



PROGRAMMABLE CONTROLLER

FP Σ

User's Manual



FP Σ User's Manual
ARCT1F333E-7 08.06

Safety Precautions

Observe the following notices to ensure personal safety or to prevent accidents.

To ensure that you use this product correctly, read this User's Manual thoroughly before use.

Make sure that you fully understand the product and information on safe.

This manual uses two safety flags to indicate different levels of danger.

WARNING

If critical situations that could lead to user's death or serious injury is assumed by mishandling of the product.

- Always take precautions to ensure the overall safety of your system, so that the whole system remains safe in the event of failure of this product or other external factor.
- Do not use this product in areas with inflammable gas. It could lead to an explosion.
- Exposing this product to excessive heat or open flames could cause damage to the lithium battery or other electronic parts.

CAUTION

If critical situations that could lead to user's injury or only property damage is assumed by mishandling of the product.

- To prevent excessive exothermic heat or smoke generation, use this product at the values less than the maximum of the characteristics and performance that are assured in these specifications.
- Do not dismantle or remodel the product. It could cause excessive exothermic heat or smoke generation.
- Do not touch the terminal while turning on electricity. It could lead to an electric shock.
- Use the external devices to function the emergency stop and interlock circuit.
- Connect the wires or connectors securely.
The loose connection could cause excessive exothermic heat or smoke generation.
- Do not allow foreign matters such as liquid, flammable materials, metals to go into the inside of the product. It could cause excessive exothermic heat or smoke generation.
- Do not undertake construction (such as connection and disconnection) while the power supply is on.
It could lead to an electric shock.

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- Matsushita Electric Works, Ltd. pursues a policy of continuous improvement of the Design and performance of its products, therefore, we reserve the right to change the manual/ product without notice.

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Before You Start

Operating environment

(Use the unit within the range of the general specifications when installing)

- Ambient temperatures: 0 ~ +55 °C
- Ambient humidity: 30% to 85% RH (at 25°C, non-condensing)
- For use in pollution Degree 2 environment.
- Do not use it in the following environments.
 - Direct sunlight
 - Sudden temperature changes causing condensation.
 - Inflammable or corrosive gas.
 - Excessive airborne dust, metal particles or saline matter.
 - Benzine, paint thinner, alcohol or other organic solvents or strong alkaline solutions such as ammonia or caustic soda.
 - Direct vibration, shock or direct drop of water.
 - Influence from power transmission lines, high voltage equipment, power cables, power equipment, radio transmitters, or any other equipment that would generate high switching surges. (100mm or more)

Static electricity

- Do not touch connector pins directly to prevent static electricity from causing damage.
- Always rid yourself of any static electricity before handling this product.

Power supplies

- Twist the wires of the power supply.
- The unit has sufficient noise immunity against the noise generated on the power line.
However, it is recommended to take measures for reducing noise such as using a isolating transformer before supplying the power.
- Allocate an independent wiring for each power supplying line, input/output device and operating device.
- If using a power supply without a protective circuit, power should be supplied through a protective element such as a fuse.
- Be sure to supply power to a control and an expansion units from a single power supply.
Turning on/off of the power of all the units must be conducted simultaneously.

Power supply sequence

In order to protect the power supply sequence, make sure to turn off the control unit before the input/output power supply. If the input/output power supply is turned off before the control unit, or if the control unit is not shut off momentarily, the controller detects change of input level, and might conduct an unexpected 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.
 - For information on the operating procedure, refer to the manuals of tool software.
- (Tool software: FPWIN Pro, FPWIN GR)

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.

Battery

Do not install the battery when it is not used.

There is a possibility of leak if the battery remains discharged.

Differences in Functions Between Versions of Controller

Usable model	Version	Usable functions																		
12k type	V1.11	Addition of F174(SP0H) instruction By SYS1 instruction Detection edge setting for external input interrupt MEWTOCOL-COM Response time setting																		
	V1.20	Writing into DT90014, DT90037, DT90038 by F0(MV) instruction																		
	V1.24	Operand and index modificaiton by F12(ICRD)/P13(ICWT) instruction																		
	V1.30	Shortening of polling cycle by MEWTOCOL-COM during 1:N communication																		
	V1.40	Setting for dealing the previous value of DF instruction in the system register 4th bit D and MC 60-step acceleration/deceleration by F171(SPDH) instruction Target value match stop mode by F172(PLSH) instruction																		
	V1.50	<u>R9005 and R9006 is always announced when the batter error occurs.</u> <u>Change in the detection timing of the battery error. It is detected 2 seconds after the power is on.</u>																		
12k type	V2.00	<u>Left expansion refresh is available.</u>																		
	V2.01	Operand and index modificaiton by F12(ICRD)/P13(ICWT) instruction																		
	V2.10	Shortening of polling cycle by MEWTOCOL-COM during 1:N communication																		
	V2.40	Setting for dealing the previous value of DF instruction in the system register 4th bit D and MC																		
	V2.50	<u>R9005 and R9006 is always announced when the batter error occurs.</u> <u>Change in the detection timing of the battery error. It is detected 2 seconds after the power is on.</u>																		
32k type	V3.00	<u>Interrupt program can be started when the high-speed counter target value matches.</u> <u>Scan time display in 100us unit</u> <u>10us ring counter DT90020</u> <u>General-purpose communication function with TOOL port</u> <u>MODBUS-RTU master/slave communication function (COM1, COM2)</u> <u>MEWTOCOL-COM master communication function (COM1, COM2)</u> <u>32k-step program capacity</u> <u>Enhancement of comment capacity</u> <u>Enhancement of security functions</u> If failed to input a correct 4-digit password for 3 times in succession, the oepration cannot be continued. 8-digit password Prohibition of program readout Forced cancel of security Reading of security information <u>Reverse setting function of PC link (32k type only)</u> <u>R9005 and R9006 is always announced when the batter error occurs.</u> <u>Change in the detection timing of the battery error. It is detected 2 seconds after the power is on.</u> <u>Real number basic compare instructions 18 types</u> <table> <tr> <td>STF=S1, S2</td><td>ANF=S1, S2</td><td>ORF=S1, S2</td></tr> <tr> <td>STF<>S1, S2</td><td>ANF<>S1, S2</td><td>ORF<>S1, S2</td></tr> <tr> <td>STF>S1, S2</td><td>ANF>S1, S2</td><td>ORF>S1, S2</td></tr> <tr> <td>STF>=S1, S2</td><td>ANF>=S1, S2</td><td>ORF>=S1, S2</td></tr> <tr> <td>STF<S1, S2</td><td>ANF<S1, S2</td><td>ORF<S1, S2</td></tr> <tr> <td>STF<=S1, S2</td><td>ANF<=S1, S2</td><td>ORF<=S1, S2</td></tr> </table>	STF=S1, S2	ANF=S1, S2	ORF=S1, S2	STF<>S1, S2	ANF<>S1, S2	ORF<>S1, S2	STF>S1, S2	ANF>S1, S2	ORF>S1, S2	STF>=S1, S2	ANF>=S1, S2	ORF>=S1, S2	STF<S1, S2	ANF<S1, S2	ORF<S1, S2	STF<=S1, S2	ANF<=S1, S2	ORF<=S1, S2
STF=S1, S2	ANF=S1, S2	ORF=S1, S2																		
STF<>S1, S2	ANF<>S1, S2	ORF<>S1, S2																		
STF>S1, S2	ANF>S1, S2	ORF>S1, S2																		
STF>=S1, S2	ANF>=S1, S2	ORF>=S1, S2																		
STF<S1, S2	ANF<S1, S2	ORF<S1, S2																		
STF<=S1, S2	ANF<=S1, S2	ORF<=S1, S2																		

Usable model	Version	Usable functions
32k type	V3.00	<u><Special instructions></u> F230 (TMSEC) F231 (SECTM) F354 (FSCAL) <u><Serial data conversion></u> F250 (BTOA) Binary → ASCII conversion F251 (ATOB) ASCII → Binary conversion <u><SYS instructions></u> UP/DOWN switching of HSC by SYS1 instruction Addition of 8-digit password operaton by SYS1 instruction Addition of operation by SYS2 instruction <u>MODBUS master instructions</u> F145 (SEND) Data send F146 (RECV) Data receive <u>MEWTOCOL master instruction</u> F145 (SEND) Data send F146 (RECV) Data receive <u>F356 (EZPID) Easy PID instruction</u> <u><Partial I/O refresh></u> Partial I/O refresh for FP0 expansion <u><10us ring counter current value read></u> F0 (MV) DT90020, D <u><New PID instruction></u> F356 (EZPID)
32k type	V3.10	<u>F182(FILTR) Time constant processing</u> <u>Sampling trace function (Refer to Chapter 9.)</u> Sampling by instrucionts F155(SMPL) Sampling F156(STRG) Sampling trigger Sampling by specifying time <u>Leading contact, trailing contact instructions</u> ST↑ AN↑ OR↑ ST↓ AN↓ OR↓ <u>An arbitrary device can be specified for the setting value of Timer/counter instruction.</u> e.g.) TML 0, DT0 <u>Other additional convenient instructions</u> F252(ACHK) ASCII data check F284(RAMP) Inclination output Baud rate setting (300, 600, 1200 bps) by SYS instruction <u>High-speed operaiton</u> F0(MV) and F1(DMV) instructions Execution time: Approx. 1us Only when every operands are without index modifier. <u>Function addition to exsiting instructions</u> F70(BCC) Block check code calculation F356(EZPID) Easy PID instruction



Reference: <Programming Manual ARCT1F313E>

Programming Tool Restrictions

Type of programming tool		Type of unit			
		FPG-C32T FPT-C32TTM	FPG-C32T2 FPG-C28P2 FPG-C24R2 FPG-C32T2TM FPG-C28P2TM FPG-C24R2TM	FPG-C32TH FPG-C32THTM	FPG-C32T2H FPG-C28P2H FPG-C24R2H FPG-C32T2HTM FPG-C28P2HTM FPG-C24R2HTM
Windows software	FPWIN GR Ver.2	Used	Used (Ver. 2.1 or later) ^{Note1)}	Used (Ver. 2.6 or later)	Used (Ver. 2.6 or later)
	FPWIN GR Ver.1	Not used	Not used	Not used	Not used
Windows software Conforms to IEC61131-3	FPWIN Pro Ver.5	Used	Used	Used (Ver. 5.2 or later)	Used (Ver. 5.2 or later)
	FPWIN Pro Ver.4	Used	Used (Ver. 4.01 or later) ^{Note2)}	Not used	Not used
MS-DOS software	NPST-GR Ver.4	Not used	Not used	Not used	Not used
	NPST-GR Ver.3	Not used	Not used	Not used	Not used
Handy programming unit	AFP1113V2 AFP1114V2	Not used	Not used	Not used	Not used
	AFP1113 AFP1114	Not used	Not used	Not used	Not used
	AFP1111A AFP1112A AFP1111 AFP1112	Not used	Not used	Not used	Not used

Note1) Either Ver. 2.13 or later is necessary for using FPΣ positioning unit.

Note2) Either Ver. 4.02 or later is necessary for using FPΣ positioning unit.



Note: Precautions concerning version upgrade

- In case of using FPWIN GR Ver.1, please purchase upgrade model FPWIN GR Ver.2.
- FPWIN GR Ver. 2.0 can be upgraded to Ver. 2.1 or later free of charge at our web site (<http://www.mew.co.jp/ac/e/fasys/>).
- FPWIN GR Ver. 4.0 can be upgraded to Ver. 4.1 or later free of charge at our web site (<http://www.mew.co.jp/ac/e/fasys/>).
- FPWIN GR Ver. 5.0 can be upgraded to Ver. 5.1 or later free of charge at our web site (<http://www.mew.co.jp/ac/e/fasys/>).
- In case of using FPWIN Pro Ver. 4.0 with FPΣ 32k type, please purchase upgrade model FPWIN GR Ver.5.

When Changing Ladder Program from 12k Type to 32k Type

It is necessary to convert the program to change the ladder program that is used for the FPΣ 12k type to the one for FPΣ 32k type.

Program Conversion

When the FPWIN GR is used to change the model, the system register is automatically initialized.

If the setting value has been changed from the default value, note it down before the program conversion.

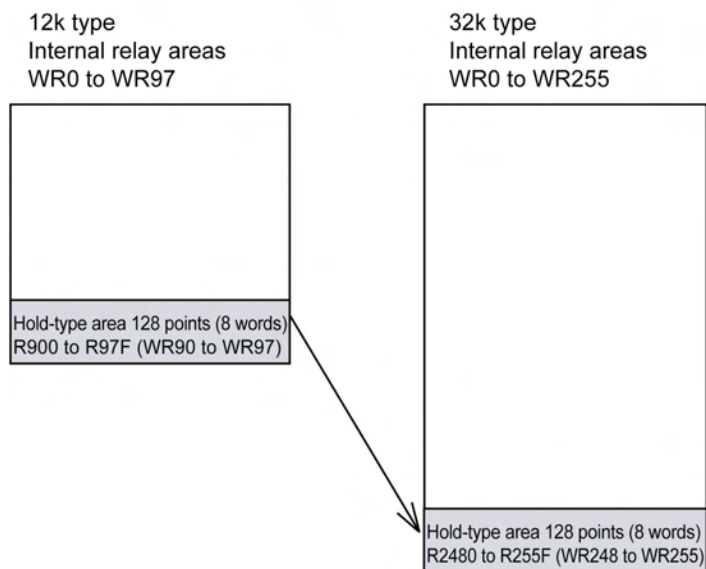
Number of points of internal relay for the 32k type is different from the 12k type.

The hold-type areas differ (automatic backup areas when the power supply was cut off) as the figure shown below.

When the hold-type area in the internal relay is used, the program for that part should be converted.

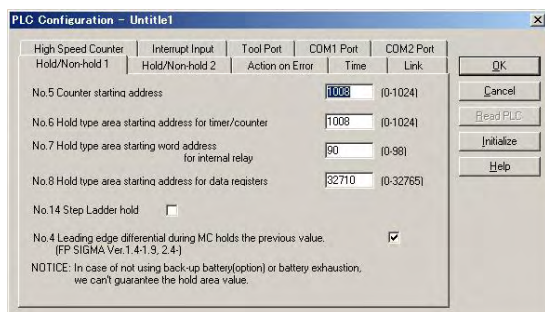
(As the number of points for the counter, timer, DT and special DT is the same for the 12k type and 32k type, the program conversion is not necessary.)

Explanation of Internal relay automatic backup areas when the power supply was cut off.

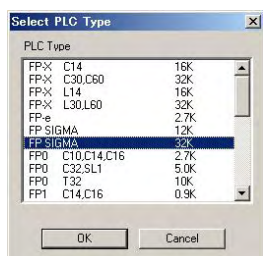


Procedure of Program Conversion

1. Retrieve a program to be converted with FPLWIN GR.

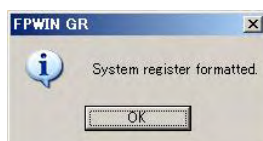


2. Select "Option" → "PLC Configuration" in the menubar.
Note down the setting value for the system registers.

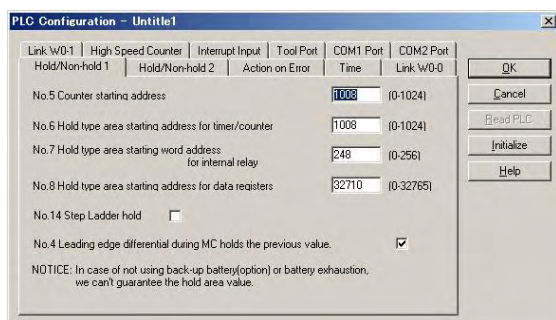


3. Select "Tool" → "Change PLC Type".

Select "FPSIGMA 32K" and click "OK" button.



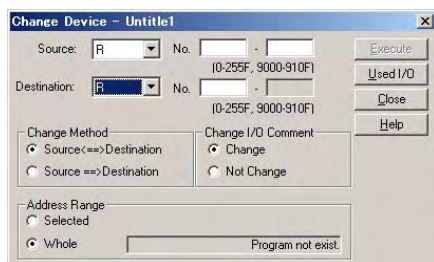
4. A message "System register formatted." is indicated.
Click "OK" button.



5. Select "Option" → "PLC Configuration".
Input the values noted down in procedure 2.

Note) When the battery is not used, the system register No. 7 "Hold type area starting word address for internal relay" should be set to "248" that is the default value for the FPΣ 32k type.

6. For the program using the hold-type area in the internal relay (R900 to R97F and WR90 to WR97), the device should be changed to the hold-type area for the FPΣ 32k type (R2480 to R255F and WR248 to WR255).



Select "Edit" → "Change Device".

Click the ▼ buttons of "Source" and "Destination" to select "R" and "WR" from the pulldown menu, and change the values.

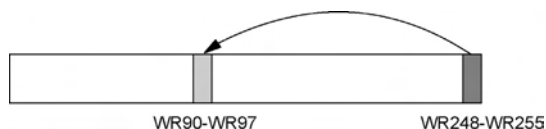
How to change an existing program

It is an easy method for changing an existing program by partially adding a program without modifying the existing program.

(When a programmable display is connected, it is not necessary to change the R and WR that are referred for the switches and data parts in the programmable display.)

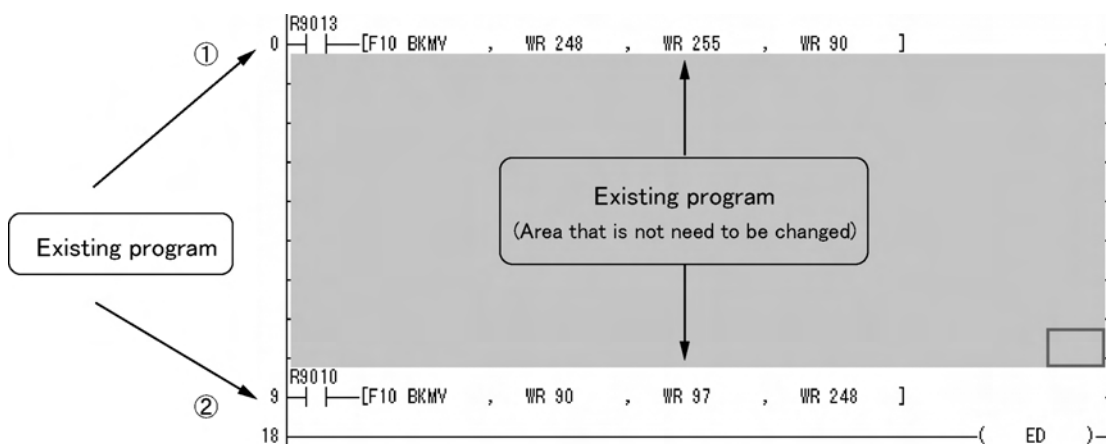
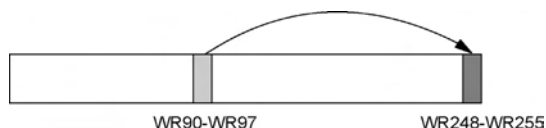
1. At the beginning of a program

Data in the hold-type area is transferred to the existing area only once when the power supply turns on.



2. At the end of a program

Data in the hold-type area is always transferred to the existing area.



<Explanation of the program>

- ① Transfers the contents stored in the hold-type area (WR248 to WR255) to the existing hold-type area WR90 to WR97 when the power supply turns on, and returns the previous state before the power supply turns off (because the area WR90 to WR97 cannot be held without a battery on V3).
- ② After returning to the previous state that is the one before the power supply turns off, always transfers the WR operated during the scan or the information of R input from the programmable display (WR90 to WR97) to the hold-type area (WR248 to WR255). And prepares for holding data when the power supply turns off.

Compatibility with 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 FP0	For FPΣ
Trapezoidal control	F168(SPD1)	F171(SPDH)
Jog feed	F169(PLS)	F172(PLSH)
Data table control	None	F174(SP0H)
Linear interpolation control	None	F175(PSH) ^{Note1)}
Circular interpolation control	None	F176(SPCH) ^{Note1)}
PWM output	F170(PWM)	F173(PWMH)

Availability of linear and circular interpolation control is limited depending on the types of FPΣ Control Unit.

Type	Using F175, F176
C32/C32TH C32H/C32HTM	Not available
C32T2/C32T2TM C32T2H/C32T2HTM	Available
C28P2/C28P2TM C28P2H/C28P2HTM	Available
C24R2/C24R2TM C24R2H/C24R2HTM	Not available

• 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 FP0	For FPΣ
Serial data communication	F144(TRNS)	F159(MTRN) ^{Note2)}

Note) 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

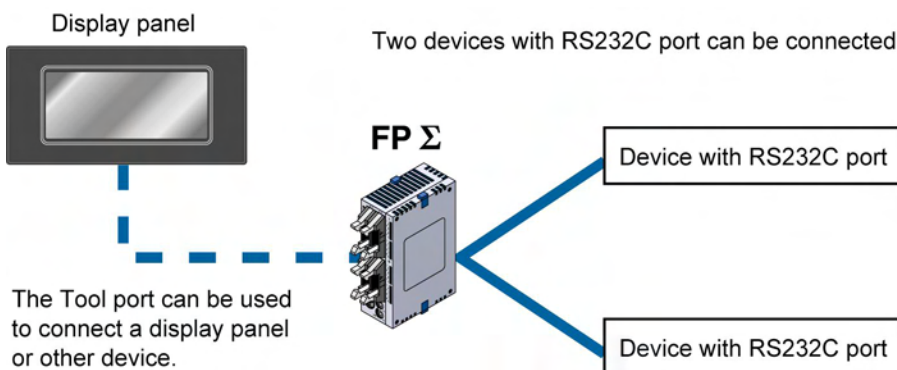
All of the functions of a mid-scale PLC are packed into the compact body size of the 32-point type FP0. A program capacity of 12k steps or 32k steps is provided as a standard feature, so you never have to worry about how much memory is left as you're programming. In addition, 32k words are reserved for 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 (up to 99 units) and PC(PLC) link function (up to 16 units).

Controlling two devices with RS232C port with one FPΣ

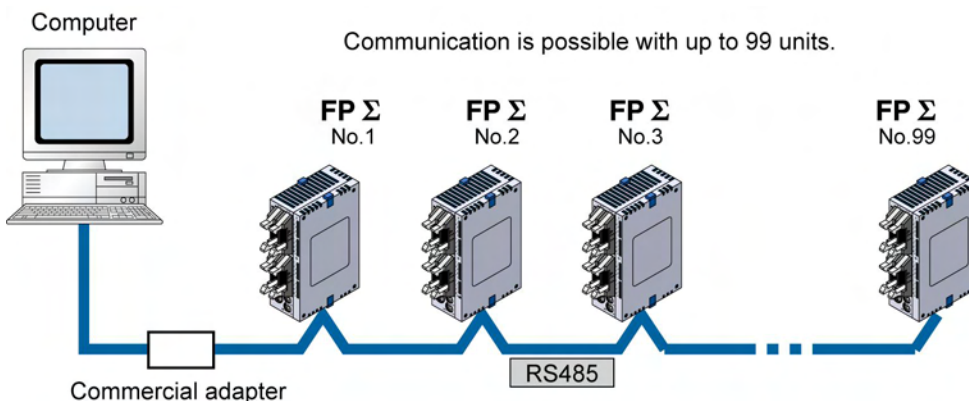
When using the 2-channel RS232C type communication cassette



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

When using the 1-channel RS485 type communication cassette

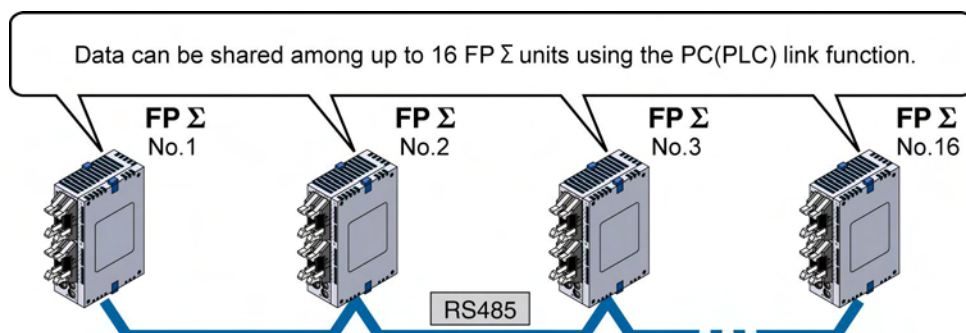
When using the 1-channel RS485 and 1-channel RS232C in combination



Data can be share among the various PLCs using the PC(PLC) link function

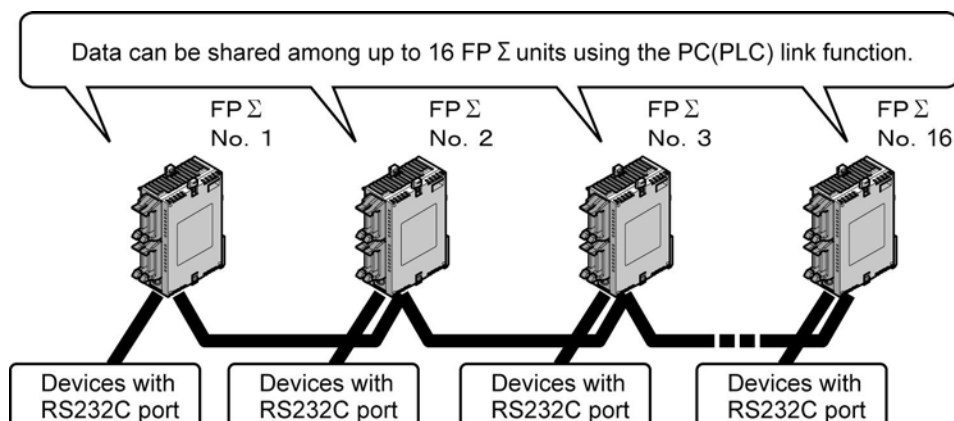
When using the 1-channel RS485 type communication cassette

When using the 1-channel RS485 and 1-channel RS232C combination type



PC(PLC) link function (up to 16 units) or 1:N communication (up to 99 units) with RS232C devices

When using the 1-channel RS485 and 1-channel RS232C in combination



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.

Type with thermister input function

For the units of which part numbers or product numbers end in "TM", the leader line which enables the thermister input is equipped instead of an analog potentionmeter. The change of the resistance value of the thermister can be taken in as an analog value.

(The thermister of which resistance value is from 200 to 75 k Ω can be used.)

Calender timer function can be added

Optional backup battery enables the calender timer function.

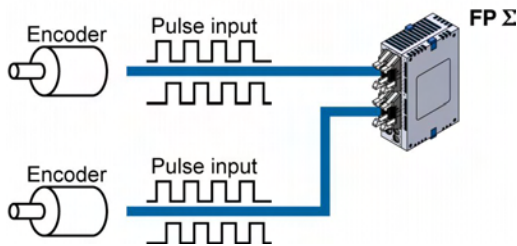
Positioning control supported through high-speed counter and pulse output

A high-speed counter and pulse output functions are provided as standard features. The pulse output function supports frequencies of up to 100kHz, 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.

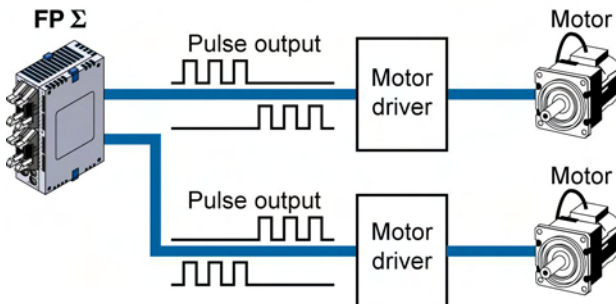
1- phase: Max. 50kHz, 2-phase: Max. 20kHz



Positioning control based on pulse output supported

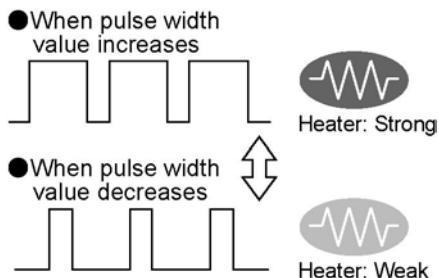
Pulse/direction and clockwise/counter –clockwise output are supported.

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



Heater control based on PWM output function supported

The pulse output at any duty ratio can be picked up with special instruction.



Security functions have been enhanced.

1. Upload protection. (Enables not to upload programs.)
2. 8-digit alphanumeric password
3. 4-digit numeric password

Easy temperature control instruction has been added.

It enables to perform the operation easily like a temperature control device.
Single-line PID instruction has been added.

Three-port general purpose serial communication

The tool port also supports the general-purpose serial communication.

Modbus RTU master unit and slave units

Communication with a temperature control device, inverter or measuring instruments can be performed with simple programs using the FPΣ as a master unit.
Communication with the existing network can be performed using the FPΣ as slave units.

MEWTOCOL master unit

Programs for the MEWTOCOL communication master unit can be easily created.

Rewrite function during RUN

Programs can be changed during RUN up to 512k steps.

1.2 Unit Types

1.2.1 FPΣ Control Unit

12k type

Name	Number of I/O points	Part No.	Product No.
FPΣ Control unit	Input: 16 points/Transistor output: 16 points NPN	FPG-C32T	AFPG2543
	Input: 16 points/Transistor output: 16 points NPN	FPG-C32T2	AFPG2643
	Input: 16 points/Transistor output: 12 points PNP	FPG-C28P2	AFPG2653
	Input: 16 points/Relay output: 8 points	FPG-C24R2	AFPG2423
FPΣ Control unit With thermister input function	Input: 16 points/Transistor output: 16 points NPN	FPG-C32TTM	AFPG2543TM
	Input: 16 points/Transistor output: 16 points NPN	FPG-C32T2TM	AFPG2643TM
	Input: 16 points/Transistor output: 12 points PNP	FPG-C28P2TM	AFPG2653TM
	Input: 16 points/Relay output: 8 points	FPG-C24R2TM	AFPG2423TM

Note) The FPΣ expansion I/O unit cannot be added to FPG-C32T nor FPG-C32TTM FPΣ control unit.

32k type

Name	Number of I/O points	Part No.	Product No.
FPΣ Control unit (High capacity type) Program capacity: 32k	Input: 16 points/Transistor output: 16 points NPN	FPG-C32TH	AFPG2543H
	Input: 16 points/Transistor output: 16 points NPN	FPG-C32T2H	AFPG2643H
	Input: 16 points/Transistor output: 12 points PNP	FPG-C28P2H	AFPG2653H
	Input: 16 points/Relay output: 8 points	FPG-C24R2H	AFPG2423H
FPΣ Control unit (High capacity type) Program capacity: 32k With thermister input function	Input: 16 points/Transistor output: 16 points NPN	FPG-C32HTM	AFPG2543HTM
	Input: 16 points/Transistor output: 16 points NPN	FPG-C32T2HTM	AFPG2643HTM
	Input: 16 points/Transistor output: 12 points PNP	FPG-C28P2HTM	AFPG2653HTM
	Input: 16 points/Relay output: 8 points	FPG-C24R2HTM	AFPG2423HTM

Note) The FPΣ expansion I/O unit cannot be added to FPG-C32TH nor FPG-C32HTM FPΣ control unit.

