FF	0000 0000 1111 1111	0000 0010 0101 0101
D	D	D	D
D	D	D	D
D	D	D	D
9999	270F	0010 0111 0000 1111	1001 1001 1001 1001

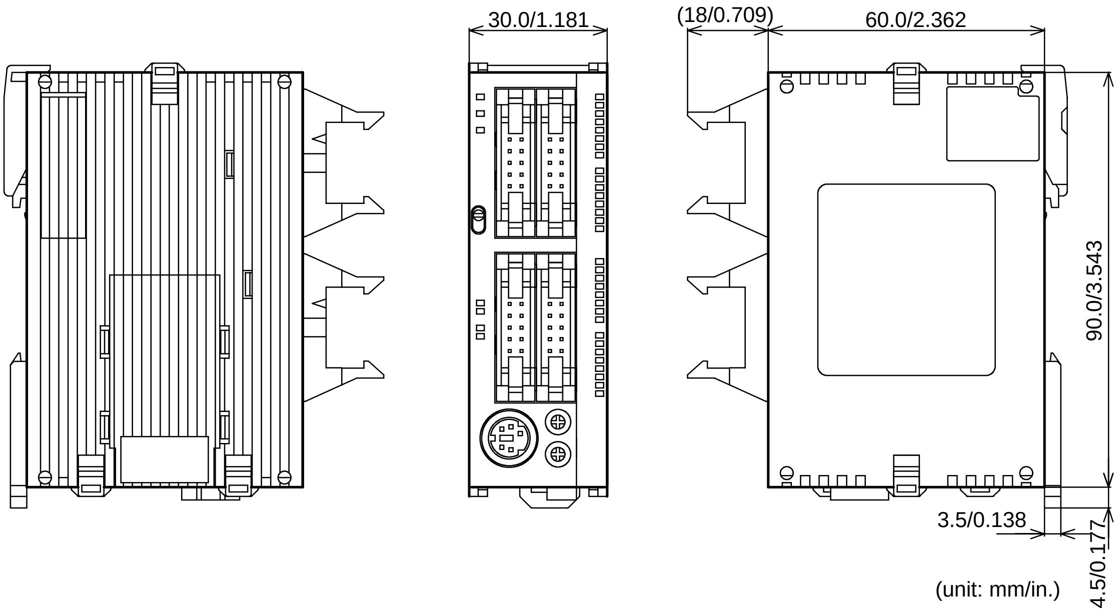
13.11 ASCII Codes

								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
b_7	b_6	b_5	b_4	b_3	b_2	b_1	b_0	ASCII HEX code		Most significant digit							
										0	1	2	3	4	5	6	7
				0	0	0	0	Least significant digit	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