1.2.2 FPΣ Expansion Unit

Name	Specifications	Part No.	Product No.	Manual
FPΣ Expansion I/O unit	Input: 32 points/Transistor output: 32 points NPN	FPG-XY64D2T	AFPG3467	This manual
	Input: 32 points/Transistor output: 32 points PNP	FPG-XY64D2P	AFPG3567	
FPΣ Positioning unit	Transistor output: 1-axis type	FPG-PP11	AFPG430	ARCT1F 365E
	Transistor output: 2-axis type	FPG-PP21	AFPG431	
	Line driver output: 1-axis type	FPG-PP12	AFPG432	
	Line driver output: 2-axis type	FPG-PP22	AFPG433	
FPΣ Expansion data memory unit	256 kbyte	FPG-EM1	AFPG201	This manual
FPΣ CC-Link slave unit	Number of points of exchanged data with CC-Link master station Max. 224 points (Input: 112 points, output: 112 point) Writing max. 16-word data Reading 4-word data	FPG-CCLS	AFPG7943	ARCT1F 380E
FPΣ S-LINK unit	128 input/output points using S-LINK	FPG-SL	AFPG780	ARCT1F 403E

Note) The FPΣ expansion I/O unit cannot be added to FPG-C32T nor FPG-C32TTM FPΣ control unit.

1.2.3 FP0 Expansion Unit

The FP0 series expansion I/O unit and intelligent unit can be used on FPΣ.



Example: <FP0 User's manual ARCT1F251>

1.2.4 Communication Cassette

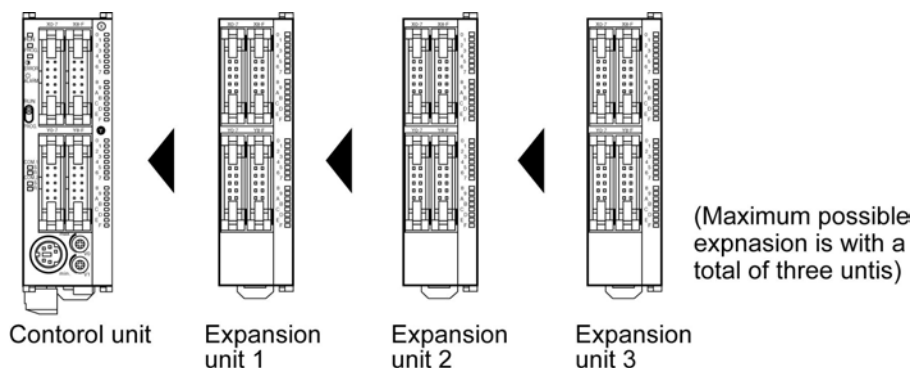
Name	Description	Part No.	Product No.
FPΣ Communication cassette 1-channel RS232C type	This communication cassette is a 1-channel unit with a five-wire RS232C port. RS/CS control is possible.	FPG-COM1	AFPG801
FPΣ Communication cassette 2-channel RS232C type	This communication cassette is a 2-channel unit with a three-wire RS232C port. 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.	FPG-COM3	AFPG803
FPΣ Communication cassette 1-channel RS485 type & 1-channel RS232C type	This communication cassette is a 1-channel unit with a two-wire RS485 port and a 1-channel unit with a three-wire RS232C port.	FPG-COM4	AFPG806

1.2.5 Related parts

Name	Description	Product No.
FPΣ battery	Necessary for the backup of data registers, etc or for using the calender function	AFPG804
10-wire I/O cable MIL one-sided socket type	With one-sided wire-press socket AWG #22 0.3 mm ² , 2 pcs	Cable length: 1 m AFP0521
		Cable length: 3 m AFP0523
FPΣ power supply cable	Maintenance parts (Packed with the control unit)	Cable length: 1 m AFPG805
FP0 terminal block socket (2 pcs)	Maintenance parts (Packed with the relay output type)	AFP0802
FP2 terminal block socket (2 pcs)	Maintenance parts (Packed with the Expansion I/O unit)	AFP2801
FP0 Wire-press shocket (2 pcs)	Maintenance parts (Packed with the Tr type)	AFP0807
FP0 mounting plate (slim type) (10 pcs)	Mounting plate to mount FP0 expansion unit on a panel vertically	AFP0803
FP0 mounting plate (slim 30 type) (10 pcs)	Mounting plate to mount FPΣ control unit, FPΣ expansion unit on a panel vertically	AFP0811
FP0 mounting plate (flat type)	Mounting plate to mount the control unit on a panel horizontally	AFP0804
Terminal driver	Necessary for the wiring of PHOENIX terminal	AFP0806

1.3 Restrictions on Unit Combinations

1.3.1 Restrictions on FP0 Expansion Unit



Up to three expansion units can be added on 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. A combination of relay output types and transistor output types is also possible.

Controllable I/O points

Type os control unit	Number of I/O points when using control unit	Number of I/O points when using FP0 expansion unit
FPG-C32	32 ponts	Max. 128 points
FPG-C28	28 points	Max. 124 points
FPG-C24	24 points	Max. 120 points ^{Note1)}

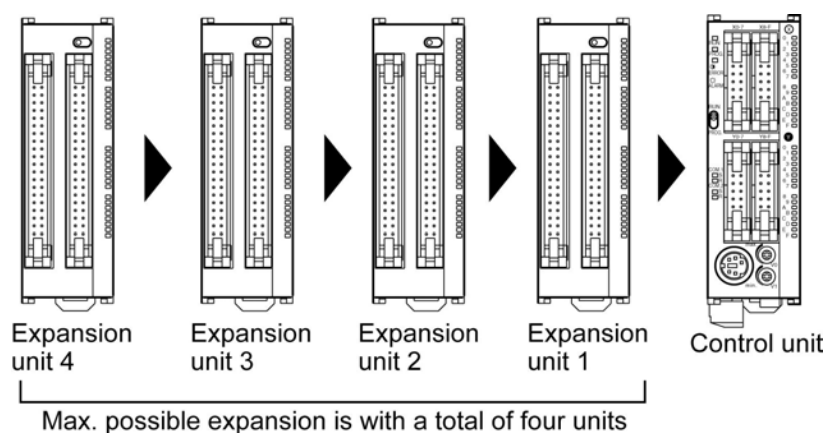
Note1) This is the number of points when combining with the transistor type FP0 expansion unit.



Note:

- Install the FP0 thermocouple unit on the right side of all other expansion units. If it is installed on the left side, the total precision will deteriorate.
- Install the FP0 CC-Link slave unit on the right side of the other expansion units. There is no expansion connector on the right side.

1.3.2 Restrictions on FPΣ Expansion Unit



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

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

Controllable I/O points

Type os control unit	Number of I/O points when using control unit	Number of I/O points when using FPΣ expansion unit
FPG-C32 ^{Note1)}	32 ponts	Max. 128 points ^{Note2)}
FPG-C28	28 points	Max. 124 points ^{Note2)}
FPG-C24	24 points	Max. 120 points

Note1) The FPΣ cannot be used for FPG-C32T, FPG-C32TTM, FPG-C32TH nor FPG-C32THTM.

Note2) This is the number of points when combining with the 64-point type FPΣ expansion unit.



Key Point:

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 FPG-C32T2 and FPG-C32T2TM.

1.4 Programming Tools

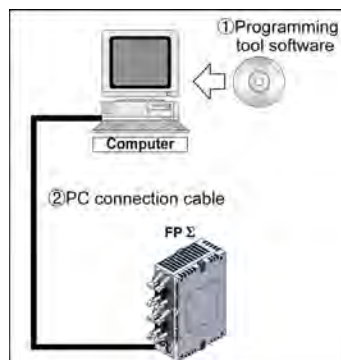
1.4.1 Tools Needed for Programming

1. Programming tool software

- The tool software can also be used with the FP series.
- “FPWIN Pro Ver.5” or “FPWIN GR Ver.2” Windows software is used with FPΣ.
FPWIN GR Ver.1x, NPST-GR and FP Programmer cannot be used.

2. PC connection cable

- The connection cable for DOS/V machine is available.



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	Product No.
FPWIN GR Ver.2 English-language menu	Full type	Windows®95 (OSR 2 or later)/ Windows®98/ Windows®Me/ WindowsNT® (Ver. 4 or later)/ Windows®2000/ Windows®XP Windows Vista®	40MB or more	AFPS10520
	Small type			AFPS11520
	Upgrade version			AFPS10520R

Note1) Ver.1.1 must be installed to install the upgrade version.

Note2) Ver.2.0 can be upgraded to Ver. 2.1 or later free of charge at our web site
(<http://www.mew.co.jp/ac/e/fasys/>).

Note3) The small type can be used only for each series of FP-e, FPΣ, FP0, FP-X, FP1 and FP-M.

Conforms to IEC61131-3 programming tool software FPWIN-Pro Ver.5

Type of software		OS (Operating system)	Hard disk capacity	Product No.
FPWIN Pro Ver.5 English-language menu	Full type	Windows®95 (OSR 2 or later)/ Windows®98/ Windows®Me/ WindowsNT® (Ver. 4 or later)/ Windows®2000/ Windows®XP Windows Vista®	100MB or more	AFPS50550
	Small type			AFPS51550

Note1) Ver.5.0 can be upgraded to Ver. 5.1 or later free of charge at our web site
(<http://www.mew.co.jp/ac/e/fasys/>).

Note2) The small type can be used only for each series of FP-e, FPΣ, FP0, FP-X, FP1 and FP-M.

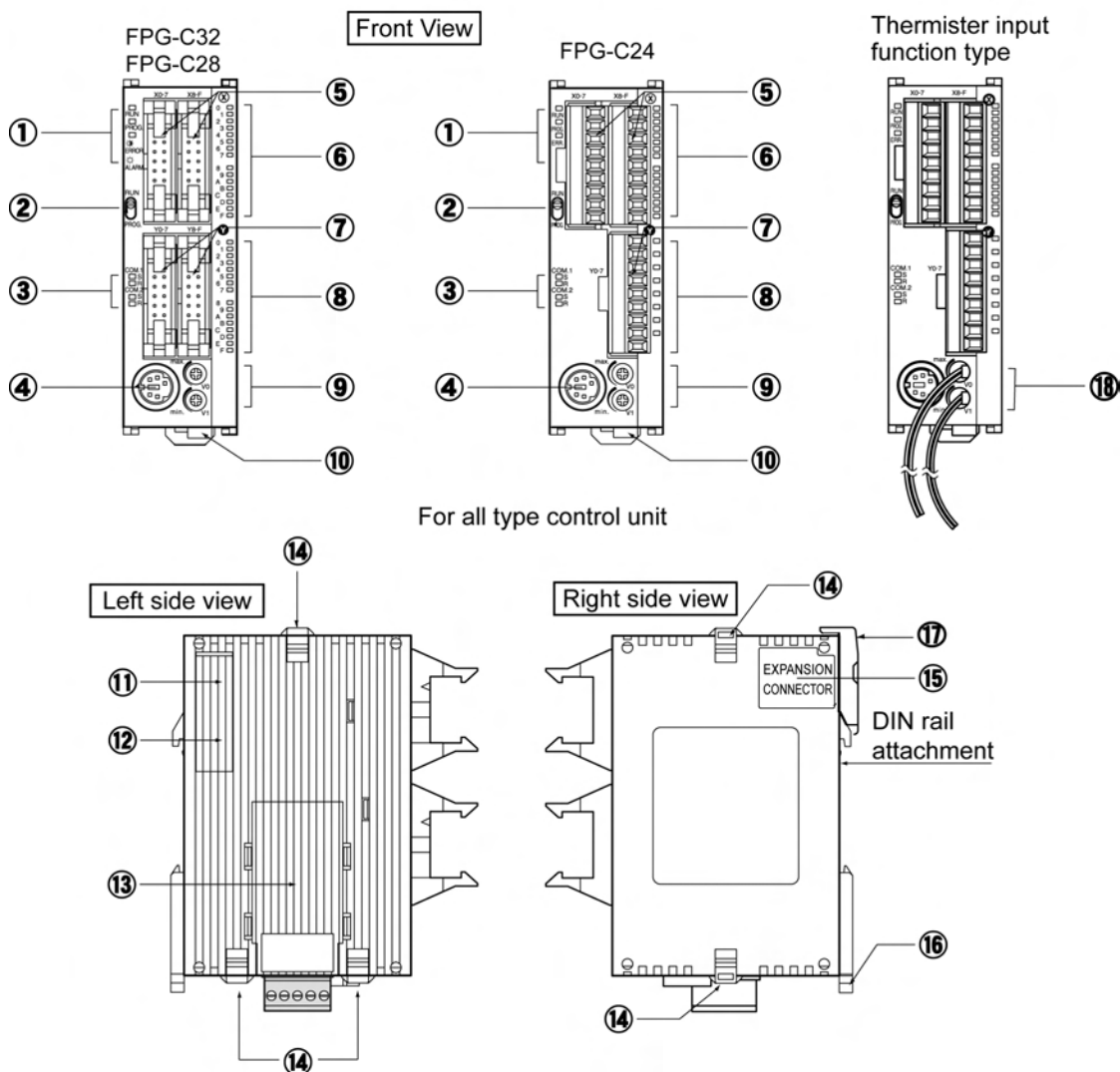
Type of computer and suitable cable

Connector	Specifications	Product No.
D-sub 9-pin	D-sub 9-pin female-Mini DIN round 5-pin	AFC8503
	D-sub 9-pin female-Mini DIN round 5-pin straight type	AFC8503S

Chapter 2

Specifications and Functions of the Unit

2.1 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. Lights when in the PROG. Mode during forced input/output. 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. (ERROR) Lights if a hardware error occurs, or if operation slows because of the program, and the watchdog timer is activated. (ALARM)

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.

- The remote switching operation from the programming tool is operable.
- When performing remote switching from the programming tool, the setting of the mode switch and the actual mode of operation may differ. Verify the mode with the status indicator LED.
- Restart FPΣ to operate in the mode set with the RUN/PROG. mode switch.

③ Communication status LEDs

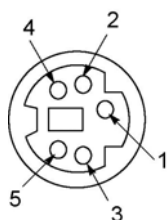
These LEDs display the communication status of the COM.1 and COM.2 ports.

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. (In case of 1-channel RS232C1 type, lights when the RS signal is ON.)
			Goes out when no data is being received.
	R	Received data monitor	Flashes while data is being received. (In case of 1-channel RS232C1 type, lights when the CS signal is ON.)
			Goes out when no data is being received.

④ Tool port (RS232C)

This port is used to connect a programming tool.

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	+5V	+5V	Unit → External device

- The followings are the default settings set when the unit is shipped from the factory. The system register should be used to change these.
 - Baud rate 9600 bps
 - Character bit 8 bit
 - Parity check Odd parity
 - Stop bit length .. 1 bit

⑤ Input connector

⑥ Input indicator LEDs

⑦ Output connector

⑧ Output indicator LEDs

⑨ Analog potentiometer (analog dial)

(excluding the type of which part No. and product No. ends in TM)

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



Example: <2.4 Analog potentiometer>

⑩ Power supply connector (24V DC)

Supply 24V DC. It is connected using the power supply cable (AFPG805) that comes with the unit.

⑪ Left-side connector for FPΣ expansion

This is used to connect dedicated FPΣ expansion unit on the left side of the control unit with the internal circuit.

Note) FPG-C32T nor FPG-C32TTM control units are not equipped with this connector.

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.) of the tool port cannot be specified. Also, in case of using a 2-channel cassette, the same station No. is specified for both channels.

(It is possible to set individually for the setting with the system register.)



The unit No. (station No.) setting switch is located under the cover on the back of the unit. Specify the unit (station) No. using the selector switch and the dial.

⑬ Communication cassette (option)

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

- 1-channel RS232C type
- 2-channel RS232C type
- 1-channel RS485 type
- 1-channel RS485 and 1-channel RS232C type in combination



Example: <Chapter 7, Communication Cassette >

⑭ Expansion hook

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

⑮ Right-side connector for FP0 expansion

This is used to connect an expansion unit to the internal circuit of the control unit.

(The connector is located under the seal.)

⑮ DIN hook

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).

⑰ Battery cover

This is uncovered to mount the backup battery sold separately.

The backup of the calendar timer function or data register is possible with the backup battery.



Example: <5.7 Installation and setting of backup battery>
<2.6 Calendar timer>

⑱ Thermister input line (The end of part No. and product No. is TM type only)

It is used to connect the thermister to read the change in the resistance value of the thermister as analog input values.



Example: <2.5 Thermister input>

2.2 Input and Output Specifications

2.2.1 Input Specifications

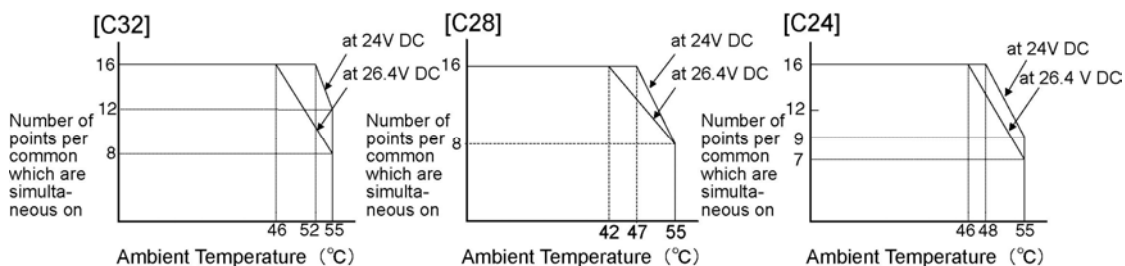
Input Specifications (for all types)

Item		Description
Insulation method		Optical coupler
Rated input voltage		24V DC
Operating voltage range		21.6 to 26.4V 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 C32, C28: 16 points/common (X0 to XF/1 common) For C24: 8 point/common (X0 to X7/1 common, X8 to XF/1 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: 19.2V DC/6 mA For X2, X5 to XF: 19.2V DC/3 mA
Max. off voltage/Max. off current		2.4V DC/1.3 mA
Input impedance		For X0, X1, X3, X4: approx. 3 k Ω For X2, X5 to X7: approx. 5.6 k Ω For X8 to XF: approx. 6.8 k Ω
Response time	off→on	For input X0, X1, X3, X4: 1 ms or less: normal input 5 μ s or less: high-speed counter, pulse catch, interrupt input settings ^{Note1)} For input X2, X5 to X7: 1 ms or less: normal input 100 μ s or less: high-speed counter, pulse catch, interrupt input settings ^{Note1)} For input X8 to XF 1 ms or less: normal input only
	on→off	Same as above
Operating mode indicator		LED display

Note1) this specification is applied when the rated input voltage is 24V DC and the temperature is 25°C/70°F.

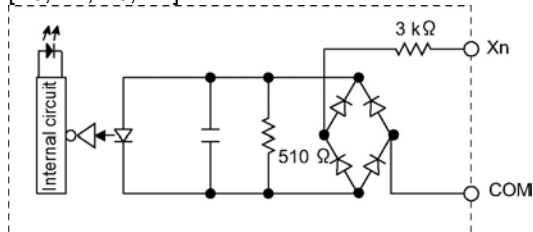
Limitations on number of simultaneous input on points

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

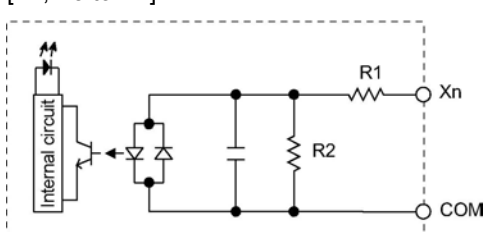


Circuit diagram

[X0, X1, X3, X4]



[X2, X5 to XF]



For X2, X5 to X7: R1=5.6kΩ R2=1kΩ

For X8 to XF: R1=6.8kΩ R2=820Ω

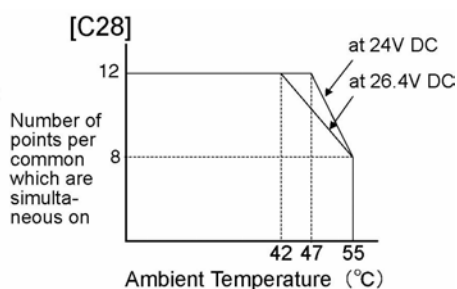
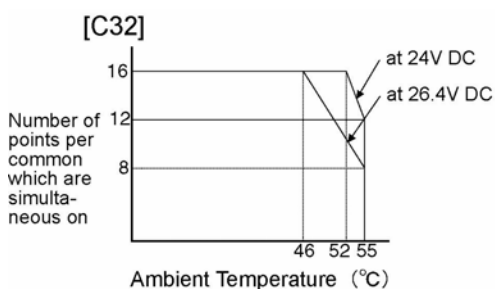
2.2.2 Output Specifications

Transistor output specifications

Item	Description	
	C32(NPN)	C28(PNP)
Insulation method	Optical coupler	
Output type	Open collector	
Rated load voltage	5 to 24V DC	24V DC
Operating load voltage range	4.75 to 26.4V DC	21.6 to 26.4V DC
Max. load current	For Y0, Y1, Y3, Y4: 0.3A For Y2, Y5 to YF: 0.1A	For Y0, Y1, Y3, Y4: 0.5A For Y2, Y5 to YB: 0.3A
Max. surge current	For Y0, Y1, Y3, Y4: 0.9A For Y2, Y5 to YF: 0.5A	For Y0, Y1, Y3, Y4: 1.5A For Y2, Y5 to YB: 0.7A
Output points per common	16 points/common	12 points/common
Off state leakage current	100 μ A or less	
On state voltage drop	0.5V or less	
Response time	off→on	For Y0, Y1, Y3, Y4 (at 15mA or less): 2 μ s or less For Y2, Y5 or later: 0.2ms or less
	on→off	For Y0, Y1, Y3, Y4 (at 15mA or less): 8 μ s or less For Y2, Y5 or later: 0.5ms or less
External power supply for driving internal circuit	Voltage	21.6 to 26.4V DC
	Current	70mA or less
Surge absorber	Zener diode	
Operating mode indicator	LED display	
Phase fault protection	Phase fault protection, thermal protection for Y2, Y5 or later	

Limitations on number of simultaneous output on points

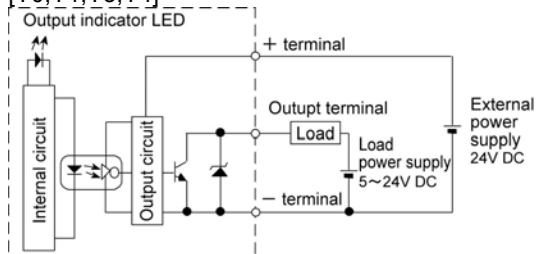
Keep the number of output points per common which are simultaneously on within the following range as determined by the ambient temperature.



Circuit diagram

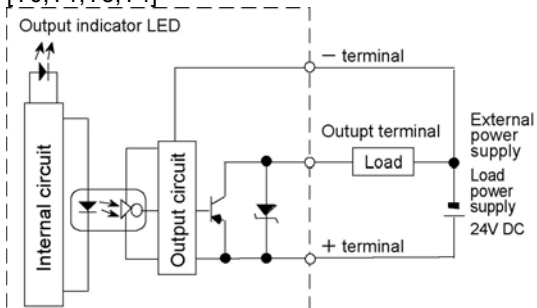
[C32]

[Y0,Y1,Y3,Y4]

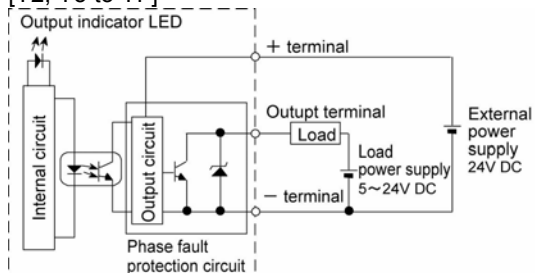


[C28]

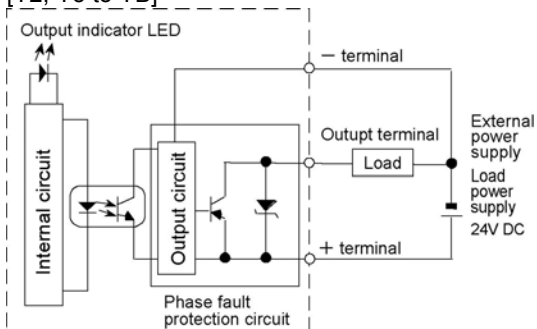
[Y0,Y1,Y3,Y4]



[Y2, Y5 to YF]



[Y2, Y5 to YB]



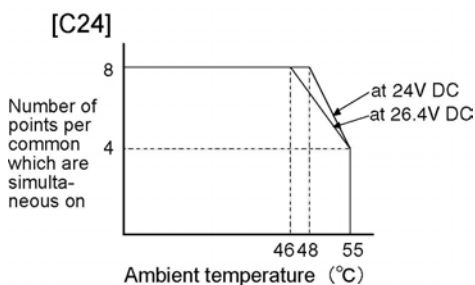
Relay output specifications (C24)

Item		Description
Output type		1a output
Rated control capacity		2A 250V AC, 2A 30V DC (4.5A per common or less) ^{Note1)}
Output points per common		8 points/common
Response time	off→on	Approx. 10ms
	on→off	Approx. 8ms
Mechanical lifetime		Min. 20,000,000 operations
Electrical lifetime		Min. 100,000 operations
Surge absorber		None
Operating mode indicator		LED display

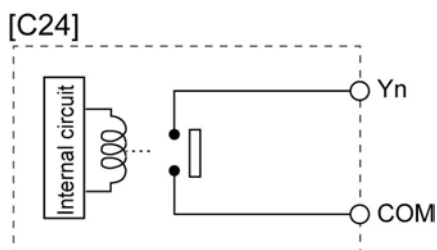
Note1) Resistance load

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.



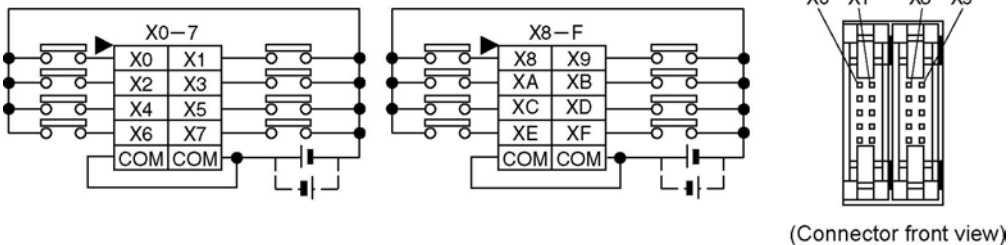
Circuit diagram



2.3 Terminal Layout Diagram

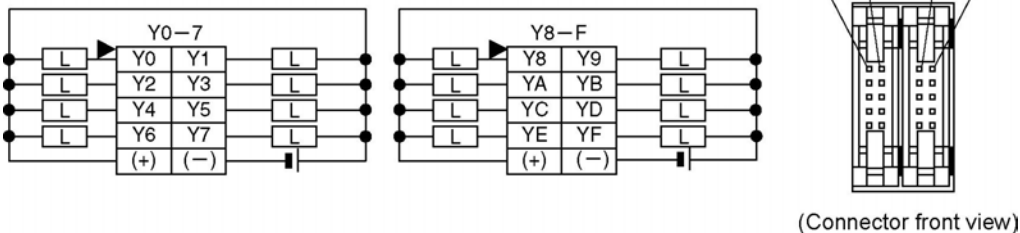
2.3.1 Control Unit (for C32)

Input



Note) The four COM terminals of input circuit are connected internally.

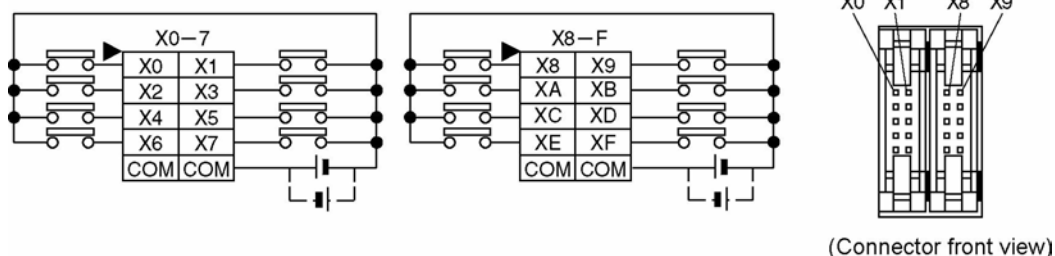
Output



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

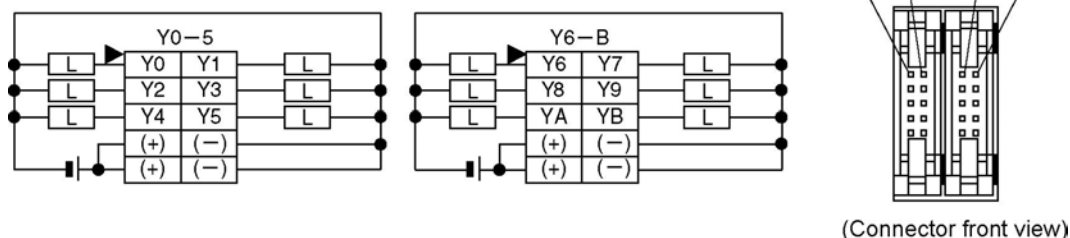
2.3.2 Control Unit (for C28)

Input



Note) The four COM terminals of input circuit are connected internally.

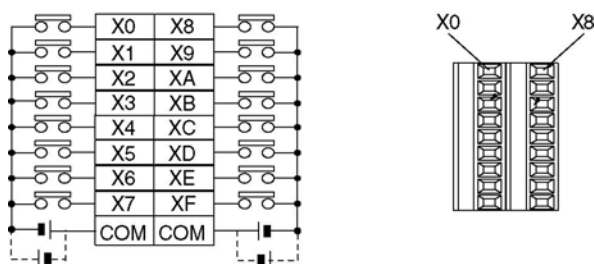
Output



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

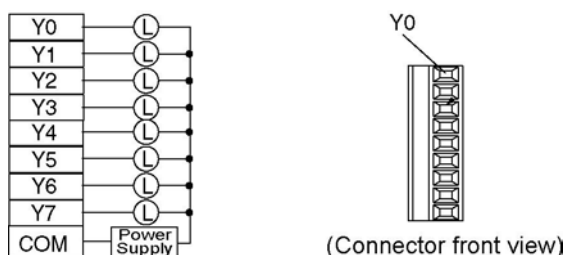
2.3.3 Control Unit (for C24)

Input



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

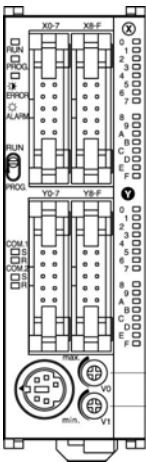
Output



2.4 Analog Potentiometer

2.4.1 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.

Applicable special data register

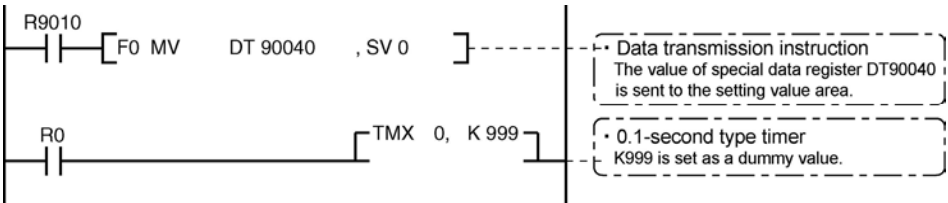
Symbol	Potentiometer No.	Special data register	Range of change
V0	Volume 0	DT90040	K0 to K1000
V1	Volume 1	DT90041	

2.4.2 Example Showing How to Use Analog Potentiometer

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.

Example: Writing 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.