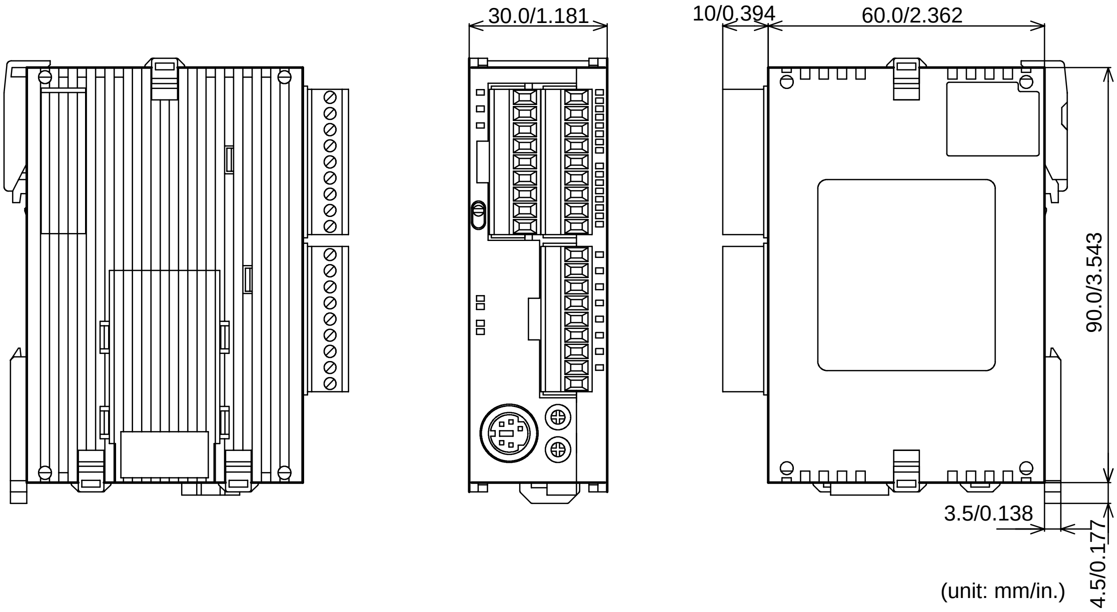
13.12 Dimensions

13.12.1 Control Unit

FPG-C32T, FPG-C32T2

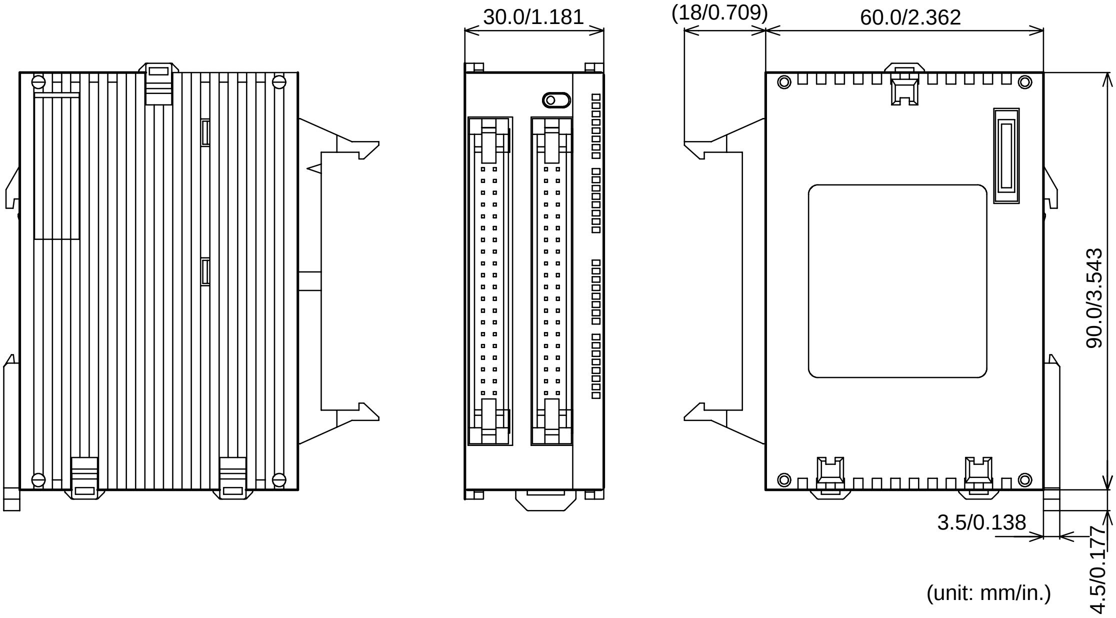


FPG-C24R2



13.12.2 Expansion Unit

FPG-XY64D2T



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Record of changes

Manual No.	Date	Description of changes
ARCT1F333E/ ACG-M333E	Sept. 2001	First edition
ARCT1F333E-1/ ACG-M333E-1	Feb. 2002	2nd edition S Additions: Control units - FPG-C32T2 - FPG-C24R2 Expansion unit - FPG-XY64D2T Tool software - FPWIN Pro Ver. 4

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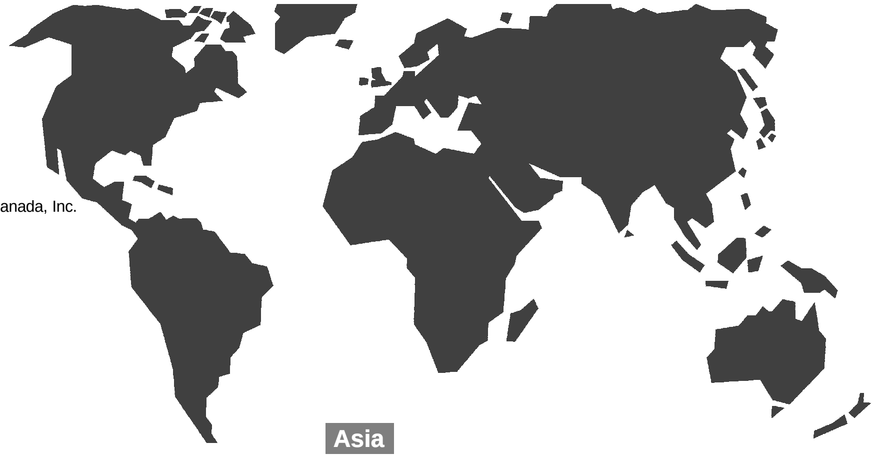

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