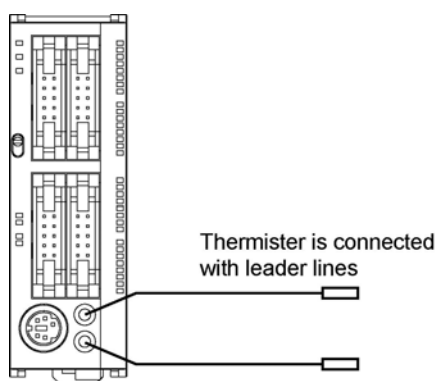
2.5 Thermister Input (Only for TM type)

2.5.1 Overview of Thermister Input

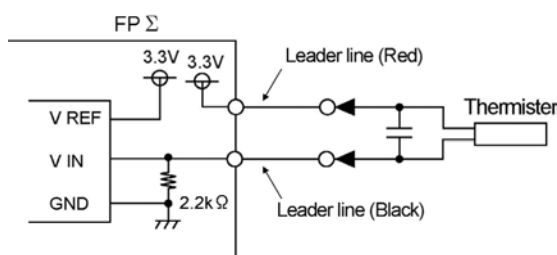
The control units of which part and product numbers end in “TM” is quipped with the leader lines which enable the thermister input instead of the analog potentiometer. The change in the termister’s resistance values can be loaded as analog values by connecting the thermister with these leader lines.

Mechanism for loading thermister input

- Loads the change in the resistance values of the thermister connected externally as the change in voltage, and then loads it as digital values by the AD converter in which a microcomputer is built.
- The values converted to digital values are reflected in the special data registers (DT90040 or DT90041) and can be read in the user’s program.



<Block diagram>



Non-isolated between the FPΣ thermister input unit and the power supply connector (24V).
The red leader line is connected with the 3.3V power supply and the black is connected with the Vin.

Total precision

Total precision

$$= (\text{Total precision of AD converter in which microcomputer is built: } \pm 5\text{LSB}^{\text{Note}}) + (\text{Precision of thermister})$$

Note) $\pm 5\text{LSB}$ means there is a margin of error of $\pm 5\text{LSB}$ for the values (0 to 1000) converted with AD converter.

Thermister resistance values and digital conversion values

- Use the following formula for conversion of thermister resistance values and digital conversion values.
- Digital conversion values changes within a range of K0 to K1000.

$$\text{Thermister resistance value (k}\Omega\text{)} = \frac{1024 \times 2.2}{(\text{Digital value} + 12)} - 2.2$$

Usable thermister

- Thermisters of which resistance values are within a range of 200Ω to 75kΩ.

Manufacturer	Thermister type (B constant)	Guide for Measuring range (°C)
Shibaura Electronics Co., Ltd.	3390 K	-50 to +100 °C
	3450 K	50 to +150 °C
	4300 K	+100 to +200 °C
	5133 K	+150 to +300 °C



Note:

- The length of the wiring between the FPΣ control unit and the thermister should be less than 10m.
- A thin wire (AWG28, length: 150 mm) is used for the leader line. Connect and bundle the wire without any stress.
- It is recommended to mount parts such as condensers externally if the converted value is unstable.

2.5.2 Loading of Thermister Temperature Data

Reading the value of the FPΣ special data register enables to load the analog value data that corresponds to the resistance value of the thermister.

Applicable special data register

Symbol	Thermister No.	Special data register	Digital value after conversion
V0	Thermister 0	DT90040	K0 to K1000
V1	Thermister 1	DT90041	

Thermister measuring temperature – A/D conversion table (example: 3450K)

- Work out the temperature and the thermister resistance value from the temperature characteristic table of the used thermister.
- The converted digital values can be calculated by the formula described in the previous page.

Temperature (°C)	Thermister resistance (kΩ)	Converted digital value	Resolution (°C)
50	4.3560	332	0.135
60	3.1470	409	0.130
70	2.3170	487	0.128
80	1.7340	561	0.135
90	1.3180	628	0.149
100	1.0170	688	0.167
110	0.7940	740	0.192
120	0.6277	785	0.222
130	0.5017	822	0.270
140	0.4052	853	0.323
150	0.3305	878	0.400

Note) (Total precision of AD converter in which microcomputer is built: $\pm 5\text{LSB}$) + (Precision of thermister) is not included in the above digital values.

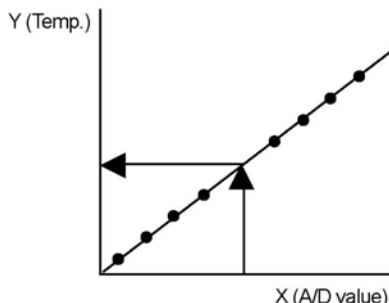
Conversion program using scaling instruction (F282)

- Appropriate data which interpolated from nonlinear data can be obtained by creating converted digital values and temperature data as a data table and executing the scaling instruction (F282).

| DT90040: Special data register
 |-----[F282 DT90040, DT0, DT100]-----
 | (Digital value after thermister input conversion)
 DT0: Beginning of data table
 DT100: Converted data (temperature)

Example of data table creation

Input data (Converted digital value)		Output data (Temperature)	
DT0	11		
DT1	332	DT12	50
DT2	409	DT13	60
DT3	487	DT14	70
•	•	•	•
•	•	•	•
DT11	878	DT22	150



Note) Specify (the number of data to be paired) + 1 for DT0.

2.6 Calendar Timer

If a backup battery is installed in the FPΣ, the clock/calendar function can be used. This function cannot be used without a backup battery.



Example: <5.7 Installation and setting of backup battery>

2.6.1 Area for Clock/Calendar Function

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

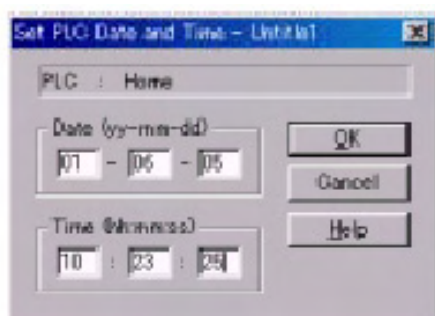
2.6.2 Setting of Clock/Calendar Function

There are two ways to set the clock/calendar function, as described below.

Setting using FPMWIN 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



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.

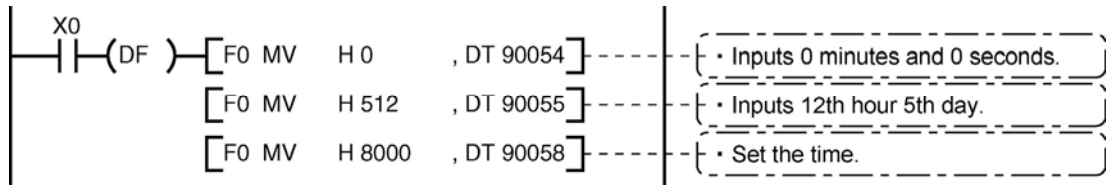
Setting and changing using program

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.



Note:

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

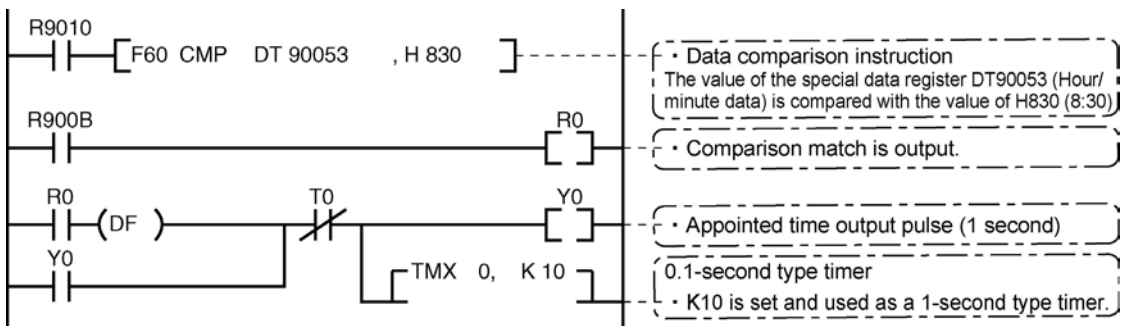
As a day of the week is not automatically set on FPWIN GR, fix what day is set to 00, and set each value for 00 to 06.

2.6.3 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.

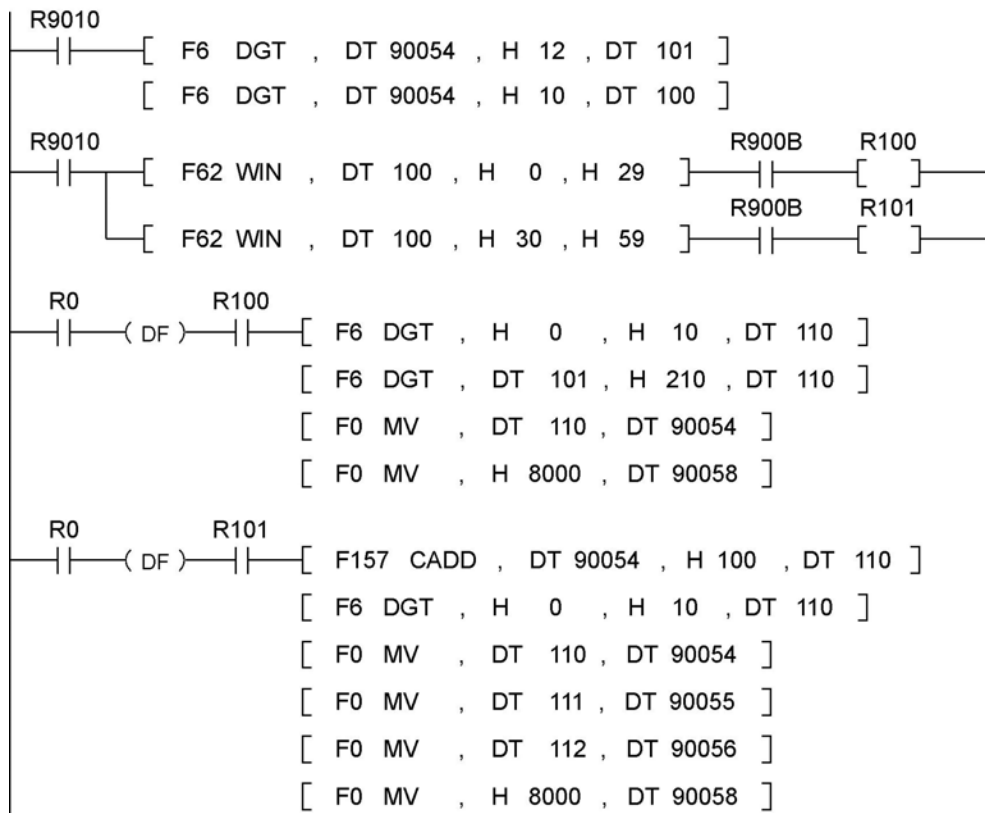
Here, the "Hour/minute" data stored in the special data register DT90053 is used to output the signal at the appointed time.



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.

2.6.4 30-second Compensation Sample Program

This is a program to perform the compensation for 30 seconds when R0 is turned ON. If the 30-second compensation is required, use this program.



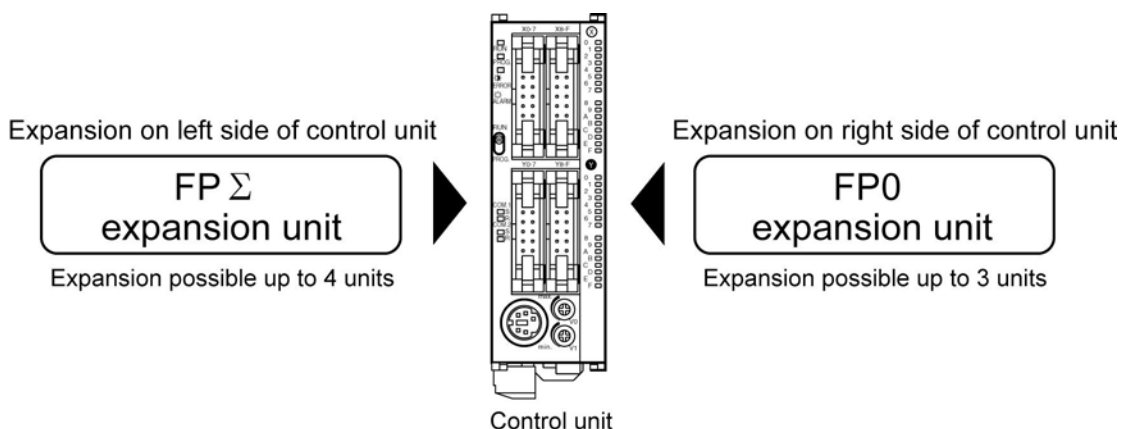
Chapter 3

Expansion

3.1 Type of Expansion Unit

The FP Σ expansion unit (including intelligent units) and the FP0 expansion unit (expansion I/O unit and intelligent unit) can be used with FP Σ .

The FP0 expansion units are connected on the right side of the control unit, just as they were with the FP0. The FP Σ expansion units are connected to the left side of the control unit.



Note:

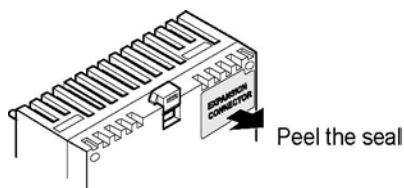
- The FP Σ expansion unit cannot be connected to FPG-C32T, FPG-C32TTM, FPG-C32TH or FPG-C32THTM. Only the FP0 expansion unit can be connected.

3.2 Expansion Method of Units for FP0 and FPΣ

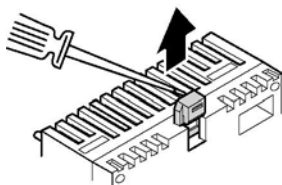
The FP0 expansion unit (expansion I/O unit, intelligent unit) is expected by connecting to the right side of the control unit.

Unit expansion is done using the right-side connector for FP0 expansion and expansion hook on the side of the unit.

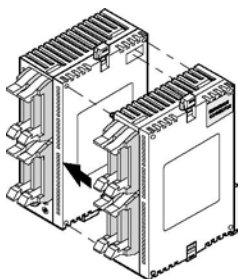
(1) Peel the seal on the side of the unit so that the internal right-side connector for FP0 expansion is exposed.



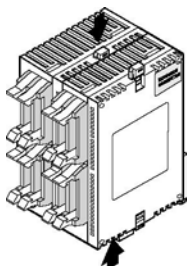
(2) Raise the expansion hooks on the top and bottom sides of the unit with a screwdriver.



(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.



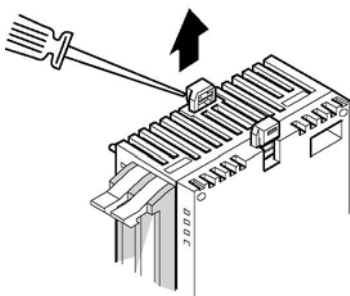
3.3 Expansion Method of FPΣ Expansion Unit

The dedicated expansion unit for FPΣ (including intelligent unit) is expanded by connecting to the left side of the control unit.

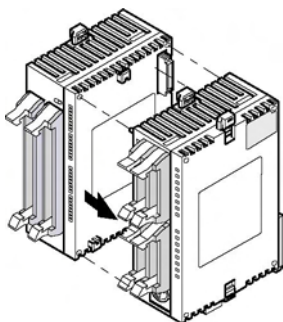
Unit expansion is done using the left-side connector for FPΣ expansion and expansion hook on the side of the unit.

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

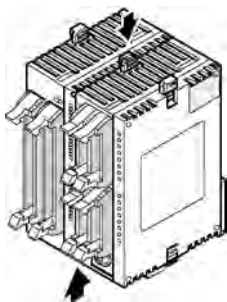
(2) Raise the expansion hooks on the top and bottom sides of the unit with a screwdriver.



(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.



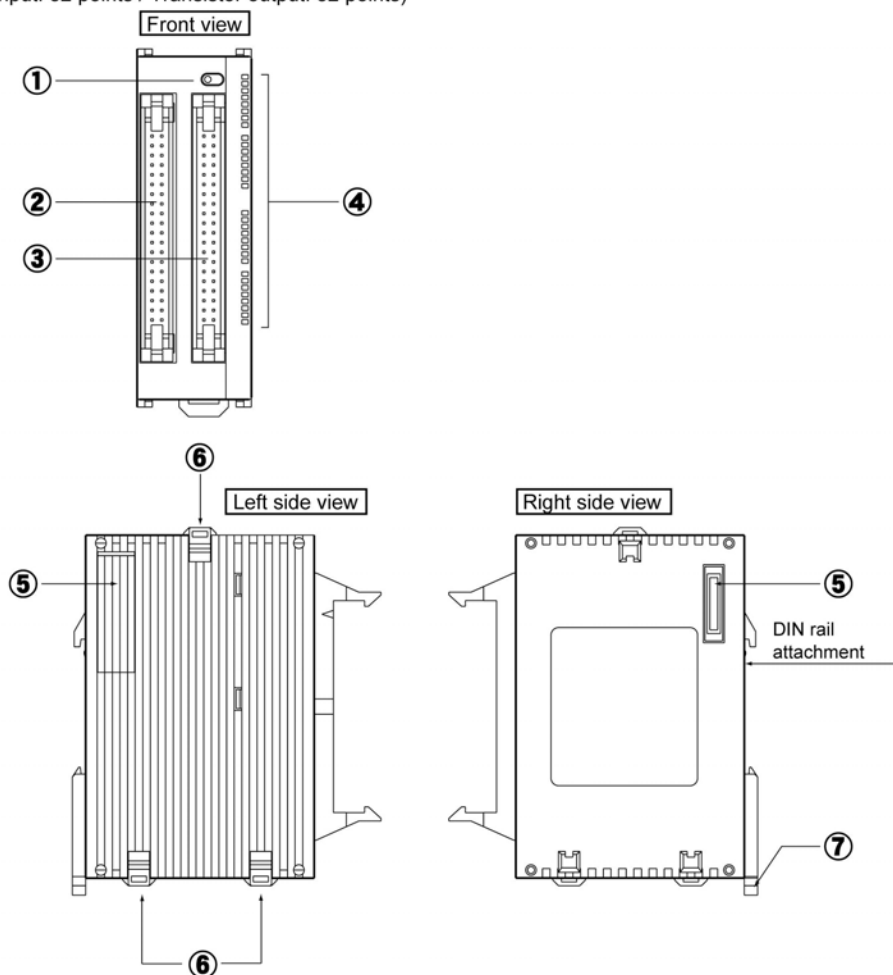
3.4 Specifications of FPΣ Expansion Unit

3.4.1 FPΣ Expansion Unit

Parts and functions

FPG-XY64D2T, FPG-XY64D2P

(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.

⑦ DIN hook

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

Input specifications

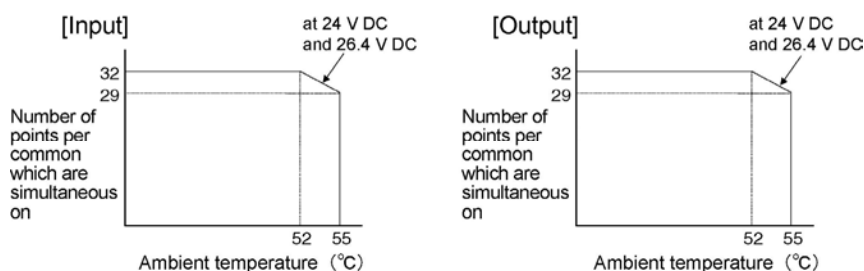
Item		Description
Insulation method		Optical coupler
Rated input voltage		24 V DC
Operating voltage range		21.6 to 26.4 V DC
Rated input current		Approx. 3.5 mA
Input points per common		32 points/common (Either the positive or negative of input power supply can be connected to common terminal.)
Min.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

Transistor output specifications

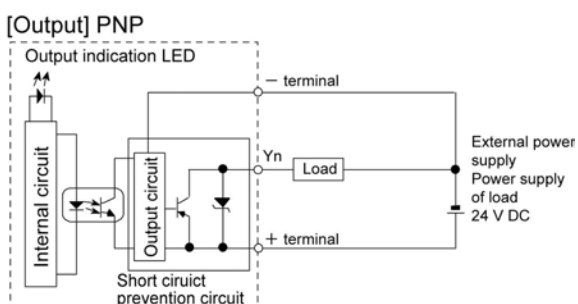
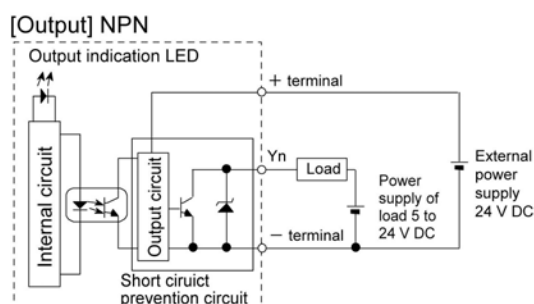
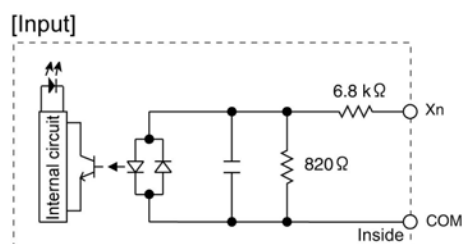
Item		Description	
		NPN	PNP
Insulation method		Optical coupler	
Output type		Open collector	
Rated load voltage		5 to 24 V DC	24 V CD
Operating load voltage range		4.75 to 26.4 V DC	21.6 to 26.4 V DC
Max. load current		0.1 A	
Max. surge current		0.5 A	
Output points per common		32 points/common	
Off state leakage current		100 μ 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	30 mA or less
Surge absorber		Zener diode	
Operating mode indicator		LED display	
Short circuit protection		Short circuit prevention, Thermal protection	

Limitations on number of simultaneous on points

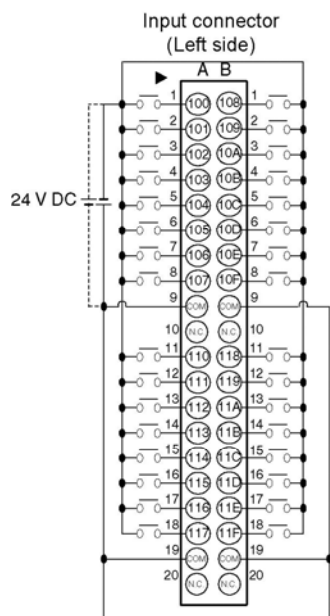
Keep the number of points which are simultaneously on within the following range as determined by the ambient temperature.



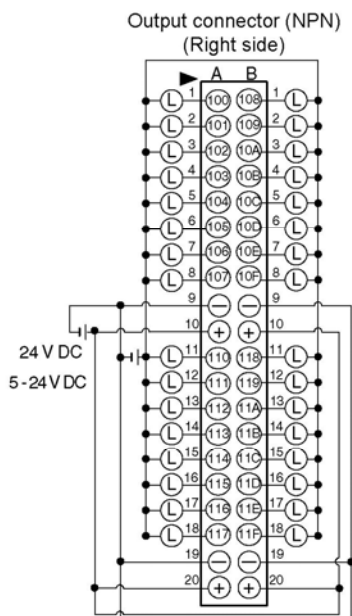
Circuit diagram



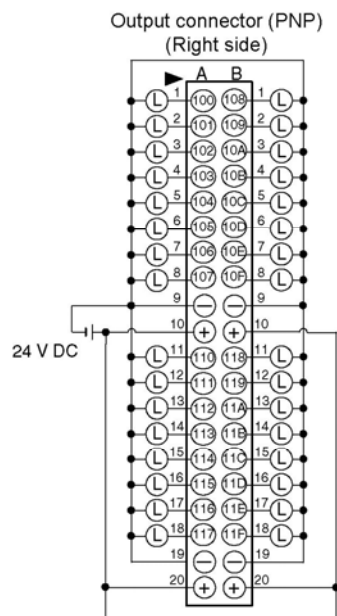
Terminal layout diagram



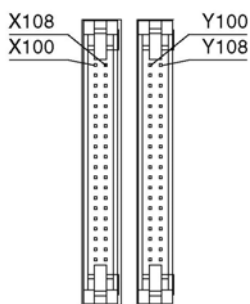
The four COM terminals are connected internally.



+ Terminals and - terminals are connected on the same connector inside the unit, but connect them outside.



+ Terminals and - terminals are connected on the same connector inside the unit, but connect them outside.



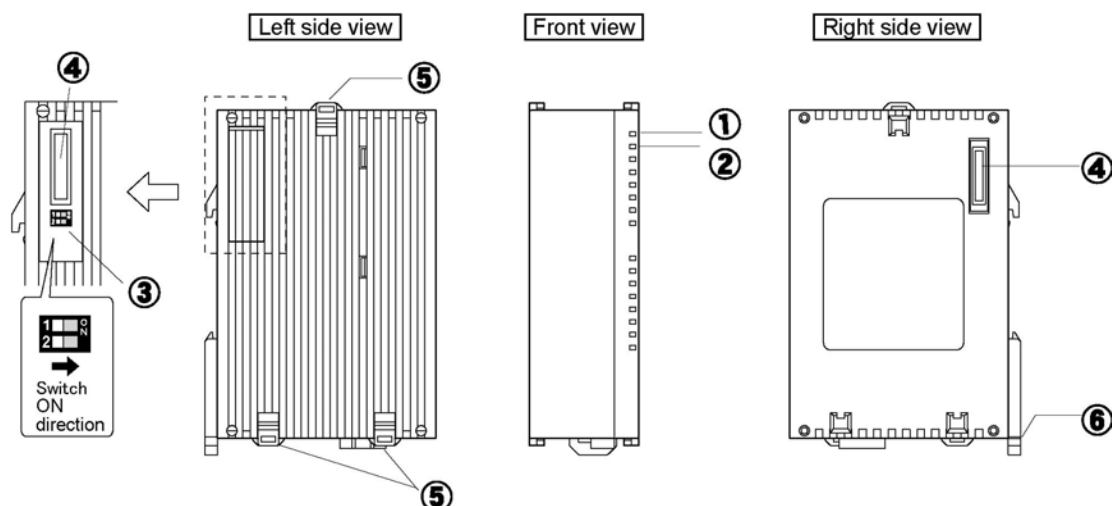
(Front view of connector)



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

3.4.2 FPΣ Expansion Data Memory Unit

Parts and Functions



① POWER LED (Green)

② BATT LED (Red)

Lights out: Battery voltage is normal.

Lights on: The voltage of the battery for memory backup reduced,
or the memory backup SW is turned off.

③ Memory backup SW

The factory default setting is "OFF" so turn both SW1 and 2 "ON" when using the unit. If this SW is turned off, the memory backup is not available as the memory is separated from the built-in battery. Turn it on when the unit is used.

④ Connector for FPΣ expansion

This connector is used to expand the unit for FPΣ.

⑤ Expansion hook

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

⑥ DIN hook

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

General specifications

Item	Description
Ambient temperature/humidity	0 to +55 °C, 30 to 85 %RH (at 25°C, non-condensing)
Storage temperature/humidity	-20 to +70 °C, 30 to 85 %RH (at 25°C, non-condensing)
Vibration resistance	10 to 55 Hz, 1 cycle/min, double amplitude of 0.75 mm, 10 min on 3 axes
Shock resistance	Shock of 98 m/s ² , 4 times on 3 axes
Noise immunity	1000 Vp-p with pulse widths 50 ns and 1μs (based on in-house measurements)
Operation condition	Free from corrosive gases and excessive dust
Weight	Approx. 80 g

Performance specifications

Item	Description
Memory	256 k words (1k word x 256 banks)
Battery life	5 years or more
Consumption current (5V)	100 mA or less
No of occupied I/O points	Input 16 points

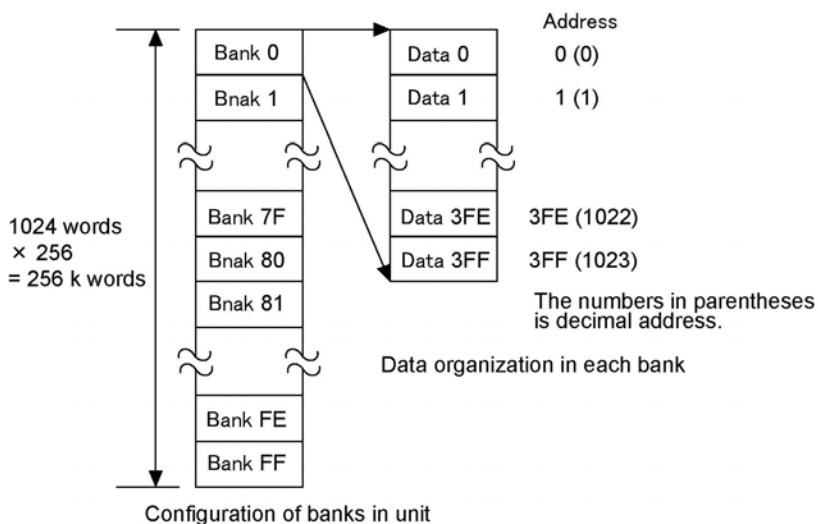
Data organization

This unit is organized with 256 banks (1 k word = 1 bank).

Banks are assigned with numbers which are from “0” to “FF” in hexadecimal.

Each bank is assigned with an address for every word, and one bank is organized with 1024 words (1k word) of a range within 0 to 3FF (0 to 1023 for decimal address).

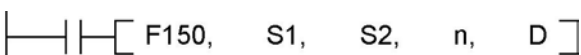
Specify the above bank No. H0 to HFF (hexadecimal) and address (K0 to K1023) for reading data from the control unit to this unit.



How to access the memory unit

The following instructions are used to access the expansion data memory unit to the control unit.

1. F150 instruction (To read data from the expansion data memory unit to the control unit)
2. F151 instruction (To write data to the expansion data memory unit from the control unit)

1. F150 

S1: The area for specifying the slot No. of an Intelligent I/O unit (this unit) and bank numbers
Specify them in hexadecimal.

Higher byte	Lower byte
Bank No. H0 to HFF	Slot No. H0 to H3

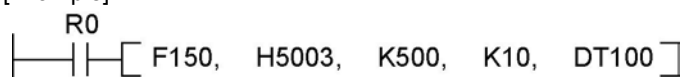
S2: The first address (word address), K0 to K1023 (H0 to H3FF), for reading the memory of an intelligent I/O unit (this unit)

The area for specifying addresses in the bank specified in S1

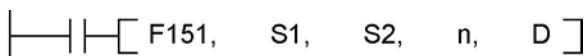
n: No. of words to read, K1 to K1024 (H1 to H400)

D: The first area No. to store read data

[Example]

R0


When R0 is on, 10 words will be read from the address K500 of the bank No. H50 in the expansion data memory unit installed in the slot No. 03 to store DT100 to DT109 in order.

2. F151 

S1: The area for specifying the slot No. of an Intelligent I/O unit (this unit) and bank numbers
Specify them in hexadecimal.

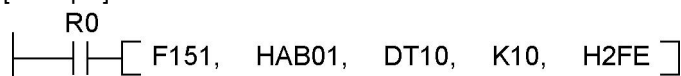
Higher byte	Lower byte
Bank No. H0 to HFF	Slot No. H0 to H3

S2: The first area No. of write data

n: No. of words to write, K1 to K1024 (H1 to H400)

D: The first area No. to store write data

[Example]

R0


When R0 is on, the contents of DT10, 11, 12 and higher are written for 10 words in order in the area starting with the address H2FE of the bank No. HAB in the expansion data memory unit installed in the slot No. H01.



Reference: <4.3.1 I/O Numbers of Expansion Unit>

**Note:**

- The operating time for the instructions is as follows.
F150 READ : $16.19 + (0.84 \times \text{No. of words to read}) \mu\text{s}$
F151 WRITE : $17.88 + (0.77 \times \text{No. of words to write}) \mu\text{s}$
- If all areas are read and written in one scan, the scanning time may be over.
- If you try to READ/WRITE data in multiple addresses in one scan, arrange the instructions using the above operating time as a guide.

Battery error

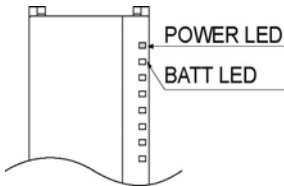
When any error occurs in a backup battery, the input will be turned on as follows.

[Example] When installing in the expansion unit 1 (slot No. 0)

X10F	X10E	X10D	X10C	X10B	X10A	X109	X108	X107	X106	X105	X104	X103	X102	X101	X100
------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------

↑
Battery error relay

X100	OFF	Battery voltage is normal.
	ON	The battery voltage for memory backup decreased. Or the memory backup SW is off.
BATT LED (Red)	Lights out	Battery voltage is normal.
	Lights	The battery voltage for memory backup decreased. Or the memory backup SW is off.

**Note:**

- If an error with a battery is detected, backup the data within one month and replace the unit with a new one.

3.4.3 Other Expansion Units

For other FPΣ expansion units, the dedicated manuals are available.

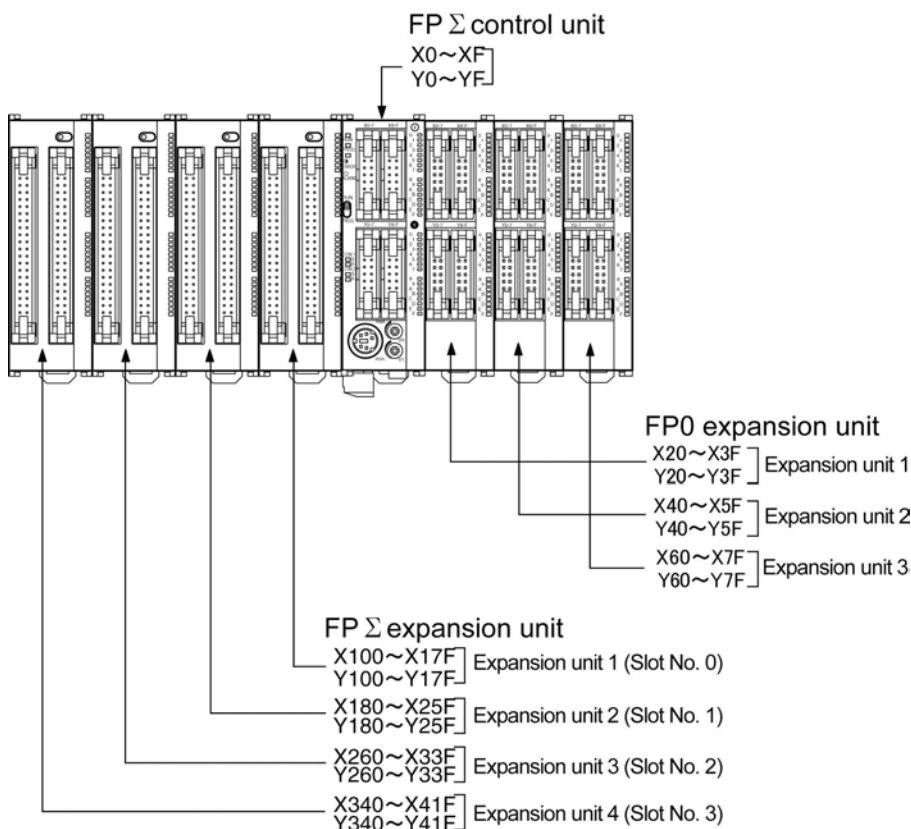


Reference: <1.2.2 FPΣ expansion unit>

Chapter 4

I/O Allocation

4.1 I/O Allocation



Note1) The usable I/O numbers are different depending on the units.

Note2) FPG-C32T and FPG-C32TTM of the FP Σ control unit are installed on the FP0 expansion unit only.

Regarding I/O number

• Specifying X and Y numbers

On the FPΣ and the FP0, the same numbers are used for input and output.

Example: X20 } The same numbers are used for input and output
Y20 }

• 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.



• Slot No.

Slot No. is the number indicating the installing position of the expansion unit which is used to generate programs by some FPΣ expansion unit.

4.2 Allocation of FPΣ Control Unit

4.2.1 I/O Number of FPΣ Control Unit

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

Type of control unit	Number of allocation	I/O number
FPG-C32T/FPG-C32TTM	Input (16 points)	X0 to XF
FPG-C32T2/FPG-C32T2TM FPG-C32TH/FPG-C32THTM	Output (16 points)	Y0 to YF
FPG-C28P2/FPG-C28P2TM	Input (16 points)	X0 to XF
FPG-C28P2H/FPG-C28P2HTM	Output (16 points)	Y0 to YB
FPG-C24R2/FPG-C24R2TM	Input (16 points)	X0 to XF
FPG-C24R2H/FPG-C24R2HTM	Output (8 points)	Y0 to Y7

4.3 Allocation of FPΣ Expansion Unit

The FPΣ expansion unit is installed on the left side of the FPΣ control unit.

The I/O numbers of the FPΣ expansion unit start with the lowest number at the right and proceed in sequential order.

4.3.1 I/O Numbers of FPΣ Expansion Unit

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

Type of unit		Number of allocation		Expansion unit 1 Slot 0	Expansion unit 2 Slot 1	Expansion unit 3 Slot 2	Expansion unit 4 Slot 3
FPΣ Expansion unit	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
FPΣ Positioning unit	1-axis type FPG-PP11 FPG-PP12	Input 16 points	1st axis	X100 to X10F	X180 to X18F	X260 to X26F	X340 to X34F
		Output 16 points		Y100 to Y10F	Y180 to Y18F	Y260 to Y26F	Y340 to Y34F
	2-axis type FPG-PP21 FPG-PP22	Input 32 points	1st axis	X100 to X10F	X180 to X18F	X260 to X26F	X340 to X34F
			2nd axis	X110 to X11F	X190 to X19F	X270 to X27F	X350 to X35F
		Output 32 points	1st axis	Y100 to Y10F	Y180 to Y18F	Y260 to Y26F	Y340 to Y34F
			2nd axis	Y110 to Y11F	Y190 to Y19F	Y270 to Y27F	Y350 to Y35F
FPΣ Expansion data memory unit	FPG-EM1	Input 16 points	Battery error	X100 to X10F	X180 to X18F	X260 to X26F	X340 to X34F
FPΣ S-LINK unit	FPG-SL	Input	-	X100 to X17F	X180 to X25F	X260 to X33F	X340 to X41F
		Output	-	Y100 to Y17F	Y180 to Y25F	Y260 to Y33F	Y340 to Y41F

- Regarding FPΣ CC-Link slave unit, please refer to the exclusive manual.

4.4 Allocation of FP0 Expansion Unit

The FP0 expansion unit is installed on the right side of the FPΣ control unit.

The I/O numbers start with the lowest number at the expansion unit nearest the control unit and proceed in sequential order.

4.4.1 I/O Numbers of FP0 Expansion Unit

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

Type of unit		Number of allocation	Expansion unit 1	Expansion unit 2	Expansion unit 3
FP0 Expansion unit	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-E8TY/P FP0-E8YR	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 FP0-E16T/P	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/P	Output (16 points)	Y20 to Y2F	Y40 to Y4F	Y60 to Y6F
FP0 Analog I/O unit	FP0-A21	Input (16 points) CH0	WX2 (X20 to X2F)	WX4 (X40 to X4F)	WX6 (X60 to X6F)
		Input (16 points) CH1	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)
FP0 A/D conversion unit FP0 thermocouple unit	FP0-A80 FP0-TC4 FP0-TC8	Input (16 points) CH0, 2, 4, 6	WX2 (X20 to X2F)	WX4 (X40 to X4F)	WX6 (X60 to X6F)
		Input (16 points) CH1, 3, 5, 7	WX3 (X30 to X3F)	WX5 (X50 to X5F)	WX7 (X70 to X7F)
FP0 D/A conversion unit	FP0-A04V FP0-A04I	Input (16 points)	WX2 (X20 to X2F)	WX4 (X40 to X4F)	WX6 (X60 to X6F)
		Output (16 points) CH0, 2, 4, 6	WY2 (Y20 to Y2F)	WY4 (Y40 to Y4F)	WY6 (Y60 to Y6F)
		Output (16 points) CH1, 3, 5, 7	WY3 (Y30 to Y3F)	WY5 (Y50 to Y5F)	WY7 (Y70 to Y7F)
FP0 I/O link unit	FP0-IOL	Input 32 points	X20 to X3F	X40 to X5F	X60 to X7F
		Output 32 points	Y20 to Y3F	Y40 to Y5F	Y60 to Y7F

- The data for the each channels of FP0 A/D conversion unit (FP0-A80), FP0 thermocouple unit (FP0-TC4/FP0-TC8) and FP0 D/A conversion unit (FP0-A04V/FP0-A04I) is converted and loaded with a user program that includes a switching flag to convert the data.
- Regarding FP0 CC-Link slave unit, please refer to the exclusive manual.

Chapter 5

Installation and Wiring

5.1 Installation

5.1.1 Installation Environment and Space

Operating environment

(Use the unit within the range of the general specifications when installing)

-Ambient temperatures: 0 ~ +55 °C

-Ambient humidity: 30% to 85% RH (at 25°C, non-condensing)

-For use in pollution Degree 2 environment.

-Do not use it in the following environments.

- Direct sunlight

- Sudden temperature changes causing condensation.

- Inflammable or corrosive gas.

-Excessive airborne dust, metal particles or saline matter.

- Benzine, paint thinner, alcohol or other organic solvents or strong alkaline solutions such as ammonia or caustic soda.

-Direct vibration, shock or direct drop of water.

- Influence from power transmission lines, high voltage equipment, power cables, power equipment, radio transmitters, or any other equipment that would generate high switching surges. (100mm or more)

Static electricity

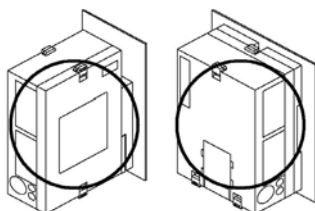
- Do not touch connector pins directly to prevent static electricity from causing damage.

- Always rid yourself of any static electricity before handling this product.

Measures regarding heat discharge

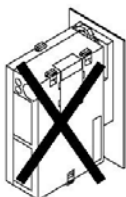
- Always install the unit orientated with the tool port facing outward on the bottom in order to prevent the generation of heat.

CORRECT

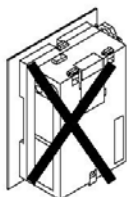


- Do not install the FPΣ control unit as shown below.

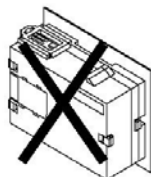
INCORRECT



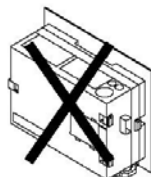
Upside-down



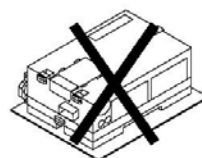
Upside-down



Installations such that the input and output connectors face down



Input and output connectors on top

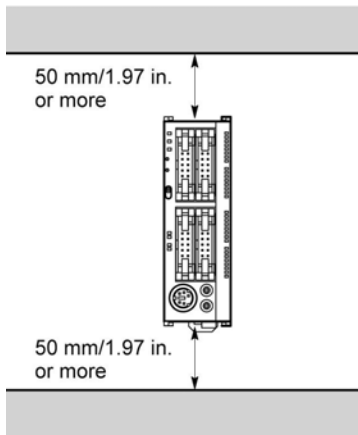


Horizontal installation of the unit

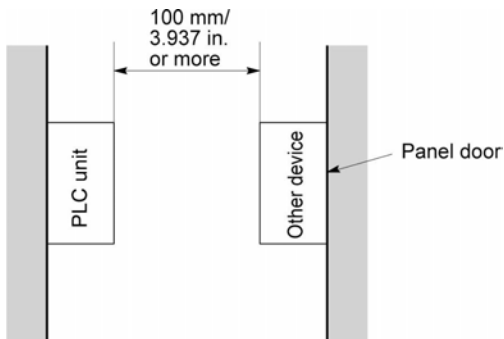
- Do not install the unit above devices which generate heat such as heaters, transformers or large scale resistors.

Installation space

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



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



- Leave at least 100mm/3.937 in. of space opean from the front surface of the control unit in order to allow room for programming tool connections and wiring.

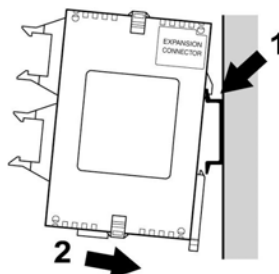
5.1.2 Installation and Removal

Attachment to DIN rail and removal from DIN rail

FPΣ unit can be simply attached to DIN rail.

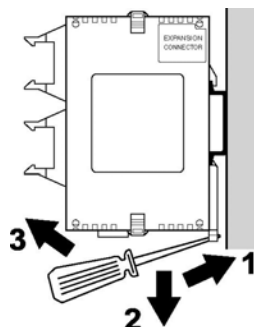
Procedure of installation method

- (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.



Procedure of removal method

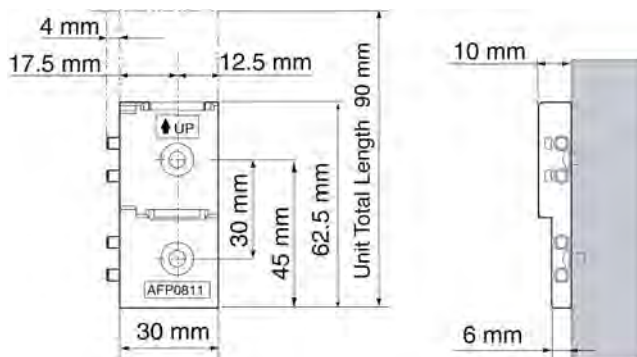
- (1) Insert a slotted screwdriver into the DIN rail attachment lever.
- (2) Pull the attachment lever downwards.
- (3) Lift up the unit and remove it from the rail.



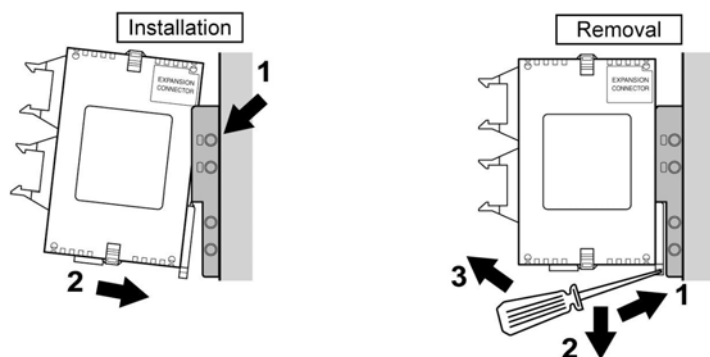
5.1.3 Installation Using the Optional Mounting Plate

When using the slim 30 type mounting plate (AFP0811) (for mounting FPΣ)

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

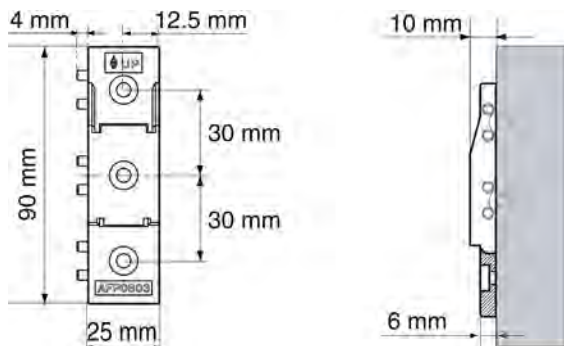


The rest of the procedure is the same as that for attaching the unit to the DIN rails.

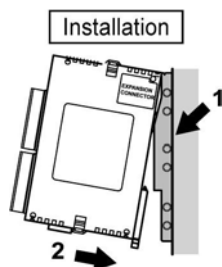


When using the slim type mounting plate (AFP0803) (for mounting FP0)

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



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



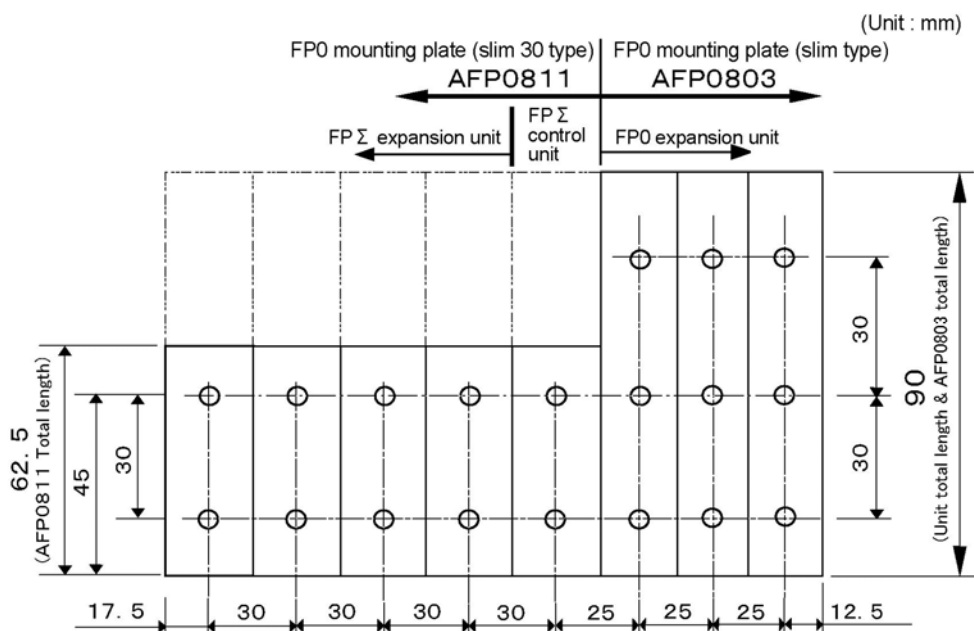
Note) The procedure for the removal is the same as AFP0811.



Note:

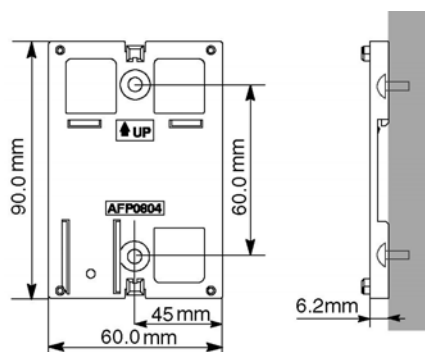
When using an expansion unit, tighten the screws after joining all of the slim type mounting plate to be connected. Tighten the screws at each of the four corners.

[Example] When using the maximum numbers of the expansion units (with AFP0811, AFP0803)



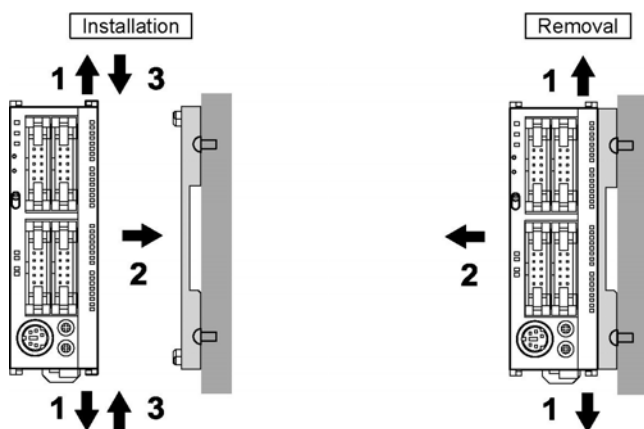
When using the flat type mounting plate (AFP0804)

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

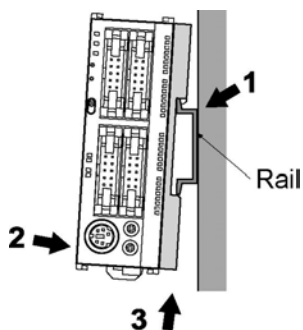


Raise the expansion hooks on the top and bottom of the unit.

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



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

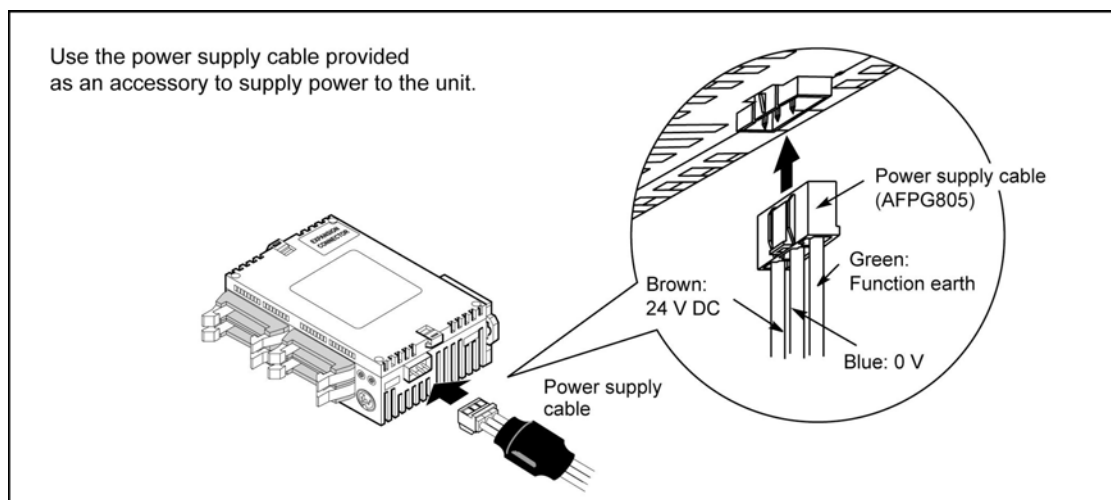


Note:

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

5.2.1 Wiring of Power Supply



Power supply wiring for the unit

Use the power supply cable (Product No.:AFPG805) that comes with the unit to connect the power supply.

- Brown: 24V DC
- Blue: 0V
- 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

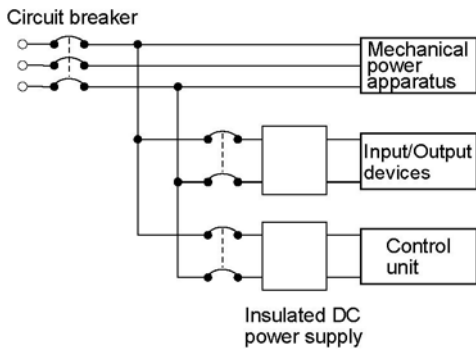
- To protect the system against erroneous voltage from the power supply line, use an insulated power supply with an internal protective circuit.
- The regulator on the unit is a non-insulated type.
- If using a power supply device without an internal protective circuit, always make sure power is supplied to the unit through a protective element such as a fuse.

Power supply voltage

Rated voltage	24V 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.



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.

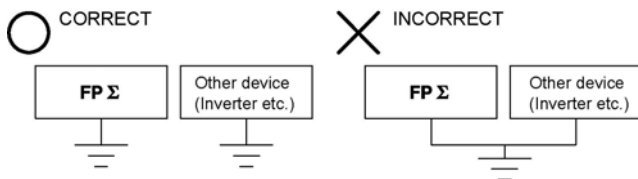
5.2.2 Grounding

In situations of excess noise

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

Exclusive grounding

- The grounding connection should have a resistance of less than 100Ω .
- 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.

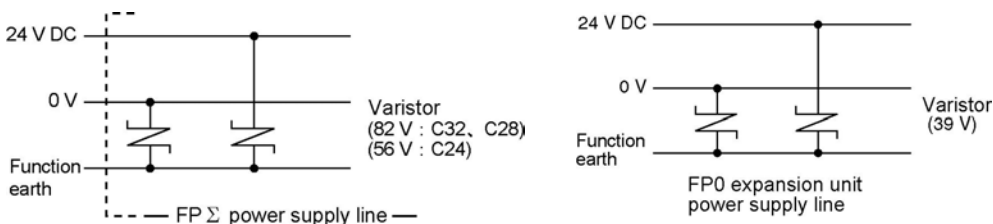


Note:

Depending on the surroundings in which the equipment is used, grounding may cause problems.

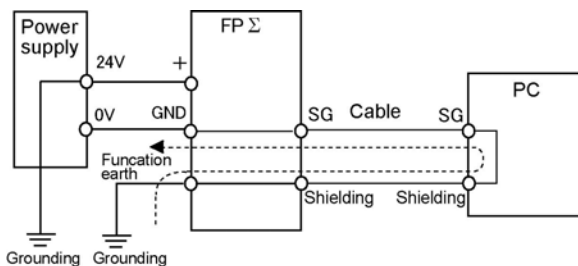
[Example]

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.



Do not ground the FPΣ function earth terminal when grounding a plus (+) terminal of the power.

In some computers, the SG terminal of RS232C port and connector shielding are connected. Also the FPΣ tool port shielding is connected with the function earth terminal. Therefore, the GND terminal of FPΣ and the function earth terminal are connected if the computer is connected. Especially when the FPΣ is connected to a computer with a plus (+) terminal grounded, therefore, an FPΣ's minus (-) terminal is connected with the function earth terminal. As a result, short circuit occurs which may lead to the breakage of FPΣ and its neighboring parts.

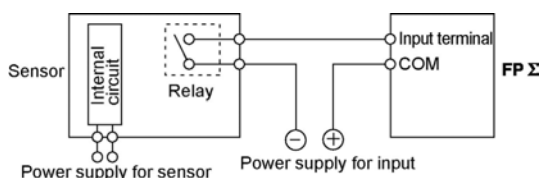


5.3 Wiring of Input and Output

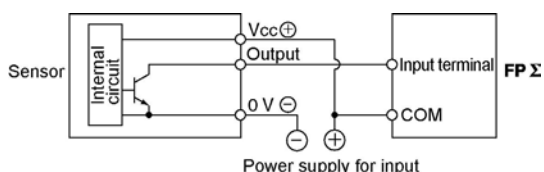
5.3.1 Input Wiring

Connection of photoelectric sensor and proximity sensor

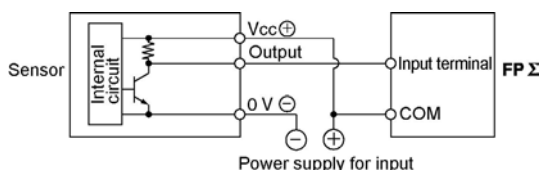
Relay output type



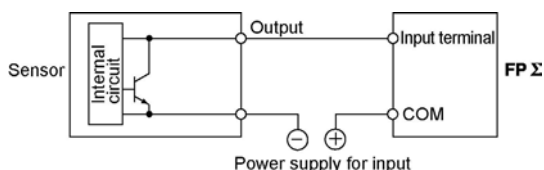
NPN open collector output type



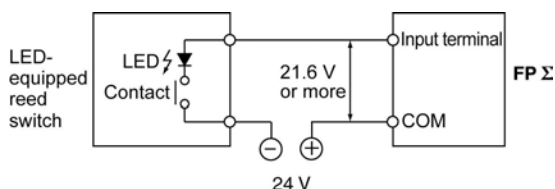
Voltage output type



Two-wire output type

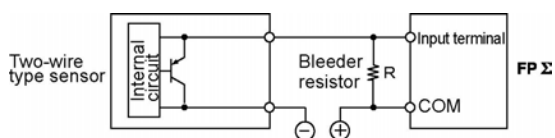


Precaution when using LED-equipped reed switch



When a LED is connected in series to an input contact such as LED-equipped reed switch, make sure that the on voltage applied to the PLC input terminal is greater than 21.6V DC. In particular, take care when connecting a number of switches in series.

Precaution when using two-wire type sensor



I : Sensor's leakage current (mA)
R : Bleeder resistor (kΩ)

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.

$$I \times \frac{5.6R}{5.6R + R} \leq 2.4 \quad \text{Therefore,}$$

$$R \leq \frac{13.44}{5.6I - 2.4} \quad (\text{k}\Omega)$$

The wattage W of the resistor is:

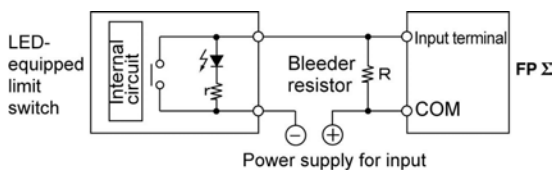
$$W = \frac{(\text{Power supply voltage})^2}{R}$$

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

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.

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

Precaution when using LED-equipped limit switch



r : Internal resistor of limit switch ($k\Omega$)
 R : Bleeder resistor ($k\Omega$)

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:

$$R \leq \frac{13.44}{5.6 \times I - 2.4} (k\Omega)$$

The wattage W of the resistor is:

$$W = \frac{(\text{Power supply voltage})^2}{R} \times (3 \text{ to } 5 \text{ times})$$

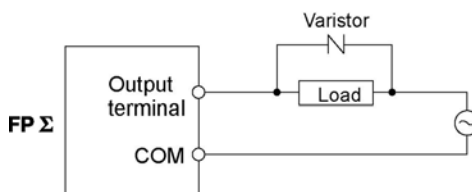
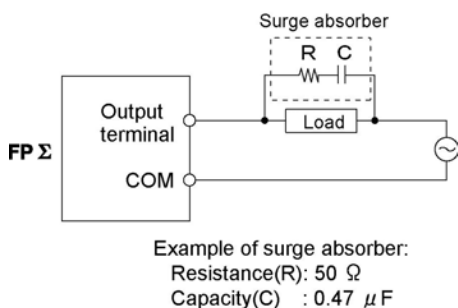
If the input of PLC does not turn off because of the leakage current from the LED-equipped limit switch, the use of a bleeder resistor is recommended, as shown below.

5.3.2 Output Wiring

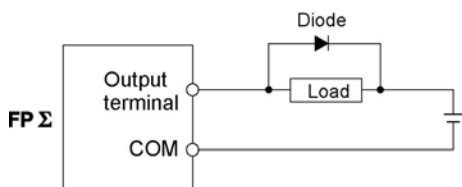
Protective circuit for inductive loads

- 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



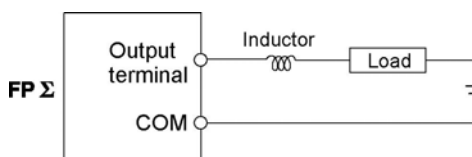
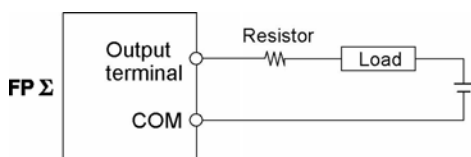
When using a DC inductive load



Diode:
Reverse voltage: 3 times the load voltage
Averag rectified forward current: 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.



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.

(Excluding the Y0, 1, 3, 4 of the FPΣ control unit and the FP0 expansion unit)

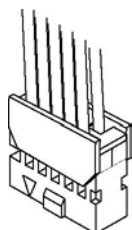
5.3.3 Precautions Regarding Input and Output Wirings

- 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 100mm/3.937 in.

5.4 Wiring of MIL Connector Type

Supplied connector and suitable wires

The connector listed below is supplied with the FPΣ control unit. Use the suitable wires given below. Also, use the required pressure connection tools for connecting the wires.



Suitable wires

Size	Nominal cross-sectional area	Insulation thickness	Rated current
AWG#22	0.3mm ²	Dia. 1.5 to dia. 1.1	3A
AWG#24	0.2mm ²		

Supplied connector (AFP0807)

Type and product No.	
Housing	10-pin type only
Semi-cover	AXW61001A
Welder (contact)	AXW7221

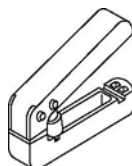
Supplied connector (AFP2801)

Type and product No.	
Housing	AXW1404A
Semi-cover	AXW64001A
Welder (contact)	AXW7221

Note) Packed with the Expansion I/O unit.

Pressure connection tool

Product No.	AXY52000
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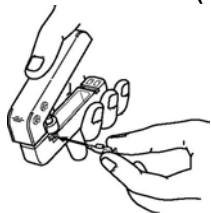


Pressure connection tool

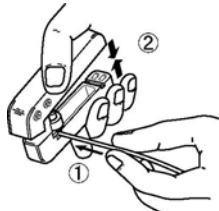
Procedure of assembly (Wiring method)

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

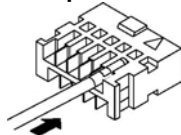
- (1) Bend the welder (contact) back from the carrier, and set it in the pressure connection tool.



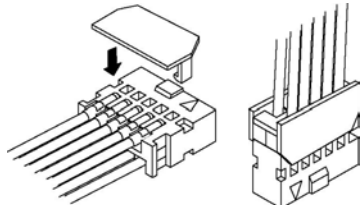
- (2) Insert the wire without removing its insulation until it stops, and lightly grip the tool.



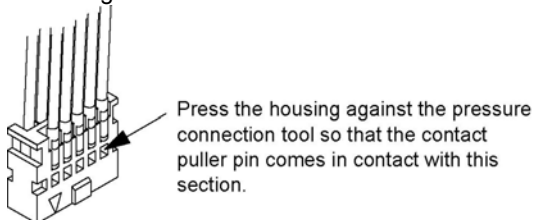
- (3) After press-fitting the wire, insert it into the housing.



- (4) When all wires have been inserted, fit the semi-cover into place.



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.



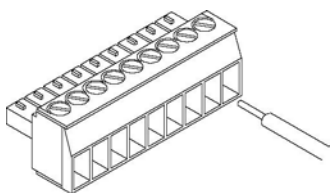
Key Point:

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

In this case, the suitable wire is AWG#28 and the rated current is 1A.

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 No.	MC1,5/9-ST-3,5
Product No.	1840434

Suitable wires

Size	Nominal cross-sectional area
AWG #22	0.3mm ²
AWG #24 to 16	0.2 to 1.25mm ²

Pole terminal with a compatible insulation sleeve

If a pole terminal is being used, the following models manufactured by Phoenix Contact Co. should be used.

Manufacturer	Cross-sectional area (mm ²)	Size	Part No.
Phoenix Contact Co.	0.25	AWG #24	AI 0,25 – 6 YE
	0.50	AWG #20	AI 0,5 – 6 WH
	0.75	AWG #18	AI 0,75 – 6 GY
	1.00	AWG #18	AI 1 – 6 RD
	0.5×2	AWG #20 (for 2 pcs)	AI – TWIN 2×0.5 – 8 WH

Pressure welding tool for pole terminals

Manufacturer	Part No.	Product No.
Phoenix Contact Co.	CRIMPFOX UD6	1204436

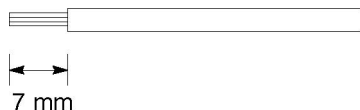
For tightening the terminal block

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 (Part No. SZS 0,4×2,5).

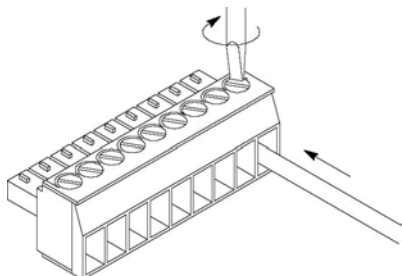
The tightening torque should be 0.22 to 0.25 N·m (2.3 to 2.5 kgf·cm) or less.

Wiring method

(1) Remove a portion of the wire's insulation.

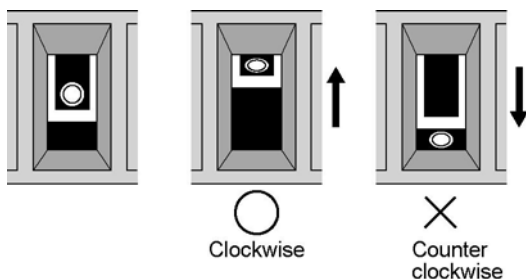


(2) Insert the wire into the terminal block until it contacts the back of the block socket, and then tighten the screw clockwise to fix the wire in place. (Tightening torque: 0.22 N·m to 0.25 N·m (2.3 kgf·cm to 2.5 kgf·cm))



Note:

- 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

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.
- Response 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 adequate 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

Provide an emergency stop circuit to the PLC externally to turn off the power supply of the output device.

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) In case of 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 3 ms, the FPΣ continues to operate. If the power is off for 3 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 Installation and Setting of Backup Battery

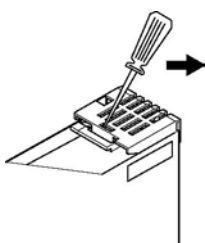
Installing a backup battery in the FPΣ makes it possible to access clock/calender functions for use, in addition to backing up data registers and other data.

Battery (Option)

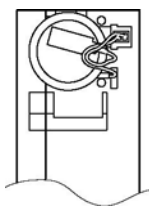
Name	Product No.
Battery for FPΣ	AFPG804

5.7.1 Installation of Backup Battery

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

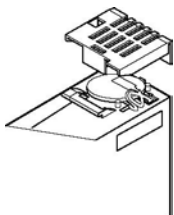


(2) Connect the connector, and place the battery so that the battery terminal fits between the two tabs.



Note) When replacing the battery, turn off the power after supplying the power more than 1 min., and then fit the new battery within 2 min of removing the old one.

(3) Insert the battery cover from above.



5.7.2 System Register Setting

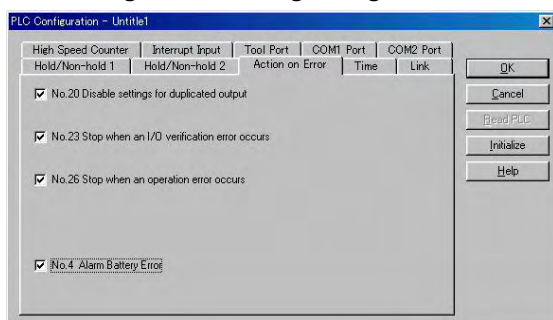
Setting of the battery error alarm

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 FPCWIN 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



Specifying the hold area

In order to use backup functions such as data registers, settings must be entered for system registers Nos. 6 to 14.

For hold area setting using FPCWIN GR, select “PLC Configuration” on the “Option” menu, and click on “Hold/Non-hold1” and “Hold/Non-hold 2”.



Note:

- The setting of the system registers Nos 6 to 14 is effective only when the backup battery is mounted.
- Without the battery, use at the default settings. If changing the settings, the “Hold/Non-hold” operation becomes unstable.
- Without the settings, the data may be lost as the result of the battery shutoff.

5.7.3 Time for Replacement of Backup Battery

If system register “No.4 Alarm Battery Error” is set to “ON”, it informs about the proper time to replace the backup battery.

1. Special internal relays R9005 and R9006 will go on if the battery voltage drops.
2. 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.

Note) When replacing the battery, turn off the power after supplying the power more than 1 min., and then fit the new battery within 2 min of removing the old one.

5.7.4 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)

5.7.5 Detection Timing of Backup Battery Error

The backup battery voltage is checked 2 seconds after the power is applied, therefore, the error is not announced in the first scan after the operation starts.

Chapter 6

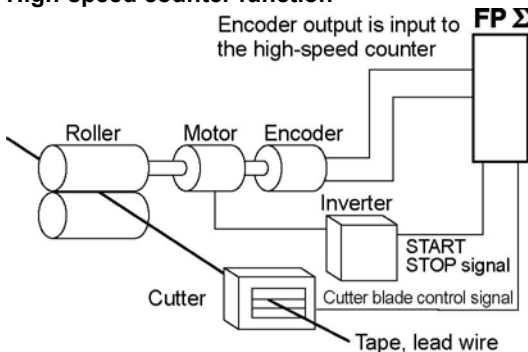
High-speed counter, Pulse Output and PWM Output functions

6.1 Overview of Each Functions

6.1.1 Three Functions that Use Built-in High-speed Counter

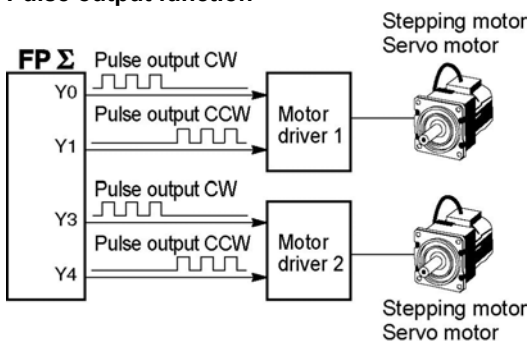
There are three functions available when using the high-speed counter built into the FPΣ.

High-speed counter function



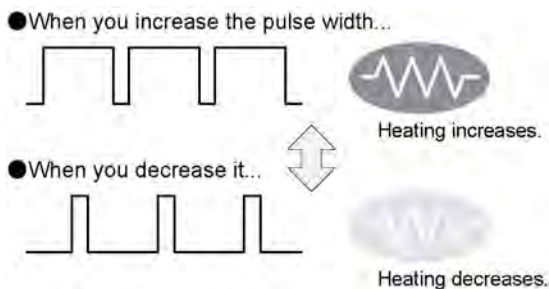
The high-speed counter function counts external inputs such as those from sensors or encoders. When the count reaches the target value, this function turns on/off the desired output.

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.

PWM output function



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

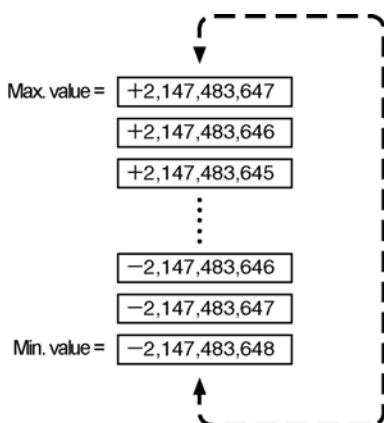
6.1.2 Performance of Built-in High-speed Counter

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 K+2, 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.



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 (Coded 24-bit binary)

The F175 and F176 instructions can be used only with the C32T2, C28P2, C32T2H and C28P2H control units.

6.2 Function Specifications and Restricted Items

6.2.1 Specifications

High-speed counter function

High-speed counter channel No.		Input/output contact No. being used	Memory area being used			Performance specifications	
		Input contact number (value in parenthesis is reset input) <small>Note1)</small>	Control flag	Elapsed value area	Target value area	Minimum input pulse width <small>Note2)</small>	Maximum counting speed
[Single phase] Incremental, Decremental	CH0	X0 (X2)	R903A	DT90044 to DT90045	DT90046 to DT90047	10μs (100μs)	Using 1 channel: Max. 50kHz (x1-ch) Using 2 channels: Max. 30kHz (x2-ch) Using 3 channels: Max. 20kHz (x3-ch) Using 4 channels: Max. 20kHz (x4-ch)
	CH1	X1 (X2)	R903B	DT90048 to DT90049	DT90050 to DT90051		
	CH2	X3 (X5)	R903C	DT90200 to DT90201	DT90202 to DT90203		
	CH3	X4 (X5)	R903D	DT90204 to DT90205	DT90206 to DT90207		
[2-phase] 2-phase input One input, Direction distinction	CH0	X0 X1 (X2)	R903A	DT90044 to DT90045	DT90046 to DT90047	25μs (100μs)	Using 1 channel: Max. 20kHz (x1-ch) Using 2 channels: Max. 15kHz (x2-ch)
	CH2	X3 X4 (X5)	R903C	DT90200 to DT90201	DT90202 to DT90203		

Related instructions:


F0(MV) :High-speed counter control

F1(DMV) :Read/write of elapsed value of high-speed counter

F166(HC1S) :Target value match on (Specify the desired output from Y0 to Y7 using instruction)

F167(CH1R) :Target value match off (Specify the desired output from Y0 to Y7 using instruction)

Note1) Reset input X2 can be set to either CH0 or CH1. Reset input X5 can be set to either CH2 or CH3.

Note2)  **Reference:** For information on minimum input pulse width, see <6.3.3 Minimum Input Pulse Width>.

Pulse output function

High-speed counter channel No.		Input/output contact number used					Memory area used		
		CW or pulse output	CCW or direction output	Deviation counter clear output	Home input	Near home input <small>Note4)</small>	Control flag	Elapsed value area	Target value area
Independence	CH0	Y0	Y1	Y2	X2	DT9005 2 <bit4>	R903A	DT90044 to DT90045	DT90046 to DT90047
	CH2	Y3	Y4	Y5	X5	DT9005 2 <bit4>	R903C	DT90020 to DT90201	DT90202 to DT90203
Interpolation	Linear	Y0 Y3	Y1 Y4	Y2 Y5 <small>Note3)</small>	X2 X5 <small>Note3)</small>	DT9005 2 <bit4>	R903A R903C	DT90044 to DT90045 DT90200 to DT90201	DT90046 to DT90047 DT90202 to DT90203
	Circular	Y0 Y3	Y1 Y4	Y2 Y5 <small>Note3)</small>	X2 X5 <small>Note3)</small>	DT9005 2 <bit4>	R903A R903C R904E R904F	DT90044 to DT90045 DT90200 to DT90201	DT90046 to DT90047 DT90202 to DT90203

Max. output frequency

- Using one ch: Max. 100 kHz (x1-ch)
- Using two chs: Max. 60 kHz (x2-ch)
- Using linear inter-polation: Max. 100 kHz
- Using circular iner-polation: Max. 20 kHz


Related instructions

F0 (MV) :high-speed counter control
 F1 (DMV) :Read/write of elapsed value of high-speed counter
 F171 (SPDH) :trape-zoidal control/home return
 F172 (PLSH) :JOG operation
 F174 (SP0H) :Data table control
 F175 (SPSH) :Linear inter-polation control
 F176 (SPCH) :circular inter-polation control

Note1) The pulse output function is only available with the transistor output type.

Note2)Linear and circular interpolation control is only available with the C32T2 or C28P2 units.

Note3)The home return operation of the interpolation axes should be performed for every channel.

Note4)  **Reference:** For DT90052, see <6.4.4 Pulse Output Control Instruction (F0) (F1)>.

PWM output function

High-speed counter channel No.	Output contact No. used	Memory area used	Output frequency (duty)	Related instructions
		Control flag		
CH0	Y0	R903A	-When resolution = 1000, 1.5 Hz to 12.5 kHz (0.0 to 99.9%)	F0(MV) (High-speed counter control) F1(DMV) (Read/write of elapsed value of high-speed counter) F173(PWMH) (PWM output)
CH2	Y3	R903C	-When resolution = 100, 15.6 kHz to 41.7 kHz (0 to 99%)	

Note) The PWM output function is only available with the transistor output type.

6.2.2 Functions Used and Restrictions

Restrictions on channels/maximum counting speed (frequency)

The same channel cannot be used by more than one function. The maximum frequency when using the high-speed counter and pulse output function is determined by the combination, as shown in the table below.

A: Available

Channel being used									Max. counting speed (frequency) [kHz]			
High-speed counter						Pulse output			High-speed counter		Pulse output	
Single phase				2-phase		Independence		Interpolation	Single phase	2-phase	Independence	Interpolation
CH0	CH1	CH2	CH3	CH0	CH2	CH0	CH2					
A									50			
	A								50			
		A							50			
			A						50			
A	A								30			
A		A							30			
A			A						30			
	A	A							30			
	A		A						30			
		A	A						30			
A	A	A							20			
A		A	A						20			
A	A		A						20			
	A	A	A						20			
				A						20		
		A		A					20	15		
			A	A					20	15		
		A	A	A					20	15		
					A					20		
A					A				20	15		
	A				A				20	15		
A	A				A				20	15		
				A	A					15		
						A					100	
	A Note3)					A			30		60	
	A Note3)	A				A			20		45	
	A	A	A			A			20		30	
					A	A				15	45	
	A				A	A			20	15	30	
							A				100	
			A Note3)				A		30		60	
A			A Note3)				A		20		45	
A	A		A				A		20		30	
				A			A			15	45	
			A	A			A		20	15	30	

A: Available

Channel being used									Max. counting speed (frequency) [kHz]			
High-speed counter						Pulse output			High-speed counter		Pulse output	
Single phase				2-phase		Independence		Interpolation	Single phase	2-phase	Independence	Interpolation
CH0	CH1	CH2	CH3	CH0	CH2	CH0	CH2					
						A Note1)	A Note1)				60	
	A Note3)					A	A		20		45	
			A Note3)			A	A		20		45	
	A Note3)		A Note3)			A	A		20		30	
								Linear				100 Note2)
								Linear				80
	A Note3)							Linear	20			60
			A Note3)					Linear	20			60
	A Note3)		A Note3)					Linear	20			45
								Circular				20
	A Note3)							Circular	20			20
			A Note3)					Circular	20			20
	A Note3)		A Note3)					Circular	20			20

Note1) If two channels are not executed simultaneously, each axis may be used up to 100 kHz.

Note2) These are the values when PC link and fixed-interval interrupt function are not used.

Note3) When using CH0 pulse output, do not use the hard reset (X2) at CH0 and CH1 of HSC.

When using CH2 pulse output, do not use the hard reset (X5) at CH2 and CH3 of HSC.

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.

Example 1:

If no reset input is used in the high-speed counter function, X2 and X5 can be as normal inputs.

Example 2:

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

Restrictions on the execution of related instructions (F166 to F176)

- If an instruction related to the high-speed counter “F166 to F176” is executed, the control flag (special internal relay: R903A to R903D) corresponding to the channel used turns on.

- Please be aware that the control flag “in progress” may change while a scan is being carried out. To prevent multiple read access to this special internal relay, you should generate a copy of it at the beginning of the program.
- When the control flag for a channel turns on, another instruction using that same channel cannot be executed.
- Executing circular interpolation control instruction F176 sets the circular interpolation in progress flag (special internal relay: R904E), and that state is maintained until the target value is achieved. During this time, other pulse output instructions (F171 to F176) cannot be executed.

6.2.3 Booting Time

The booting time is the time span from the execution of the instruction to the actual pulse output.

Type of instruction	Booting time	
Pulse output instruction F171 (SPDH) Trapezoidal control/home return	CW/CCW is set :	Approx. 200 μ s (with 30 steps)
		Approx. 400 μ s (with 60 steps)
	Pulse/direction is set :	Approx. 500 μ s (with 30 steps) ^{Note)}
		Approx. 700 μ s (with 60 steps) ^{Note)}
Pulse output instruction F172 (PLSH) JOG operation	CW/CCW is set :	Approx. 20 μ s
	Pulse/direction is set :	Approx. 320 μ s ^{Note)}
Pulse output instruction F174 (SP0H) Data table control	CW/CCW is set :	Approx. 30 μ s
	Pulse/direction is set :	Approx. 330 μ s ^{Note)}
PWM output instruction F173 (PWMH)	Approx. 30 μ s	

Note) If pulse/direction is set, a waiting time (approx. 300 μ s) is included from the time that the direction output goes on until the pulse output instruction can be executed.

6.3 High-speed Counter Function

6.3.1 Overview of High-speed Counter Function

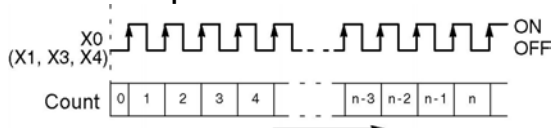
- The high-speed counter function counts the input signals, and when the count reaches the target value, turns on and off the desired output.
- To turn on an output when the target value is matched, use the target value match ON instruction F166 (HC1S). To turn off an output, use the target value match OFF instruction F167 (HC1R).
- Preset the output to be turned on and off with the SET/RET instruction.

Setting the system register

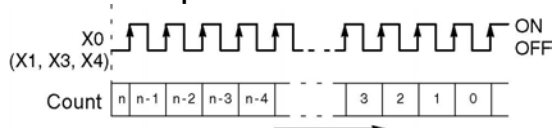
In order to use the high-speed counter function, it is necessary to set system register numbers nos. 400 and 401.

6.3.2 Input Modes and Count

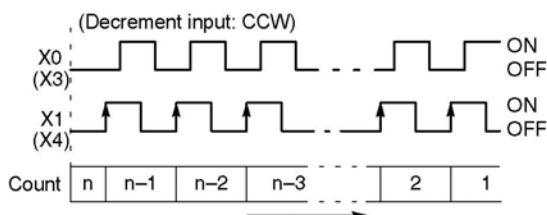
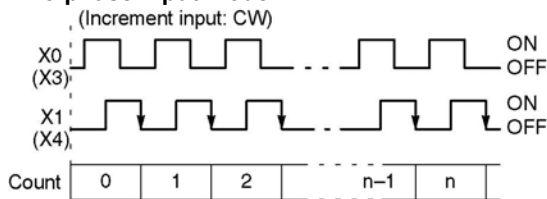
Incremental input mode



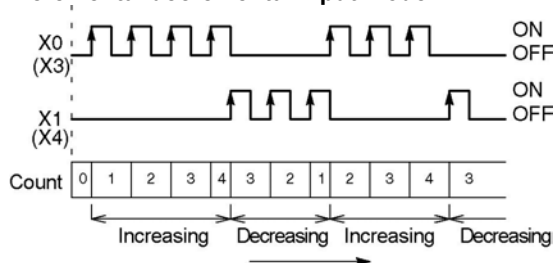
Decremental input mode



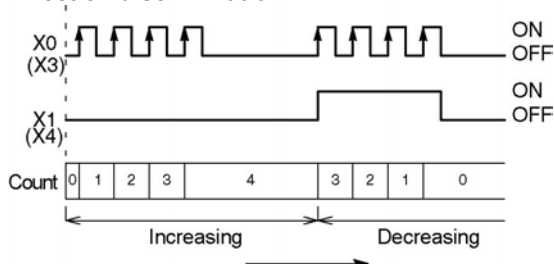
Two-phase input mode



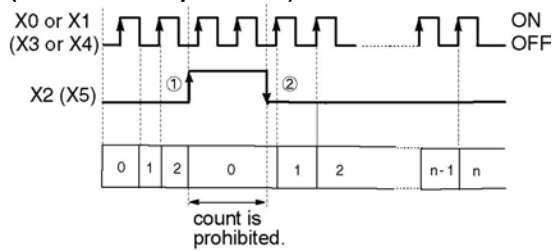
Incremental/decremental input mode



Direction discrimination



Count for reset input (Incremental input mode)



The reset input is executed by the interruption at (1) on (edge) and (2) off (edge).

(1) on (edge) ... Count disable, Elapsed value clear

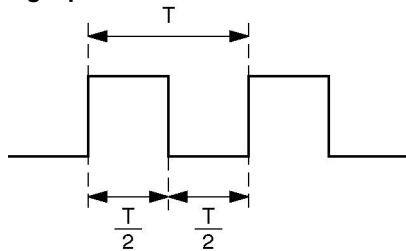
(2) off (edge) ... Count enable

DT90052 (bit2): "able/disable" setting of the input can be set by the reset input.

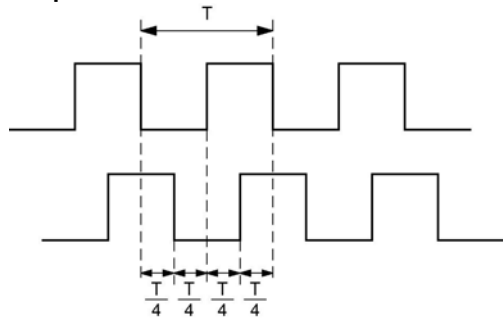
6.3.3 Minimum Input Pulse Width

For the period T (1/frequency), a minimum input pulse width of $T/2$ (single-phase input) or $T/4$ (two-phase input) is required.

<Single phase>



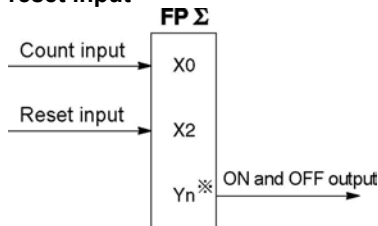
<Two-phase>



6.3.4 I/O Allocation

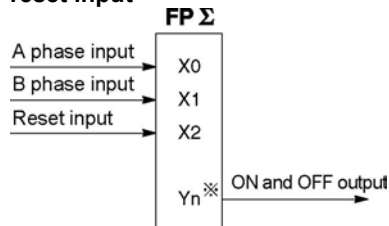
- As shown in the table in the previous section “6.2.1”, the inputs and outputs used will differ depending on the channel number being used.
- The output turned on and off can be specified from Y0 to Y7 as desired with instructions F166 (HC1S) and F167 (HC1R).

When using CH0 with incremental input and reset input



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

When using CH0 with two-phase input and reset input



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



Reference: <6.2.1 Table of Specifications>

6.3.5 Instructions used with High-speed Counter Function

High-speed counter control instruction (F0)

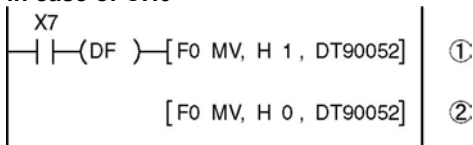
- This instruction is used for counter operations such as software reset and count disable.
- Specify this instruction together with the special data register DT90052.
- Once this instruction is executed, the settings will remain until this instruction is executed again.

Operations that can be performed with this instruction

- Counter software reset (bit0)
- Counting operation enable/disable (bit1)
- Hardware reset enable/disable (bit2)
- Clear high-speed counter instructions F166 to F176
- Clear target value match interrupt

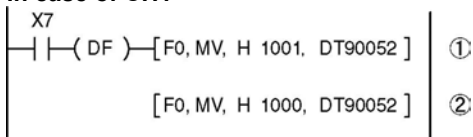
Example: Performing a software reset

In case of CH0

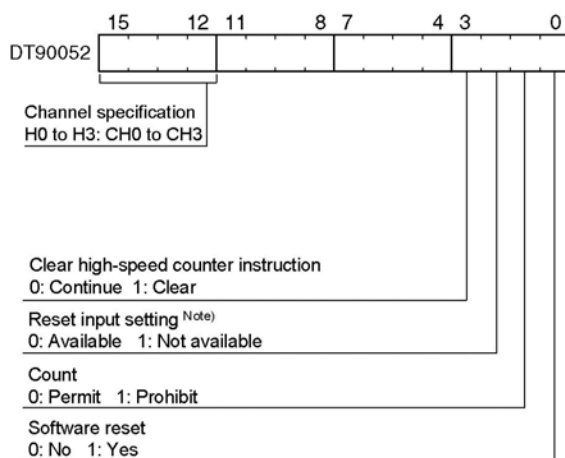


In the above program, the reset is performed in step (1) and 0 is entered just after that in step (2). The count is now ready for operation. If it is only reset, counting will not be performed.

In case of CH1



High-speed counter/pulse output control flag area of FPΣ



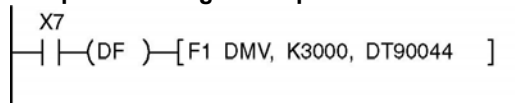
- The area DT90052 for writing channels and control codes is allocated as shown in the left figure.
- Control codes written with an F0 (MV) instruction are stored by channel in special data registers DT90190 to DT90193.

Note) In the reset input setting, the reset input (X2 or X5) allocated in the high-speed counter setting of the system registers are defined to “enable/disable”.

Elapsed value write and read instruction (F1)

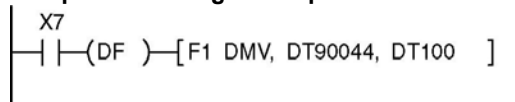
- This instruction changes or reads the elapsed value of the high-speed counter.
- Specify this instruction together with the special data register DT90044.
- The elapsed value is stored as 32-bit data in the combined area of special data registers DT90044 and DT90045.
- Use this F1 (DMV) instruction to set the elapsed value.

Example 1: Writing the elapsed value



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

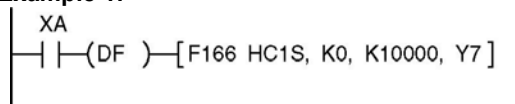
Example 2: Reading the elapsed value



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

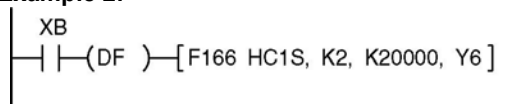
Target value match ON instruction (F166)

Example 1:



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

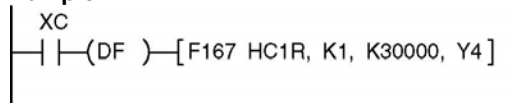
Example 2:



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

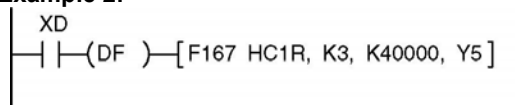
Target value match OFF instruction (F167)

Example 1:



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

Example 2:

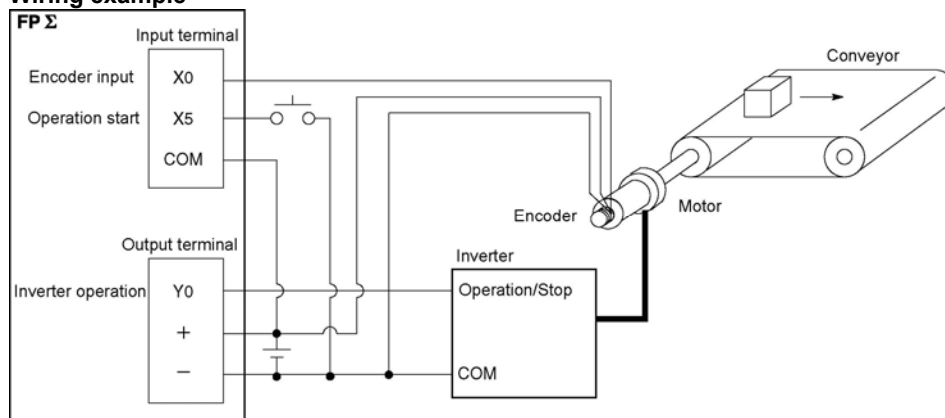


If the elapsed value (DT90204 and DT90205) for channel 3 matches K40000, output Y5 turns off.

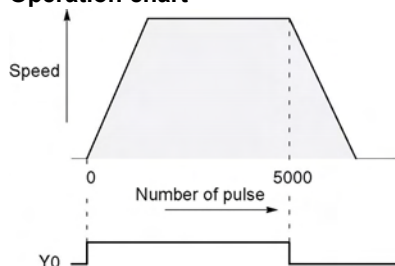
6.3.6 Sample program

Positioning operations with a single speed inverter

Wiring example



Operation chart

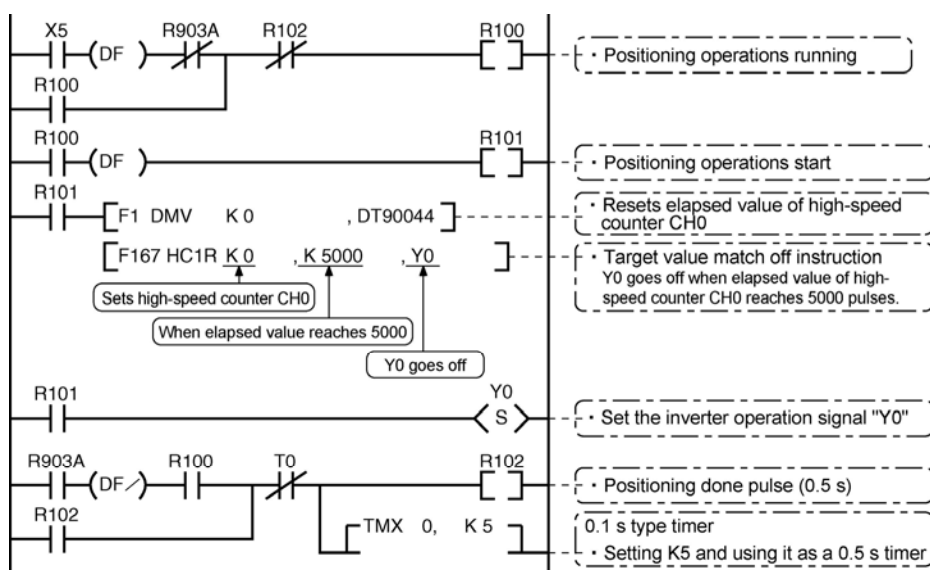


I/O allocation

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

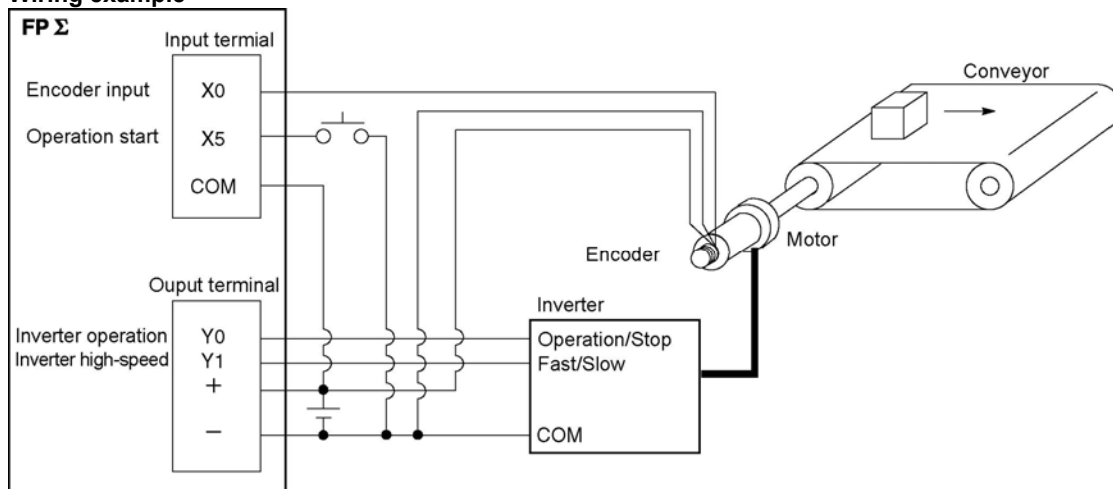
Program

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.

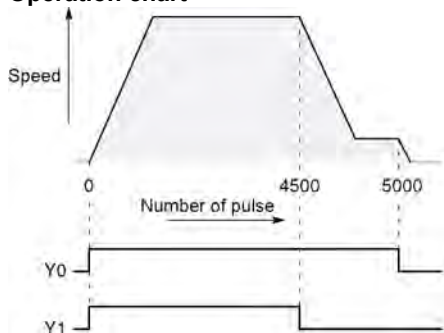


Positioning operations with a double speed inverter

Wiring example



Operation chart

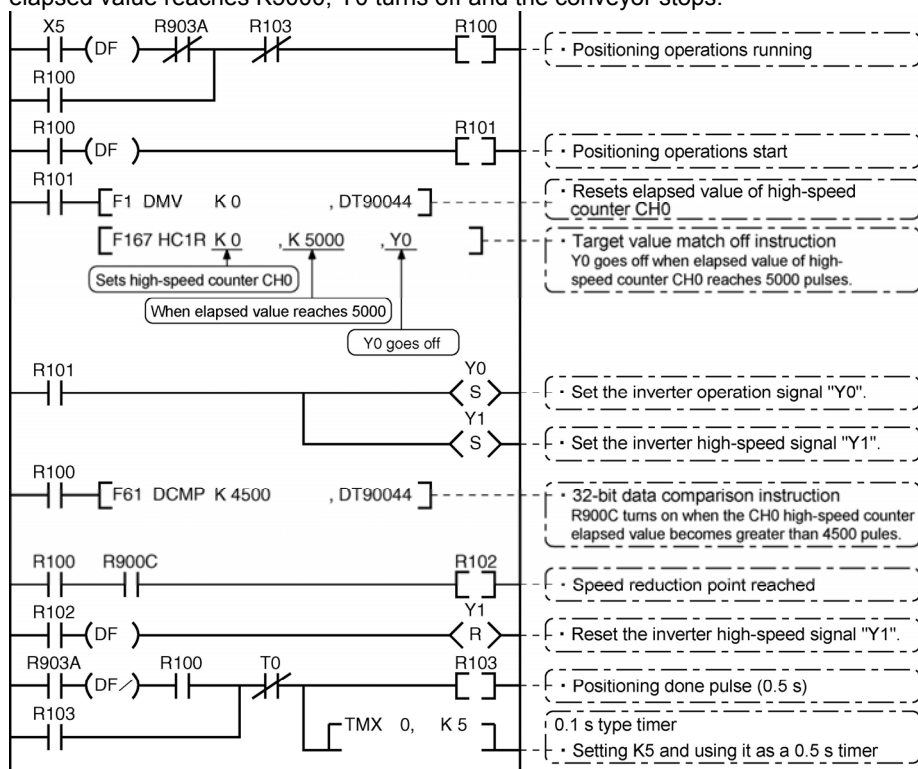


I/O allocation

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

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.



6.4 Pulse Output Function

6.4.1 Overview of Pulse Output Function

Instructions used and controls

Together with a commercially available pulse-string input type motor driver, the pulse output function can be used for positioning control.

Type of control	Exclusive instruction	Description	Usable unit
Trapezoidal control	F171 (SPDH)	Provides trapezoidal (table-shaped) control for automatically obtaining pulse outputs by specifying the initial speed, maximum speed, acceleration/deceleration time and target value.	C32T C32T2 C28P2 C32TH C32T2H C28P2H
Home return		Enables automatic home return operation.	
JOG operation	F172 (PLSH)	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.	
Data table control	F174 (SP0H)	Enables positioning control in accordance with the data table.	
Linear interpolation	F175 (SPSH)	Enables pulses to be output using linear interpolation control, by specifying the composite speed, the acceleration/deceleration time, and the target value.	C32T2 C28P2 C32T2H C28P2H
Circular interpolation	F176 (SPCH)	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:

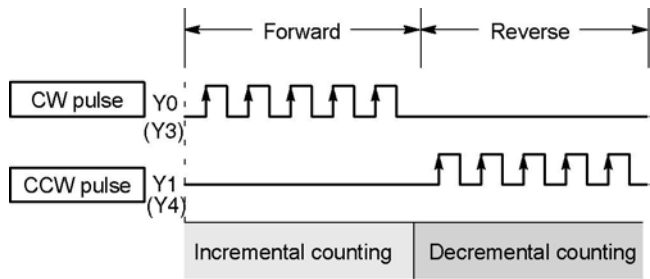
- The thermister input type for various units is included.
- The pulse output function can be used with the transistor output type only.

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”.

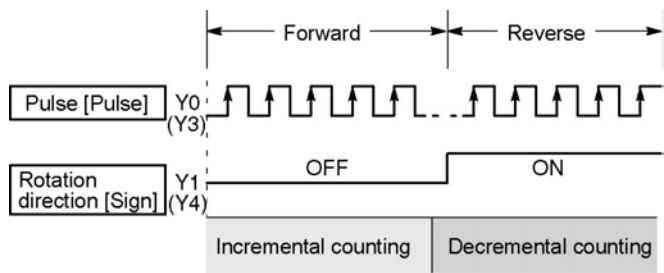
6.4.2 Types of Pulse Output Method and Operation Modes

Clockwise/counter-clockwise output method



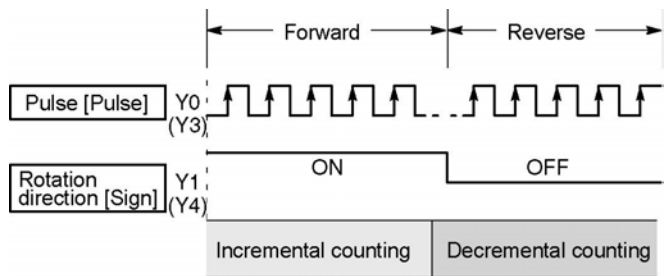
Control is carried out using two pulses: a forward rotation pulse and a reverse rotation pulse.

Pulse/direction output method (forward: OFF/reverse: ON)



Control is carried out using one pulse output to specify the speed and another to specify the direction of rotation with on/off signals. In this mode, forward rotation is carried out when the rotation direction signal is OFF.

Pulse/direction output method (forward: ON/reverse: OFF)



Control is carried out using one pulse output to specify the speed and another to specify the direction of rotation with on/off signals. In this mode, forward rotation is carried out when the rotation direction signals is ON.

Operation mode

Incremental <Relative value control>

Outputs the pulses set with the target value.

Selected Mode Target value	CW/CCW	Pulse and direction forward OFF/ reverse ON	Pulse and direction forward ON/ reverse OFF	HSC counting Method
Positive	Pulse output from CW	Pulse output when direction output is OFF	Pulse output when direction output is ON	Incremental
Negative	Pulse output from CCW	Pulse output when direction output is ON	Pulse output when direction output is OFF	Decremental

Example:

When the current position (value of elapsed value area) is 5000, the pulse of 1000 is output from CW by executing the pulse output instruction with the target value +1000, and the current position will be 6000.

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	Pulse and direction forward OFF/ reverse ON	Pulse and direction forward ON/ reverse OFF	HSC counting method
Target value greater than current value	Pulse output from CW	Pulse output when direction output is OFF	Pulse output when direction output is ON	Incremental
Target value less than current value	Pulse output from CCW	Pulse output when direction output is ON	Pulse output when direction output is OFF	Decremental

Example:

When the current position (value of elapsed value area) is 5000, the pulse of 4000 is output from CCW by executing the pulse output instruction with the target value +1000, and the current position will be 1000.

Home return

- When executing the F171 (SPDH) instruction, the pulse is continuously output until the home input (X2 or X5) is enabled.
- To decelerate the movement when near the home position, designate a near home input and set bit 4 of special data register DT90052 to off → on → off.
- The deviation counter clear output can be output when home return 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.

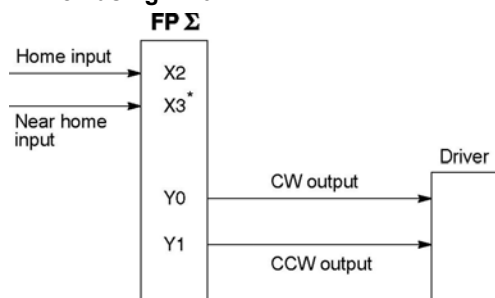
6.4.3 I/O Allocation

Double pulse input driver

(CW pulse input and CCW pulse input method)

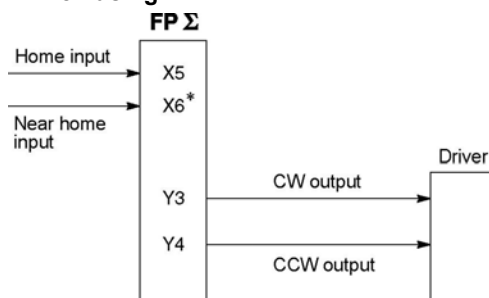
- Two output contacts are used as a pulse output for “CW, CCW”.
- The I/O allocation of pulse output terminal and home input is determined by the channel used.
- Set the control code for F171 (SPDH) instruction to “CW/CCW”.

<When using CH0>



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

<When using CH2>



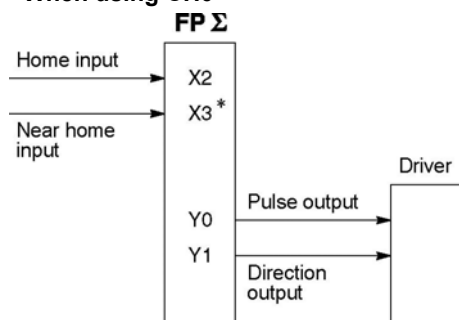
* X6 or any other input can be specified for the near home input.

Single pulse input driver

(pulse input and directional switching input method)

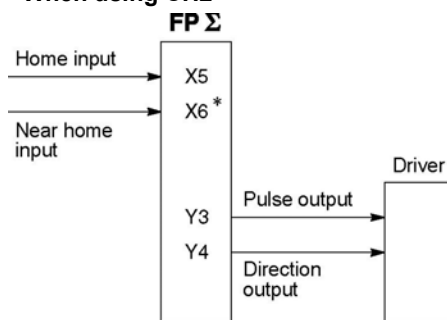
- One output point is used as a pulse output and the other output is used as a direction output.
- The I/O allocation of pulse output terminal, direction output terminal, and home input is determined by the channel used.
- Near home input is substituted by allocating the desired contact and turning on and off the <bit4> of special data register DT90052.
- Up to two driver systems can be connected.

<When using CH0>



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

<When using CH2>



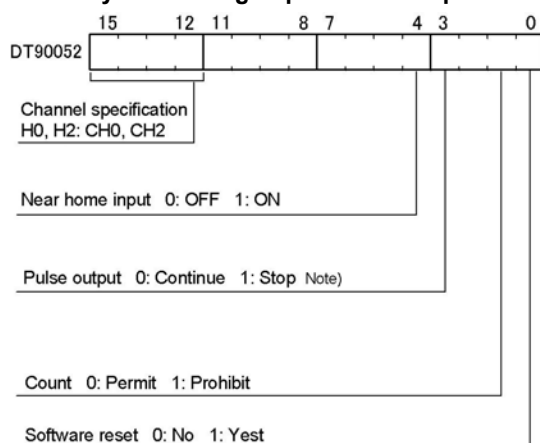
* X6 or any other input can be specified for the near home input.



Reference: <6.2.1 Table of Specifications>



Key Point: : High-speed counter/pulse output control flag area of FPΣ



- The area DT90052 for writing channels and control codes is allocated as shown in the left figure.

- Control codes written with an F0 (MV) instruction are stored by channel in special data register DT90190 and DT90192.

Note) The output counting value of the elapsed value area may be different from the input counting value of the motor side if the pulse output is stopped by the “Continue/stop of pulse output”. After the pulse output stops, execute the home return.



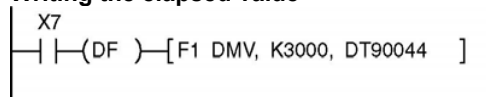
Reference: <6.2.1 Table of specifications> for information on the special data register.

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 register DT90044 and DT90045.
- Use only this F1 (DMV) instruction to set the elapsed value.

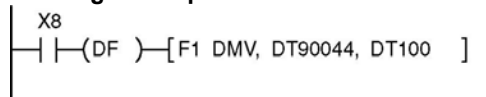
Example 1:

Writing the elapsed value



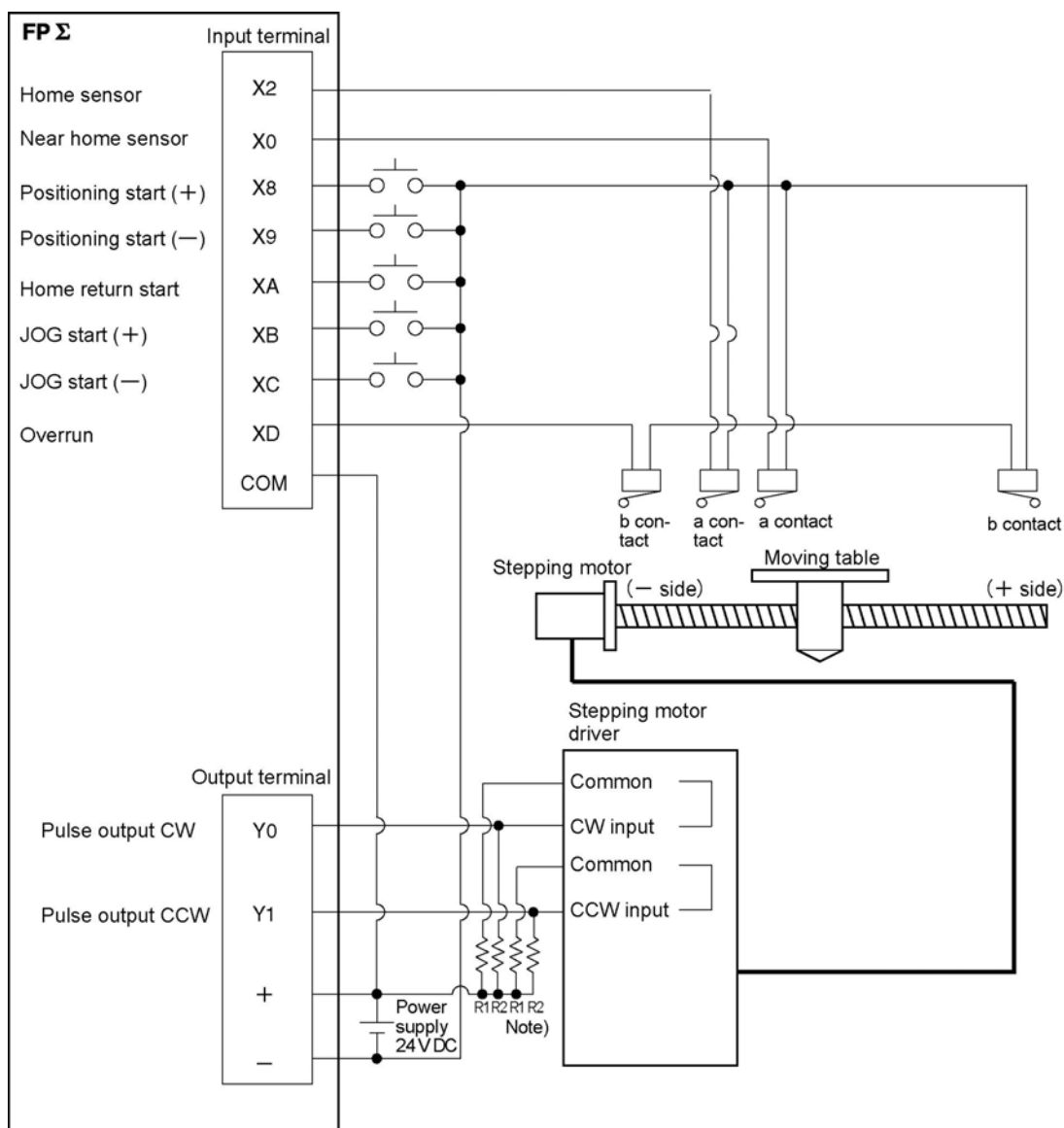
Set the initial value of K3000 in the high-speed counter.

Reading the elapsed value



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

Wiring example



Note) When the stepping motor input is a 5 V optical coupler type, connect a resistor of 2 k Ω (1/2 W) to R1, and connect a resistor of 2 k Ω (1/2 W) – 470 Ω (2 W) to R2.

Table of I/O allocation

I/O No.	Description	I/O No.	Description
X2	Home sensor input	XD	Overrunning signal
X0	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

6.4.5 Positioning Control Instruction F171 - Trapezoidal Control (Common to Transistor type)

- This instruction automatically performs trapezoidal control according to the specified data table.

X8	(DF)	[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]

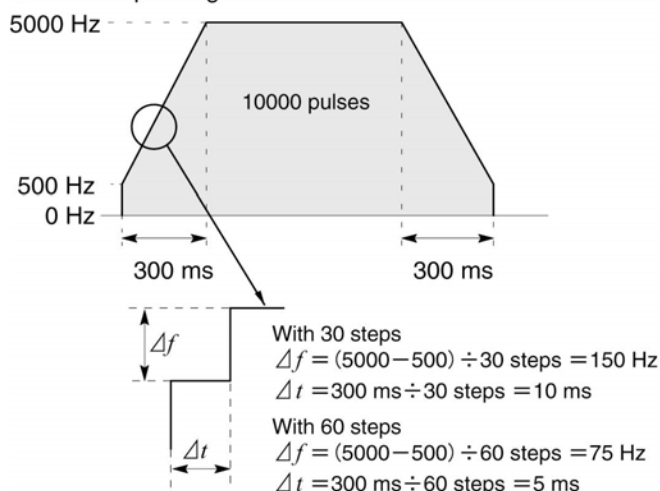
Pulses are generated from output Y0 at an initial speed of 500 Hz, a maximum speed of 5000 Hz, an acceleration/ deceleration time of 300 ms, and a movement amount of 10000 pulses.

When this program runs, 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	Max. speed	*2 : 5000 Hz
DT106 DT107	Acceleration/ deceleration time	*3 : 300 ms
DT108 DT109	Target value	*4 : 10000 pulse
DT110 DT111	Pulse stop	: K0

● Pulse output diagram



● Regarding the specification of acceleration/deceleration time

- For specifying acceleration/deceleration time, No. of steps and initial speed, set the value to be calculated by the formula below. Specify acceleration/deceleration time in the 30 ms unit with 30 steps, and in the 60 ms unit with 60 steps. *5

Acceleration/deceleration time

$$t [\text{ms}] \geq (\text{No. of steps} \times 1000) / \text{Initial speed } f_0 [\text{Hz}]$$

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

0 : Fixed

■ Number of acceleration/deceleration steps

0 : 30 steps

1 : 60 steps (Can be used with Ver 1.4 or later.)

■ Duty (on width) *6

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 pulse and direction (forward off / reverse on)

03 : Incremental pulse and direction (forward on / reverse off)

10 : Absolute CW/CCW

12 : Absolute pulse and direction (forward off / reverse on)

13 : Absolute pulse and direction (forward on / reverse off)

(*2) : Frequency (Hz) <K constant>

Frequency range

0 : 1.5 Hz to 9.8 kHz [K1 to K9800 (unit : Hz)]
(Max. error near 9.8 kHz approx. -0.9 kHz)

* Set "K1" to specify 1.5 Hz.

1 : 48 Hz to 100 kHz [K48 to K100000 (unit : Hz)]
(Max. error near 100 kHz approx. -3 kHz)

2 : 191 Hz to 100 kHz [K191 to K100000 (unit : Hz)]
(Max. error near 100 kHz approx. -0.8 kHz)

Initial speed: Set 30 kHz or less.

(*3) : Acceleration/deceleration time (ms) <K constant>

With 30 steps: K30 to K32760 (Specify by 30 steps)

With 60 steps: K60 to K32760 (Specify by 60 steps)

(*4) : Target value <K constant>

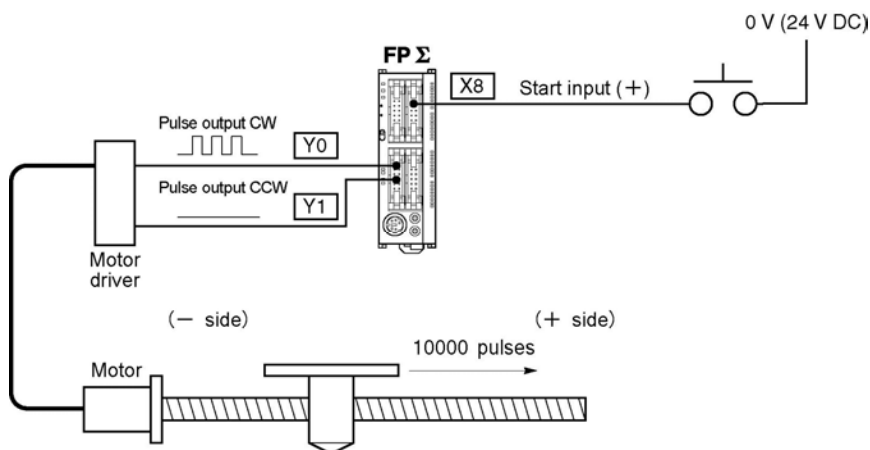
K-2147483648 to K2147483647

(*5) : When the time is not specified in 30 ms units nor 60 ms units,
it will be automatically corrected to the multiple value (larger
value) of 30 ms or 60 ms.

(*6) : When the frequency is set to 50Hz or higher, the duty must
be set to 1/4 (25%).

Incremental Position Control Operation: Plus Direction

0 V (24 V DC)



Positioning operation using table-shaped control

Positioning data table

DT100 DT101	Control code * : H 1100
DT102 DT103	Initial speed : 500 Hz
DT104 DT105	Max. speed : 5000 Hz
DT106 DT107	Acceleration time : 200 ms
DT108 DT109	Target value (Movement amount) : 10000 pulses
DT110 DT111	Pulse stop

* Control code H 1 1 0 0
 Duty 1/4 (25%)
 48 Hz to 100 kHz
 Incremental CW and CCW

Positioning operation running

Positioning operation start

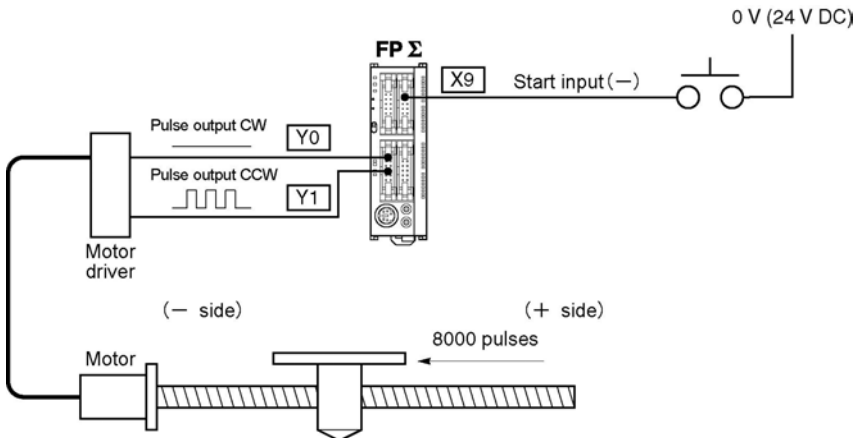
Positioning done pulse (1 second)

0.1 s type timer

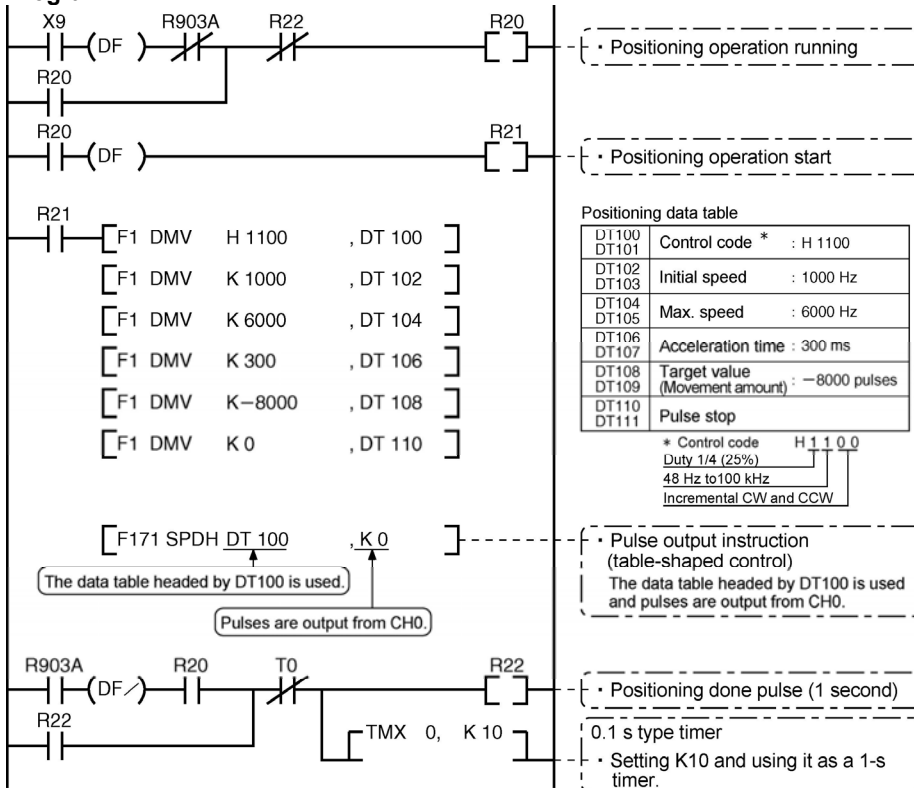
Setting K10 and using it as a 1-s timer.

Incremental Position Control Operation: Minus Direction

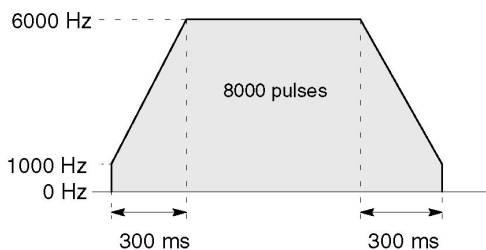
When X9 turns on, the pulse is output from CCW output Y0 of the specified channel CH0.



Program

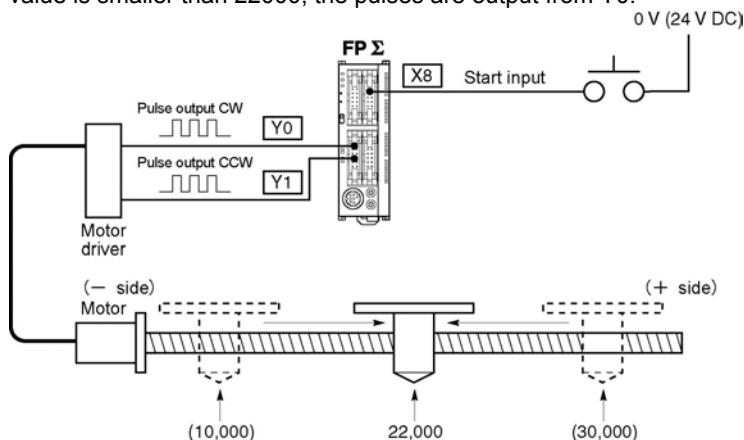


Pulse output diagram

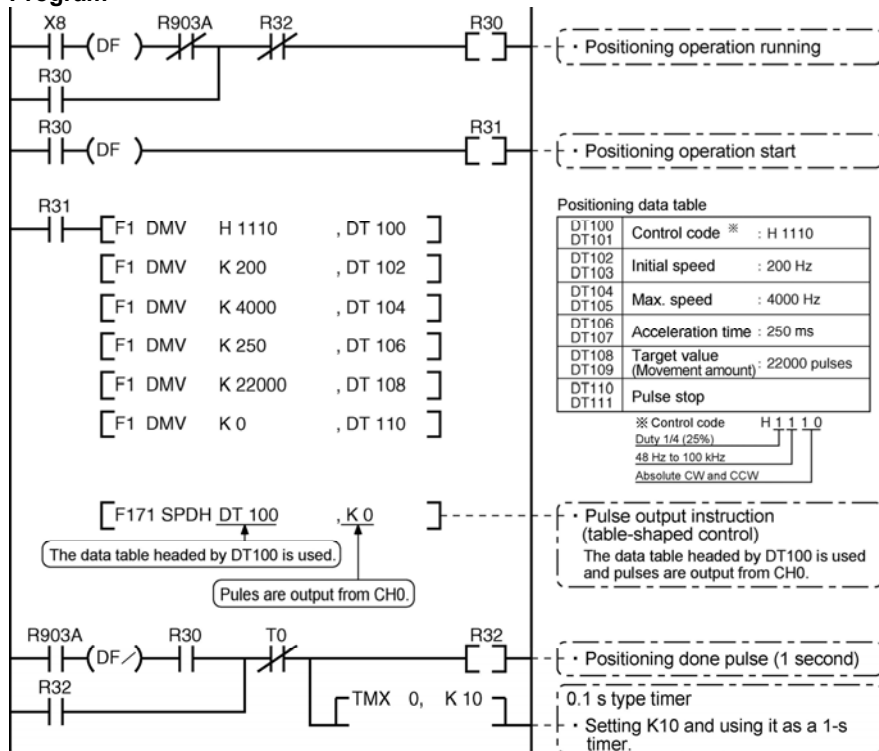


Absolute position control operation

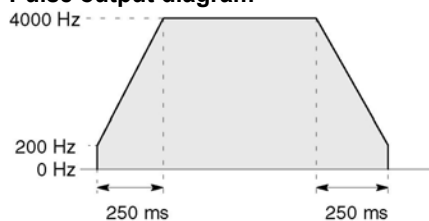
When X1 is turned on, pulses are output from CW output Y0 or CCW output Y1 of the specified channel CH0. If the current value at that point is larger than 22000, the pulses are output from Y1, and if the value is smaller than 22000, the pulses are output from Y0.



Program



Pulse output diagram



6.4.6 Positioning Control Instruction F171 – Home Return (Common to Transistor type)

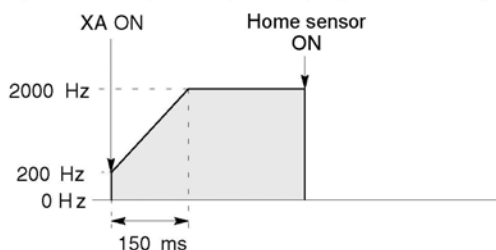
- This function performs home return according to the specified data table. The elapsed value area CH0 (DT90044, DT90045) and CH1 (DT90200, DT90202) is cleared to zero after the completion of home return.

XA	[F1 DMV, H1125, DT200]	Pulses are output from Y1 and a return to the home position is carried out at an initial speed of 200 Hz, a maximum speed of 2000 Hz, and an acceleration/deceleration time of 150 ms.
	[F1 DMV, K200, DT202]	
	[F1 DMV, K2000, DT204]	
	[F1 DMV, K150, DT206]	
	[F1 DMV, K10, DT208]	
	[F171 SPDH, DT200, K0]	When this program runs, the positioning data table and the pulse output diagram will be as shown below.

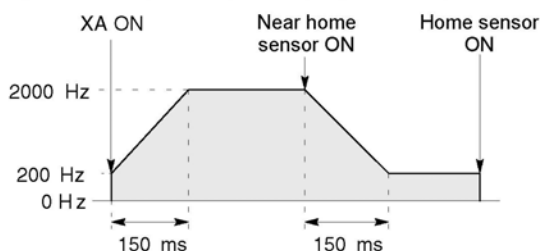
●Positioning data table

DT200 DT201	Control code *1	: H 1125
DT202 DT203	Initial speed *2	: 200 Hz
DT204 DT205	Max. speed *2	: 2000 Hz
DT206 DT207	Acceleration/ deceleration time *3	: 150 ms
DT208 DT209	Deviation counter *4 clear signal output time	: 10 ms

●Pulse output diagram (when home position proximity input is not used)



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



●Regarding the specification of acceleration/deceleration time

- For specifying acceleration/deceleration time, No. of steps and initial speed, set the value to be calculated by the formula below. Specify acceleration/deceleration time in the 30 ms unit with 30 steps, and in the 60 ms unit with 60 steps. *5

Acceleration/deceleration time

$$t [\text{ms}] \geq (\text{No. of steps} \times 1000) / \text{Initial speed } f_0 [\text{Hz}]$$

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

0 : Fixed

■ Number of acceleration/deceleration steps

0 : 30 steps

1 : 60 steps (Can be used with Ver 1.4 or later.)

■ Duty (on width) *6

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

■ Optional 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 clear

25 : Type I home return CCW and deviation counter clear

26 : Type I home return Direction output OFF and deviation counter clear

27 : Type I home return Direction output ON and deviation counter clear

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 clear

35 : Type II home return CCW and deviation counter clear

36 : Type II home return Direction output OFF and deviation counter clear

37 : Type II home return Direction output ON and deviation counter clear

(*2) : Frequency (Hz) <K constant>

Frequency range

0 : 1.5 Hz to 9.8 kHz [K1 to K9800 (unit : Hz)]

(Max. error near 9.8 kHz approx. -0.9 kHz)

* Set "K1" to specify 1.5 Hz.

1 : 48 Hz to 100 kHz [K48 to K100000 (unit : Hz)]

(Max. error near 100 kHz approx. -3 kHz)

*Duty 1/4 is recommended for this range.

2 : 191 Hz to 100 kHz [K191 to K100000 (unit : Hz)]

(Max. error near 100 kHz approx. -0.8 kHz)

*Duty 1/4 is recommended for this range.

Initial speed: Set 30 kHz or less.

(*3) : Acceleration/deceleration time (ms) <K constant>

With 30 steps: K30 to K32760 (Specify in 30 steps) *5

With 60 steps: K60 to K32760 (Specify in 60 steps) *5

(*4) : Deviation counter clear signal (ms) <K constant>

Output time of deviation counter clear signal is specified.

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.

Deviation counter clear signal is allocated in Y2 for CH0 and in Y5 for CH2.

(*5) : When the time is not specified in 30 ms units nor 60 ms units, it will be automatically corrected to the multiple value (larger value) of 30 ms or 60 ms.

(*6) : When the frequency is set to 50Hz or higher, the duty must be set to 1/4 (25%).

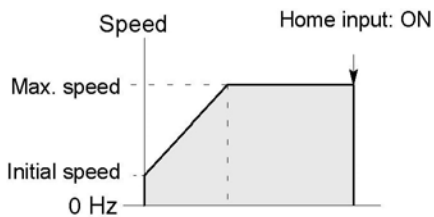
Home return operation modes

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

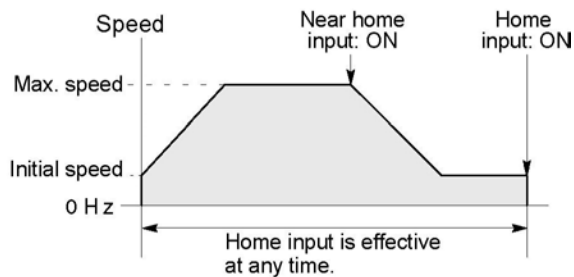
Type I home return

The home input is effective regardless of whether or not there is a near home input, whether deceleration is taking place, or whether deceleration has been completed.

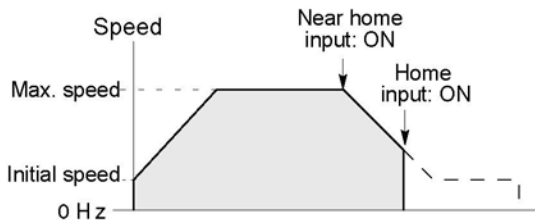
• Without near home input



• With near home input

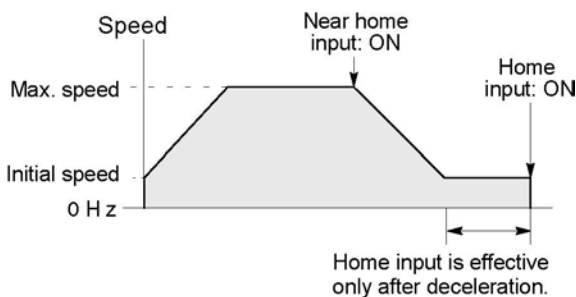


• Home input ON during deceleration



Type II home return

In this mode, the home input is effective only after deceleration (started by near home input) has been completed.



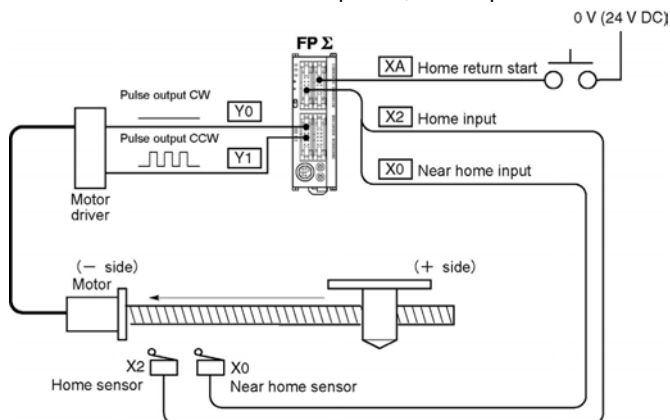
Reference:

The Pulse output control instruction (F0) is used for the near home input.
<6.4.4 Pulse output control instructions (F0) (F1)>.

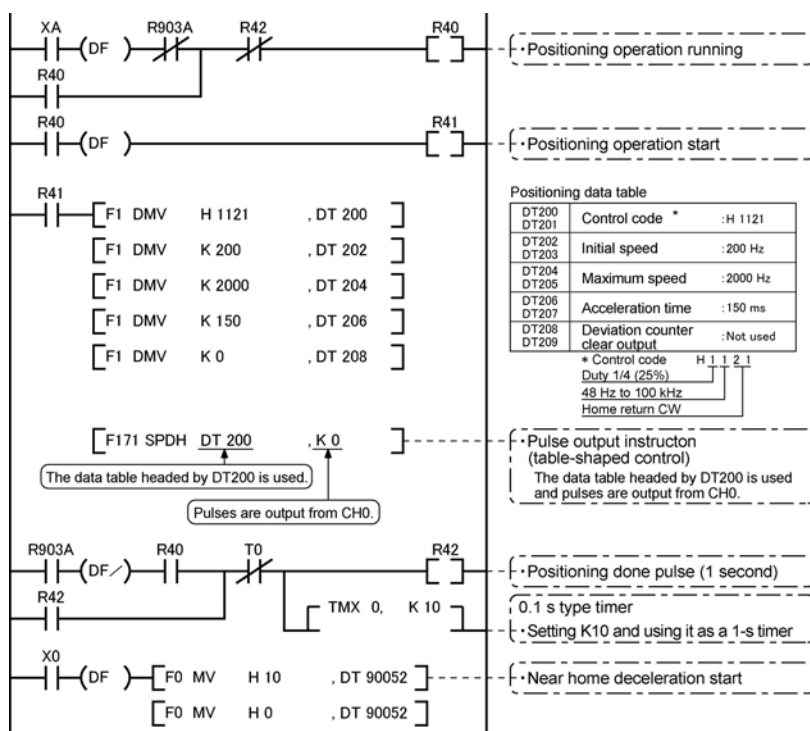
Sample program

Home return operation using CH0: Minus direction

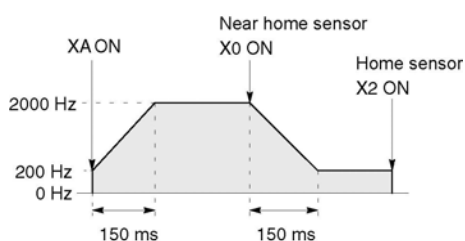
When XA turns on, a pulse is output from CCW output Y1 of the specified channel CH0 and the return to home begins. When X0 turns on, deceleration begins, and when X2 turns on, home return is completed. After the return to home is completed, the elapsed value areas DT90044 and DT90045 are cleared to 0.



Program



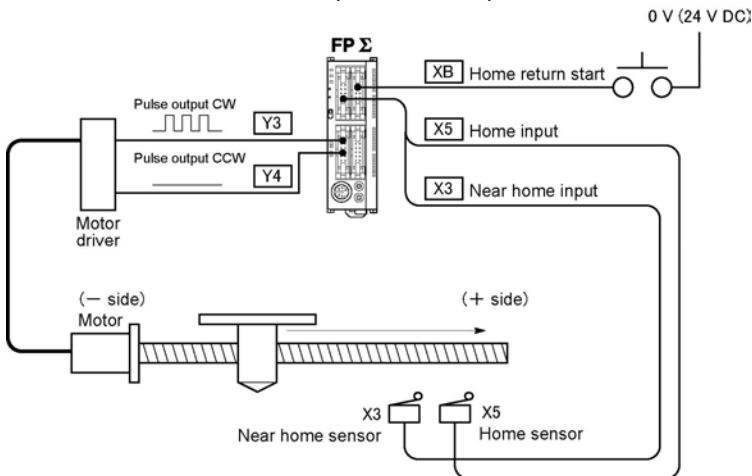
Pulse output diagram



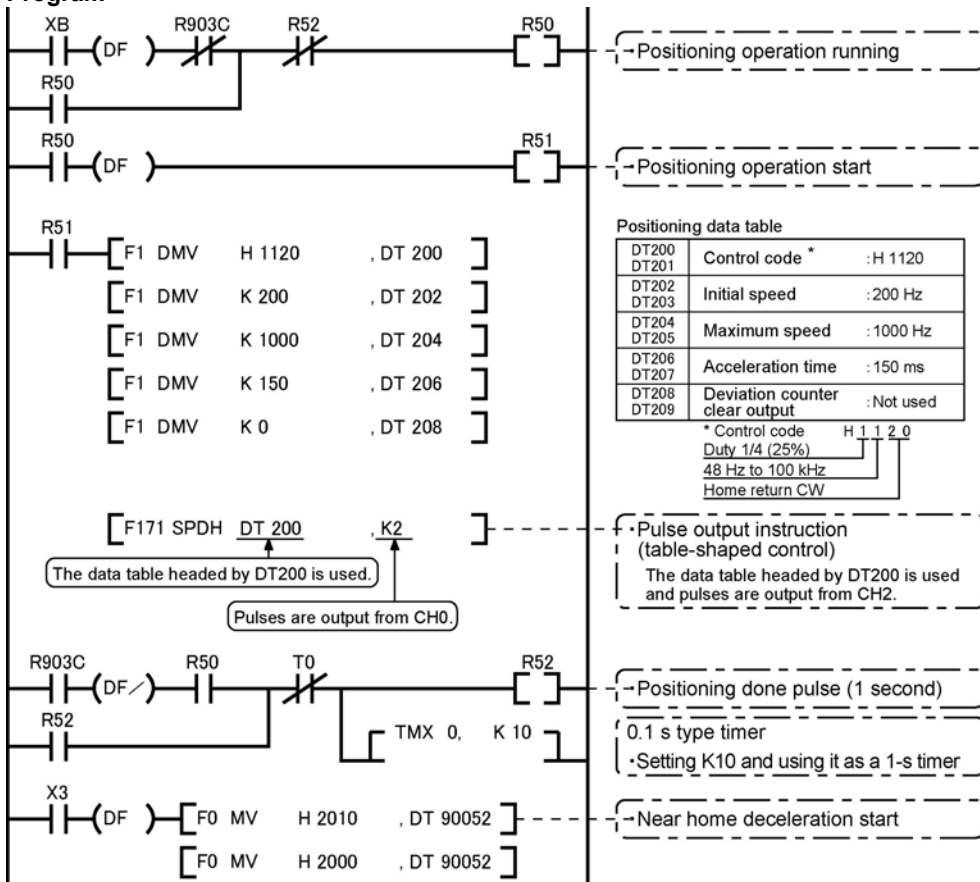
Sample program

Home return operation using CH2: Plus direction

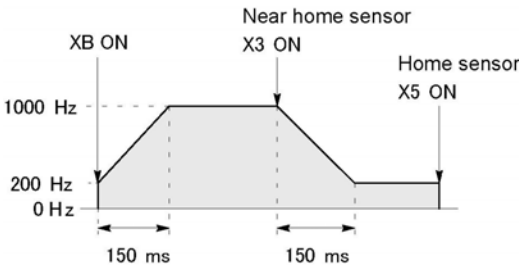
When XB turns on, a pulse is output from CW output Y3 of the specified channel CH2 and the return to home begins. When X3 turns on, deceleration begins, and when X5 turns on, home return is completed. After the return to home is completed, the elapsed value areas DT90200 and DT90201 are cleared to 0.



Program

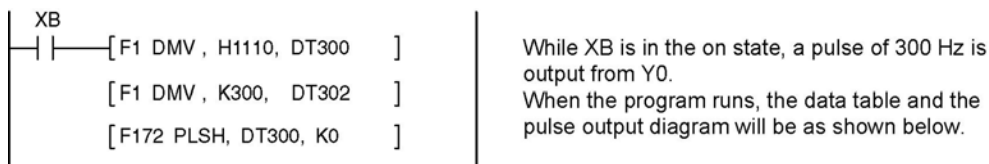


Pulse output diagram



6.4.7 Pulse Output Instruction F172 – JOG operation (Common to Transistor type)

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



●Data table

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

●Pulse output diagram



(*1) : Control code <H constant>

0 : Fixed

■Target value setting

0 : Mode with no target value

1 : Target value match stop mode
(can be used with Ver 1.4 or later.)

■Duty (on width) *4

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 : Incremental counting

CW

12 : Incremental counting

Direction output OFF

13 : Incremental counting

Direction output ON

21 : Decremental counting

CCW

22 : Decremental counting

Direction output OFF

23 : Decremental counting

Direction output ON

(*2) : Frequency (Hz) <K constant>

Frequency range

0 : 1.5 Hz to 9.8 kHz [K1 to K9800 (unit : Hz)]
(Max. error near 9.8 kHz approx. -0.9 kHz)
* Set "K1" to specify 1.5 Hz.

1 : 48 Hz to 100 kHz [K48 to K100000 (unit : Hz)]
(Max. error near 100 kHz approx. -3 kHz)

2 : 191 Hz to 100 kHz [K191 to K100000 (unit : Hz)]
(Max. error near 100 kHz approx. -0.8 kHz)

In case of count mode, set the frequency to 30 kHz or less
for executing instructions at the first time.

(*3) : Target value (Absolute value)

(Can be used with Ver 1.4 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 designated value. The target value setting
is ignored in the no count mode.

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

(*4) : When the frequency is set to 50Hz or higher, the duty must
be set to 1/4 (25%).



Key Point:

The FPΣ supports two operation modes for JOG operation, one in which no target value is specified, and one in which feed stops when the target value is reached.

Normal jogging operation feed (no target value specified)

Pulses are output in accordance with the conditions set in the data table, as long as execution condition is on.

● Data table

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

● Pulse output diagram



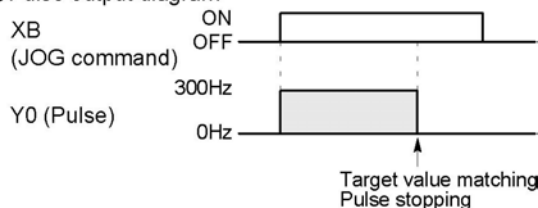
Output stops when target value is reached (FPΣ Ver 1.4 or later)

With FPΣ Ver 1.4 or later, a target value at which pulse output stops can be specified for jogging operation. As shown below, this mode is selected in the control code, and the target value (an absolute value) is specified in the data table.

● Data table

DT300 DT301	Control code ※1 : H 11110
DT302 DT303	Frequency ※2 : 300 Hz
DT304 DT305	Target value ※3 : K 1000

● Pulse output diagram

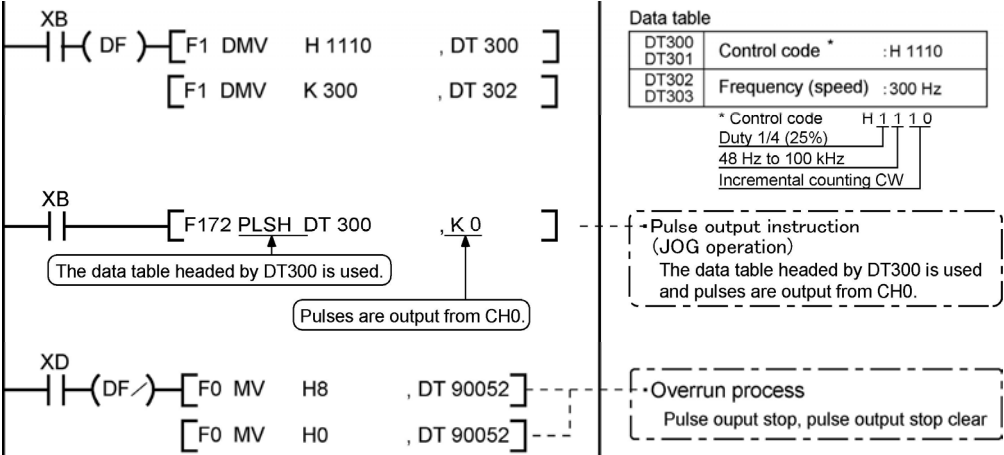


Sample program

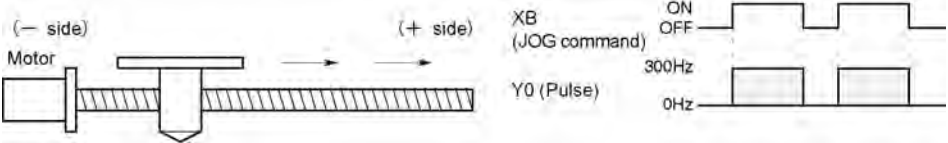
JOG operation : Plus direction

While XB is in the ON state, a pulse is output from the CW output Y0 of the specified channel CH0.

Program



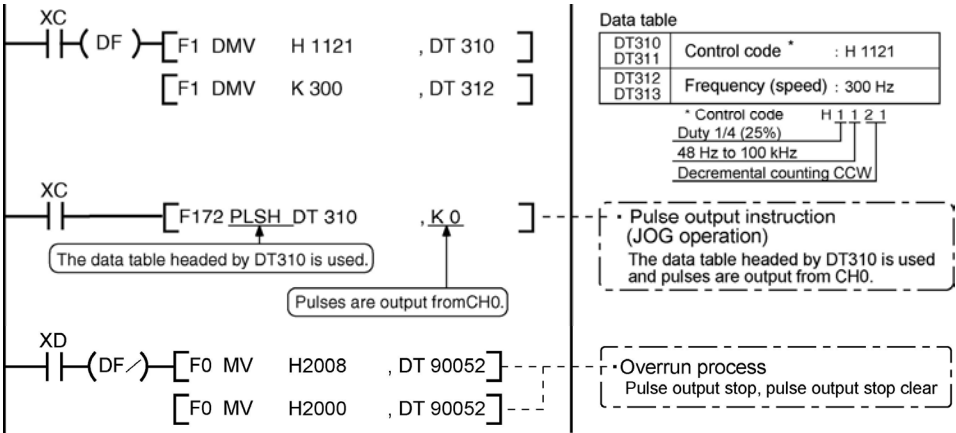
Pulse output diagram



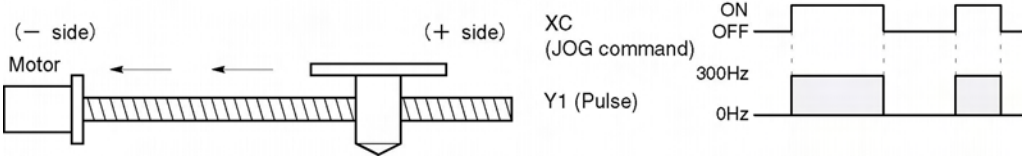
JOG operation : Minus direction

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

Program



Pulse output diagram



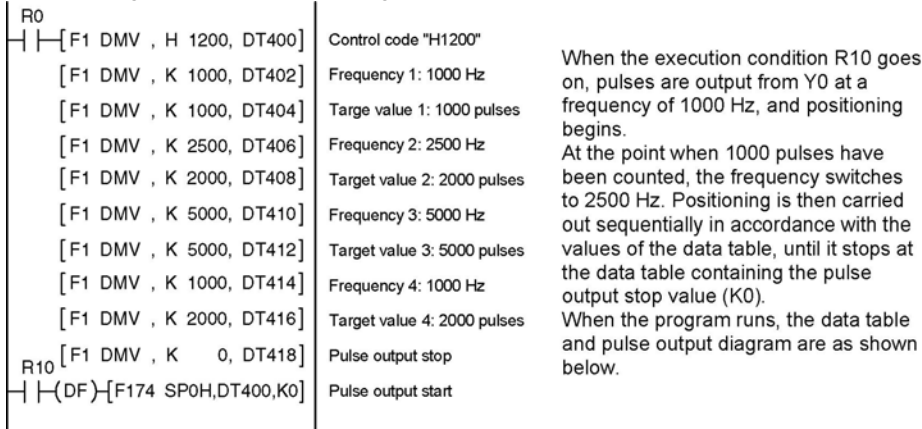
Reference:

The pulse output control instruction (F0) is used for the pulse output stop.

<6.4.4 Pulse output control instruction (F0)>

6.4.8 Positioning Control Instruction F174 – Data Table Contro.

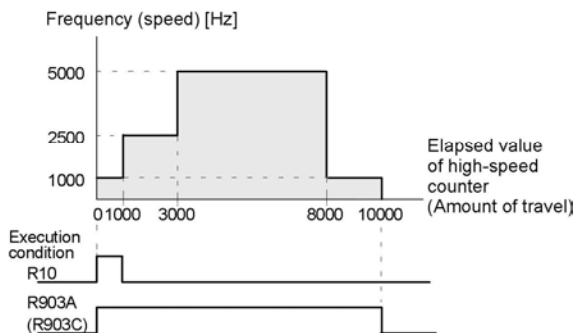
- Positioning is performed according to the specified data table.



●Positioning data table

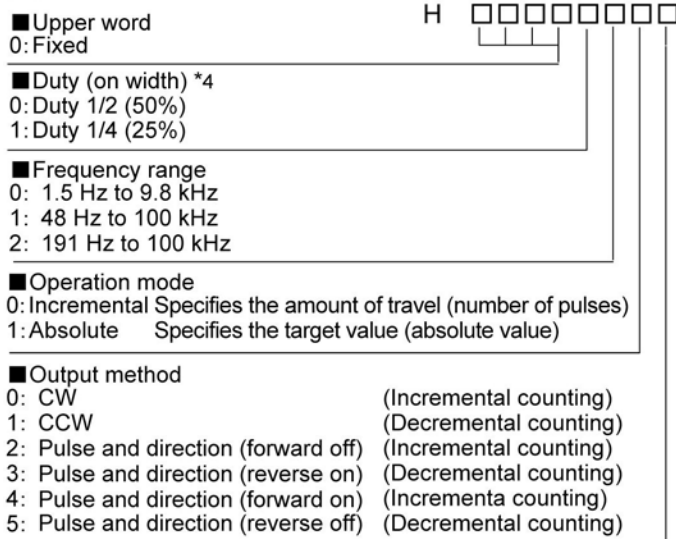
DT400 DT401	Control code	*1 : H 1200
DT402 DT403	Frequency 1	*2 : 1000 Hz
DT404 DT405	Target value 1	*3 : 1000 pulses
DT406 DT407	Frequency 2	: 2500 Hz
DT408 DT409	Target value 2	: 2000 pulses
DT410 DT411	Frequency 3	: 5000 Hz
DT412 DT413	Target value 3	: 5000 pulses
DT414 DT415	Frequency 4	: 1000 Hz
DT416 DT417	Target value 4	: 2000 pulses
DT418 DT419	Pulse output stop setting	: K 0

●Pulse output diagram



Note) When the execution condition R10 of the F174 (SP0H) instruction goes on, the high-speed counter control flag R903A (R903C) goes on. When the elapsed value reaches 10000 and pulse output stops, R903A (R903C) goes off.

(*1) : Control code <H constant>



(*2) : Frequency (Hz) <K constant>

Frequency range

- 0 : 1.5 Hz to 9.8 kHz [K1 to K9800 (unit : Hz)]
(Max. error near 9.8 kHz approx. -0.9 kHz)
* Set "K1" to specify 1.5 Hz.
- 1 : 48 Hz to 100 kHz [K48 to K100000 (unit : Hz)]
(Max. error near 100 kHz approx. -3 kHz)
- 2 : 191 Hz to 100 kHz [K48 to K100000 (unit : Hz)]
(Max. error near 100 kHz approx. -0.8 kHz)

Set the frequency 1 which is initial speed to 30 kHz or less.

(*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	Incremental counting	Specifies a positive value.
	Decremental counting	Specifies a negative value.
Absolute	Incremental counting	Specifies a value larger than the current value
	Decremental counting	Specifies a value smaller than the current value

(*4) : When the frequency is set to 50Hz or higher, the duty must be set to 1/4 (25%).

6.4.9 Action of the Flag concerning Linear Interpolation and Circular Interpolation



Key Point:

Can be used with C32T2, C28P2, C32T2H and C28P2H only.

Table of flag Allocation

Address	Flag conditions	The uses of the flag in the program
R903A Control flag (CH0)	Turns on during execution of pulse output instructions that include a circular interpolation instruction and then maintains that state during pulse output from CH0. This flag is the same for instructions F166 to F176.	Use this to prohibit the simultaneous execution of other high-speed counter instructions and pulse output instructions, and to verify completion of an action.
R903C Control flag (CH2)	Turns on during execution of pulse output instructions that include a circular interpolation instruction and then maintains that state during pulse output from CH2. This flag is the same for instructions F166 to F176.	Use this to prohibit the simultaneous execution of other high-speed counter instructions and pulse output instructions, and to verify completion of an action.
R904E Control flag for circular interpolation	Turns on when circular interpolation instruction F176 starts up and maintains that state until the target value is reached. When the target value has not been reached even if the circular interpolation instruction execution condition is off, that state is maintained.	Use this to prohibit the simultaneous execution of other high-speed counter instructions and to verify completion of a circular interpolation action. When this flag is on, other positioning instructions F171 to F176 cannot be started.
R904F Confirmation flag for overwriting circular interpolation	Turns on for one scan when the circular interpolation instruction F176 starts up. (The set time is ON time when the periodical interrupt program is executed.)	When conducting control with the continuous mode for performing continuous circular interpolation actions, use this after circular interpolation instruction startup when overwriting the next target value.

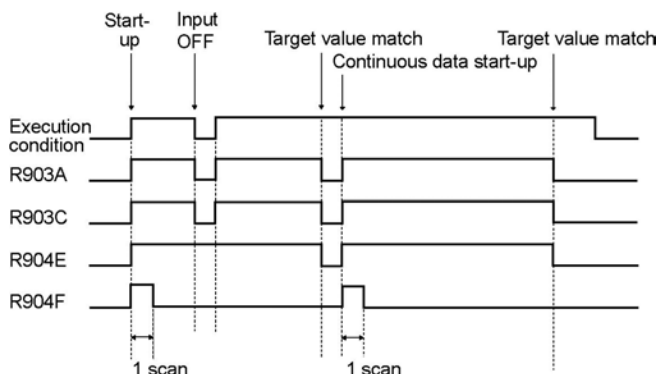


Note:

- When the target value has not been reached and the execution condition is off, circular interpolation control flag R904E turns on and other positioning instructions F171 to F176 cannot be start up.
- The above flags vary during scanning.

Example: If the above flags are used for more than one time as input conditions, there may be the different states in the same scan. Replace with internal relays at the beginning of the program as a measure.

Flag movement when command running



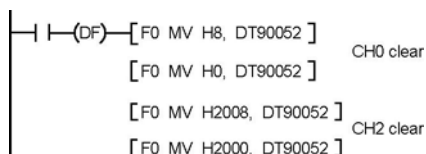
Action when the execution conditions turn OFF

- Differing from other pulse output instructions, circular interpolation instruction F176 executes the execution conditions as continually ON.
- Circular interpolation instruction F176 stops pulse output when the execution conditions turn OFF.



Note:

- Right when the execution condition turn off, positioning instructions F171 to F176, other than the currently running instruction F176, cannot be started up when the target value has not been reached.
- When restarting, use pulse output control instruction F0, below, to reset the pulse output instruction. This operation resets the control flag for circular interpolation (R904E).



About composite speed setting

- The maximum composite speed setting is 20 kHz.
Use the range of the formula given below as a guide when setting the composite speed.

$$F_v (\text{Hz}) \leq r (\text{pulse}) \times 10/t (\text{ms})$$

F_v : Composite speed (Hz)

R : Radius (pulse)

t : Scan time (ms)

Example: Radius r : 1000 (pulse), Scan time 5ms

$$F_v \leq 1000 (\text{p}) \times 10/5 (\text{ms}) = 2000 \text{ Hz}$$



Note:

- The instruction calculates the component speed at each scan. Therefore, accuracy may be degraded if the scan time exceeds 10 ms. If this should happen, execute circular interpolation instruction F176 using the periodical interrupt function with an interrupt time of around 0.5 ms.

Restrictions on positioning data setting

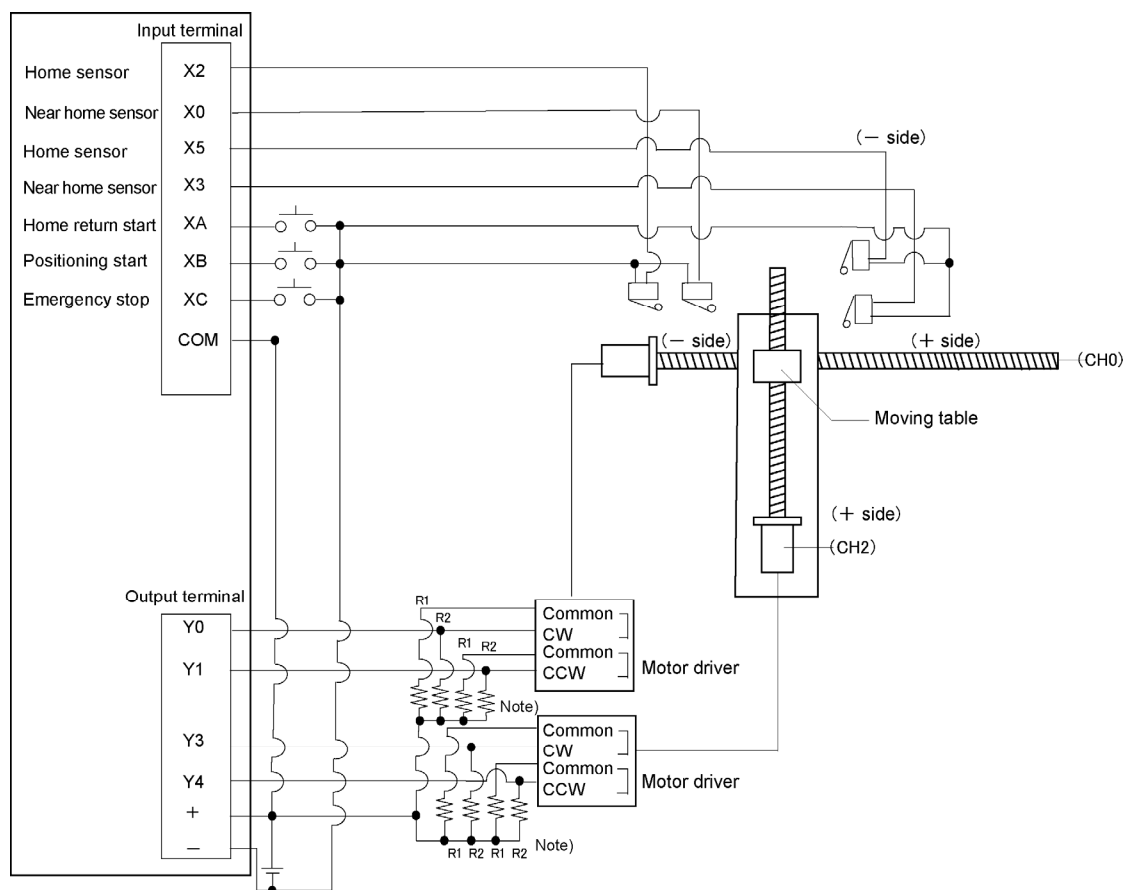
- Designate settings for the target position, pass position and center position so they are within the following range.

Allowable range: -8,388,608 to +8,388,608

- When using in combination with other positioning instructions like F171, designate so the target value is within the above range, even in those instructions.

Sample program for interpolation control

Wiring diagram



Note) If the input of the stepping motor is 5V photocoupler type, connect a resistor of $2k\Omega$ (1/2 W) to R1, and connect a resistor of $2k\Omega$ (1/2 W) – 470Ω (2 W) to R2.

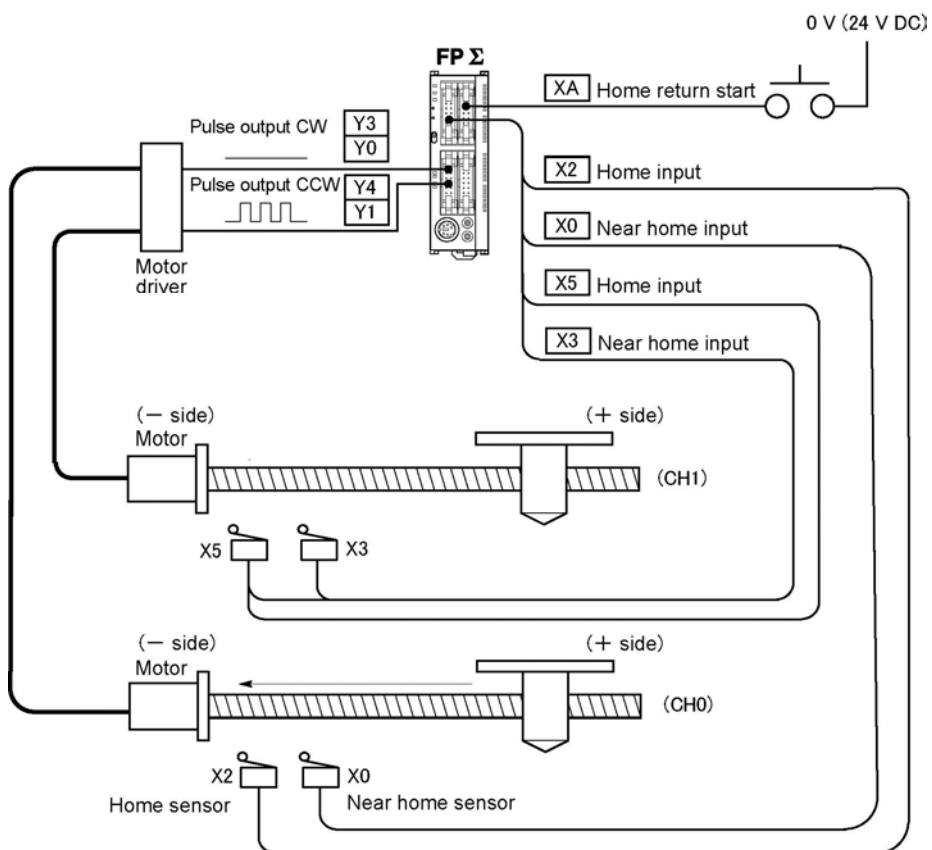
Home return operation (Minus direction)

When XA turns on, the pulse is output from CCW output Y1 of the specified channel CH0 and CCW output Y4 of the specified channel CH2, and the return to home begins.

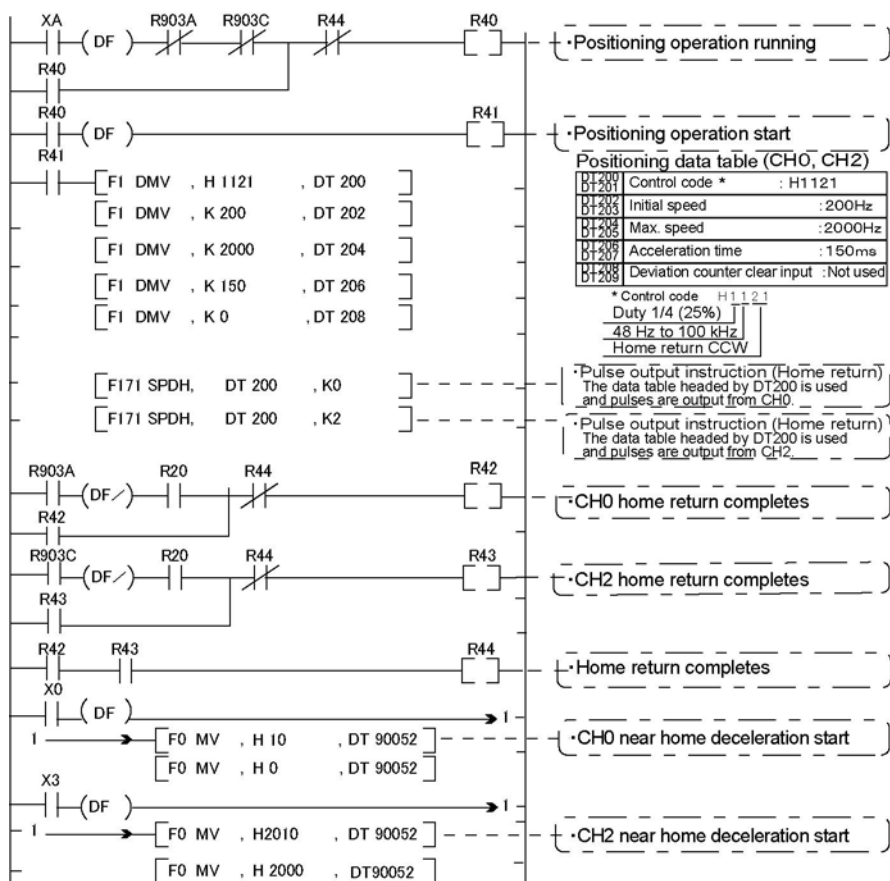
In CH0, when X3 turns on, deceleration begins, and when X2 turns on, home return is completed. After the return to home is completed, the elapsed value areas DT90044 and DT90045 are cleared to 0.

In CH2, when X6 turns on, deceleration begins, and when X5 turns on, home return is completed. After the return to home is completed, the elapsed value areas DT90200 and DT90201 are cleared to 0.

When the operations in both CHs is completed, the return to home completes.



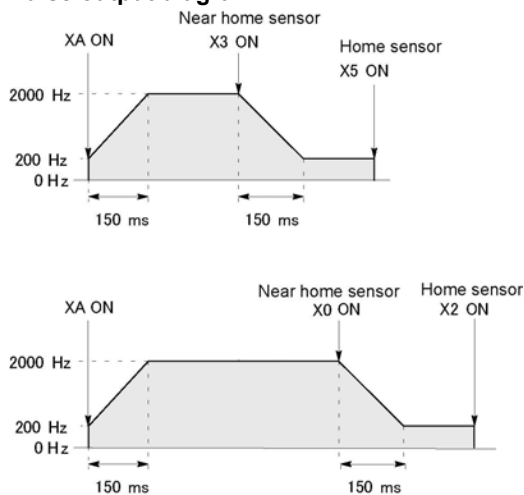
Program



Key Point:

As there is not interpolation function for the home return, the home return should be executed for each channel. After the home return for both channels is completed, the positioning operation running program (R40) turns off.

Pulse output diagram



6.4.10 Pulse Output Instruction F175 – Linear Interpolation (Only for C32T2, C28P2, C32T2H and C28P2H)

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

R11	[(DF) [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]

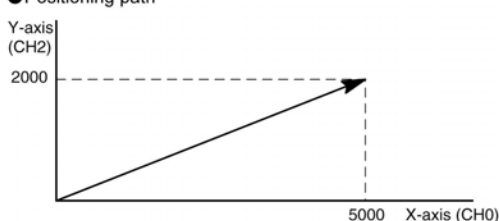
Pulses are output from the X axis (CH0) and the Y axis (CH2), so that the composite speed is an initial speed of 500 Hz, the maximum speed is 5000 Hz, and the acceleration/deceleration time is 300 ms. The two axes are controlled so that a linear path is followed to the target position.

When the program runs, the data table and positioning

●Positioning data table

DT500 DT501	Control code : H 1000	*1	Setting area Designated with user program
DT502 DT503	Composite speed (Initial speed) : 500 Hz	*2	
DT504 DT505	Composite speed (Max. speed) : 5000 Hz	*2	
DT506 DT507	Acceleration/ Deceleration speed : 300 ms	*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 (Max. speed)		
DT516 DT517	Y-axis (CH2) component speed (Initial speed)		
DT518 DT519	Y-axis (CH2) component speed (Max. 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		

●Positioning path



(*1): Control code <H constant>

0 : Fixed	H	S+1	S
■ Duty (on width) *8 0 : Duty 1/2 (50%) 1 : Duty 1/4 (25%)			
0 : Fixed			
■ Operation mode and output method 00 : Incremental CW/CCW 02 : Incremental pulse and direction (forward off/reverse on) 03 : Incremental pulse and direction (forward on/reverse off) 10 : Absolute CW/CCW 12 : Absolute pulse and direction (forward off/reverse on) 13 : Absolute pulse and direction (forward on/reverse off)			

(*2): Composite speed (Initial speed, Max. speed) (Hz) <K constant>
1.5 Hz to 100 kHz [K1 to K100000]

However, 1.5 Hz is for an angle of 0 deg or 90 deg 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 60 kHz or higher.
- If initial speed is set equal to maximum speed, pulses will be output with no acceleration/deceleration.
Composite speed (Initial speed): 30 kHz or less
- Specify composite speed to make the component speed of each axis become 1.5 Hz or higher.

(*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 (Movement amount)

K-8388608 to K8388607

It must not exceed the target value.

When operating only one axis,

- In incremental mode, set the target value for the axis which will not be operated.
 - In absolute mode, set the target value for the axis which will not be operated the same as the current value.
- Infinite feeding is not available during the linear interpolation control.

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

This is stored as 2 words in real numbers type.

$$\text{X-axis component speed} = \frac{(\text{composite speed}) \times (\text{X-axis movement amount})}{\sqrt{((\text{X-axis movement amount})^2 + (\text{Y-axis movement amount})^2)}}$$

$$\text{Y-axis component speed} = \frac{(\text{composite speed}) \times (\text{Y-axis movement amount})}{\sqrt{((\text{X-axis movement amount})^2 + (\text{Y-axis movement amount})^2)}}$$

Composite speed (Initial speed): Set to 30kHz or less.

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: 1.5 Hz to 9.8 kHz

Range 1: 48 Hz to 100 kHz

Range 2: 191 Hz to 100 kHz

- If maximum speed ≤ 9800 Hz
If initial speed < 1.5 Hz, initial speed is corrected to 1.5 Hz, and range 0 is selected.
If initial speed ≥ 1.5 Hz, range 0 is selected.
- If $9800 \text{ Hz} < \text{maximum speed} \leq 100000 \text{ Hz}$,
If initial speed < 48 Hz, initial speed is corrected to 48 Hz, and range 0 is selected.
If $48 \text{ Hz} \leq \text{initial speed} < 191 \text{ Hz}$, range 1 is selected.
If initial speed $\geq 191 \text{ Hz}$, 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) \times component initial speed (Hz)

Example)

With incremental, initial speed 300 Hz, max. speed 5 kHz, acceleration/deceleration time 0.5 s, CH0 target value 1000, CH2 target value 50

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

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

$$\text{CH0 number of acceleration/deceleration steps} = 500 \times 10^{-3} \times 299.626 \div 147.8 \Rightarrow 60 \text{ steps}$$

$$\text{CH2 number of acceleration/deceleration steps} = 500 \times 10^{-3} \times 14.981 \div 7.4 \Rightarrow 7 \text{ steps}$$

Note) Precaution for the specification of composite speed (initial speed)

If each component speed (initial speed) of CH0 and CH2 which is calculated using the following formula is not 1.5 kHz or higher, the path may not be linear.

$$f \geq \frac{1.5 \sqrt{(\Delta x)^2 + (\Delta y)^2}}{\Delta x}$$

Δx : CH of which distance between the target value and the current value is short.

Δy : CH of which distance between the target value and the current value is long.

(*8) : When the frequency is set to 40Hz or higher, the duty must be set to 1/4 (25%).

6.4.11 Pulse Output Instruction F176 – Circular Interpolation (Only for C32T2, C28P2, C32T2H and C28P2H)

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

R12	[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 500 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 ($\theta = 60^\circ$, $X_s=5000$, $Y_s=8660$) using circular interpolation control, and when the pass position ($\theta = 20^\circ$, $X_p=9396$, $Y_p=-3420$) has been passed, pulse output stops at the target position ($\theta = 30^\circ$, $X_e=8660$, $Y_e=-5000$).

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

●Positioning data table

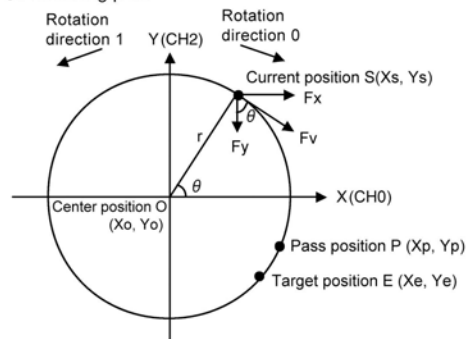
<Pass position setting method>

DT600 DT601	Control code : H 10	*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	
DT614 DT615	X-axis (CH0) center position : 0 pulse	Parameters for each axis component, calculated due to instruction execution, are stored here.	
DT616 DT617	Y-axis (CH2) center position : 0 pulse		

<Center position setting method>

DT600 DT601	Control code : H 110	*1	Setting area
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	X-axis (CH0) center position : 0 pulse		
DT610 DT611	Y-axis (CH2) center position : 0 pulse		
DT612 DT613	Radius : 10000 pulse		Operation result storage area

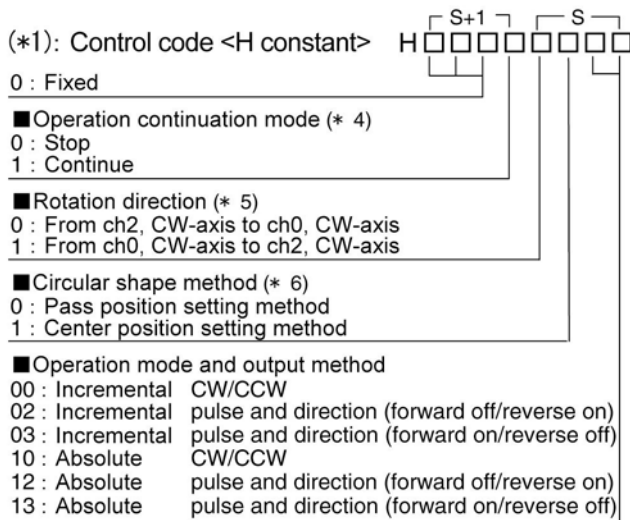
●Positioning path



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

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

$$F_x = F_v \sin \theta = F_v \frac{|Y_e - Y_o|}{r} \quad F_y = F_v \cos \theta = F_v \frac{|X_e - X_o|}{r}$$



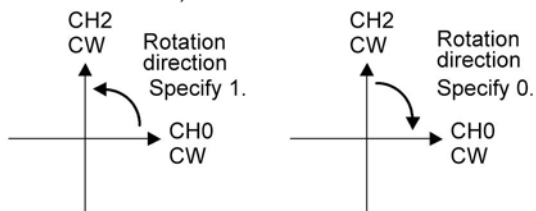
(*2): Composite speed (Frequency) <K constant>
100 Hz to 20 kHz [K100 to K20000]
Use the following formula to calculate composite speed.

$$F_v[\text{Hz}] \leq \frac{\text{Radius "r" [Pulse]} \times 10}{\text{Scan time [ms]}}$$

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

(*4): Operation continuation mode
Stop: It will stop when the target position is reached.
Continue: It will continue the circular interpolation action by setting the next target position before the target position is reached during the circular interpolation action.

(*5): Rotation direction
The code to be specified differs depending on the direction of axes and rotation direction setting (clockwise or counterclockwise).

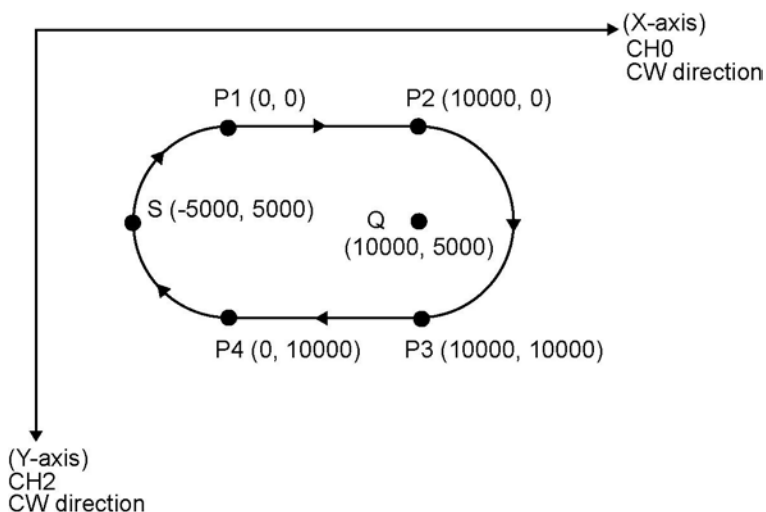


(*6): Circular shape method
Pass position setting: Specify the pass and target positions for the current position.
Center position setting: Specify the center and target positions for the current position.

Sample program

Continuous interpolation control (linear and circular)

- Using linear and circular interpolation functions, perform positioning control that draws trajectory like the one shown below.
- The interval between the first position P1 and P2 and the interval between P3 and P4 perform control using linear interpolation.
- The interval between P2 and P3 performs circular interpolation control using center designation.
- The interval between P4 and P1 performs circular interpolation control using passing position designation.



I/O Allocation

I/O No.	Description	I/O No.	Description
XB	Positioning start	R9010	Always ON
XC	Emergency stop switch	R903A	Control flag (CH0)
R20	From P1 to P2 start	R903C	Control flag (CH2)
R21	From P2 to P3 start	R904E	Circular interpolation control flag
R22	From P3 to P4 start		
R23	From P4 to P1 start		
R2F	Positioning done		

Data register allocation

Item	Data register No.	Details	On this program details
User setting area for linear interpolation P1 to P2 P3 to P4	DT0 to DT1	Control code	Control code when executing linear interpolation, absolute
	DT2 to DT3	Startup speed	2000 Hz
	DT4 to DT5	Target speed	2000 Hz
	DT6	Acceleration/deceleration time	0 ms
	DT8 to DT9	Target position (X-axis)	Specify the target position of X-axis when moving from P1 to P2 and P3 to P4.
	DT10 to DT11	Target position (Y-axis)	Specify the target position of Y-axis when moving from P1 to P2 and P3 to P4.
Work area	DT12 to DT23	Operation result storage area	Parameters calculated due to instruction execution are stored.
User setting are for circular interpolation P4 to P1	DT40 to DT41	Control code	Specify control codes when executing the circular interpolation of P4 to P1. Stop mode, Pass position setting, Absolute From CH0-CW to CH2-CW direction
	DT42 to DT43	Composite speed	2000 Hz
	DT44 to DT45	Target position (X-axis)	Specify the target position of X-axis when moving from P4 to P1.
	DT46 to DT47	Target position (Y-axis)	Specify the target position of Y-axis when moving from P4 to P1.
	DT48 to DT49	Pass position (X-axis)	Specify the X-coordinate of the pass position when moving from P4 to P1.
	DT50 to DT51	Pass position (Y-axis)	Specify the Y-coordinate of the pass position when moving from P4 to P1.
Work area for circular interpolation	DT52 to DT57	Operation result storage area	Parameters calculated due to instruction execution are stored.
User setting area for circular interpolation P2 to P3	DT60 to DT61	Control code	Specify control codes when executing the circular interpolation of P2 to P3. Stop mode, Center position setting, Absolute From CH0-CW to CH2-CW direction
	DT62 to DT63	Composite speed	2000 Hz
	DT64 to DT65	Target position (X-axis)	Specify the target position of X-axis when moving from P2 to P3.
	DT66 to DT67	Target position (Y-axis)	Specify the target position of Y-axis when moving from P2 to P3.
	DT68 to DT69	Center position (X-axis)	Specify the X-coordinate of the center position when executing the circular interpolation of P2 to P3.
	DT70 to DT71	Center position (Y-axis)	Specify the Y-coordinate of the center position when executing the circular interpolation of P2 to P3.
Work area for circular interpolation	DT72 to DT73	Operation result storage area	Parameters calculated due to instruction execution are stored.



Key Point:

- With this program, because the next action that follows circular interpolation control is linear interpolation, the control code is designated with the stop mode.
- The rotation direction during circular interpolation is the same direction for both P2 to P3 and P4 to P1. Designate the control code rotation direction with “from CH0-CW direction to CH2-CW direction”.
- Use the circular interpolation control flag R904E to verify completion of the circular interpolation action.

Program

R9010 Always ON	[F1 DMV , H 1010]	, DT 0	Absolute
	[F1 DMV , K 2000]	, DT 2	Composite speed setting (base)
	[F1 DMV , DT 2]	, DT 4	Composite speed setting (for linear)
	[F1 DMV , K 0]	, DT 6	Acceleration/deceleration time
R9010 Always ON	[F1 DMV , H 1010]	, DT 40	Pass position setting
	[F1 DMV , DT 2]	, DT 42	Composite speed
	[F1 DMV , K 0]	, DT 44	Target position setting
	[F1 DMV , K 0]	, DT 46	Target position setting
	[F1 DMV , K -5000]	, DT 48	Pass position setting
	[F1 DMV , K 5000]	, DT 50	Pass position setting
R9010 Always ON	[F1 DMV , H 1110]	, DT 60	Center setting
	[F1 DMV , DT 2]	, DT 62	Composite speed
	[F1 DMV , K 10000]	, DT 64	Target position setting
	[F1 DMV , K 10000]	, DT 66	Target position setting
	[F1 DMV , K 10000]	, DT 68	Center position setting
	[F1 DMV , K 5000]	, DT 70	Center position setting

Positioning data table
(From P1 to P2 and from P3 to P4)

- Control code: Absolute
- Composite speed: 2000 Hz
- Acceleration/deceleration time: 0 ms

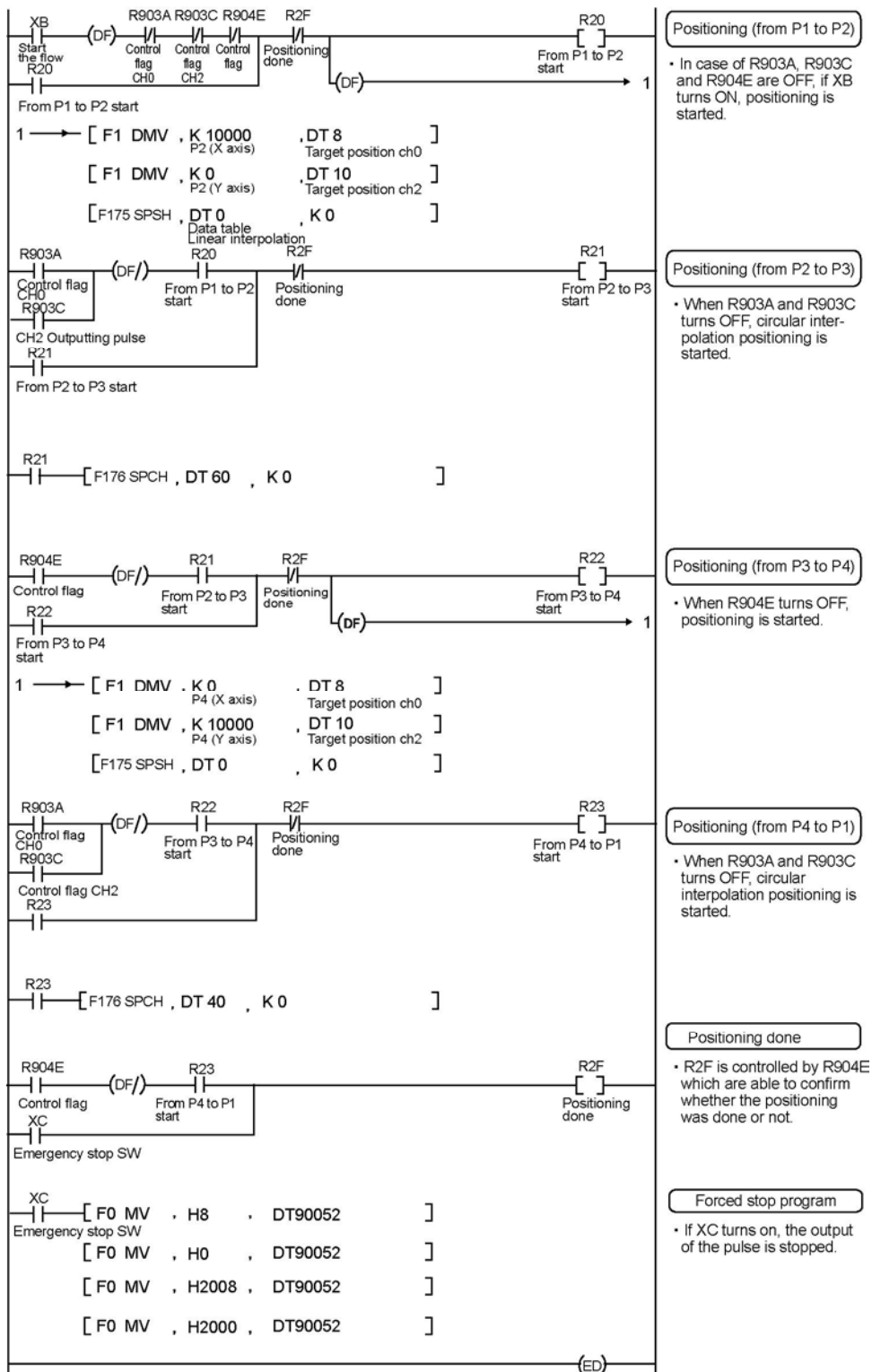
Positioning data table
(From P4 to P1)

- Control code:
Stop mode, Pass position setting
from CH0-CW to CH2-CW direction,
Absolute (CW/CCW)
- Composite speed: 2000 Hz
- Target position: (0, 0)
- Pass position: (-5000, 5000)

Positioning data table
(From P2 to P3)

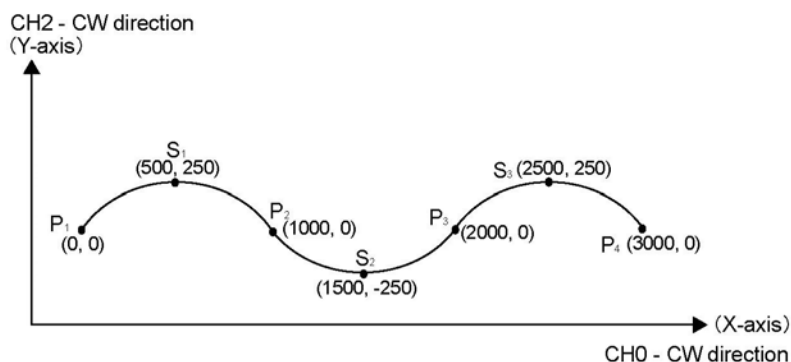
- Control code:
Stop mode, Center position setting
from CH0-CW to CH2-CW direction,
Absolute (CW/CCW)
- Composite speed: 2000 Hz
- Target position: (10000, 10000)
- Center position: (10000, 5000)

(Continued on the next page)



Sample program (Continue mode method)

- This is a program that continually executes the circular interpolation action.
- Start the first point P1 (0, 0), overwrite the target value three times, and move to final position P4.
- To overwrite the data after startup, use the special internal relay R904F and a shift register.



I/O Allocation

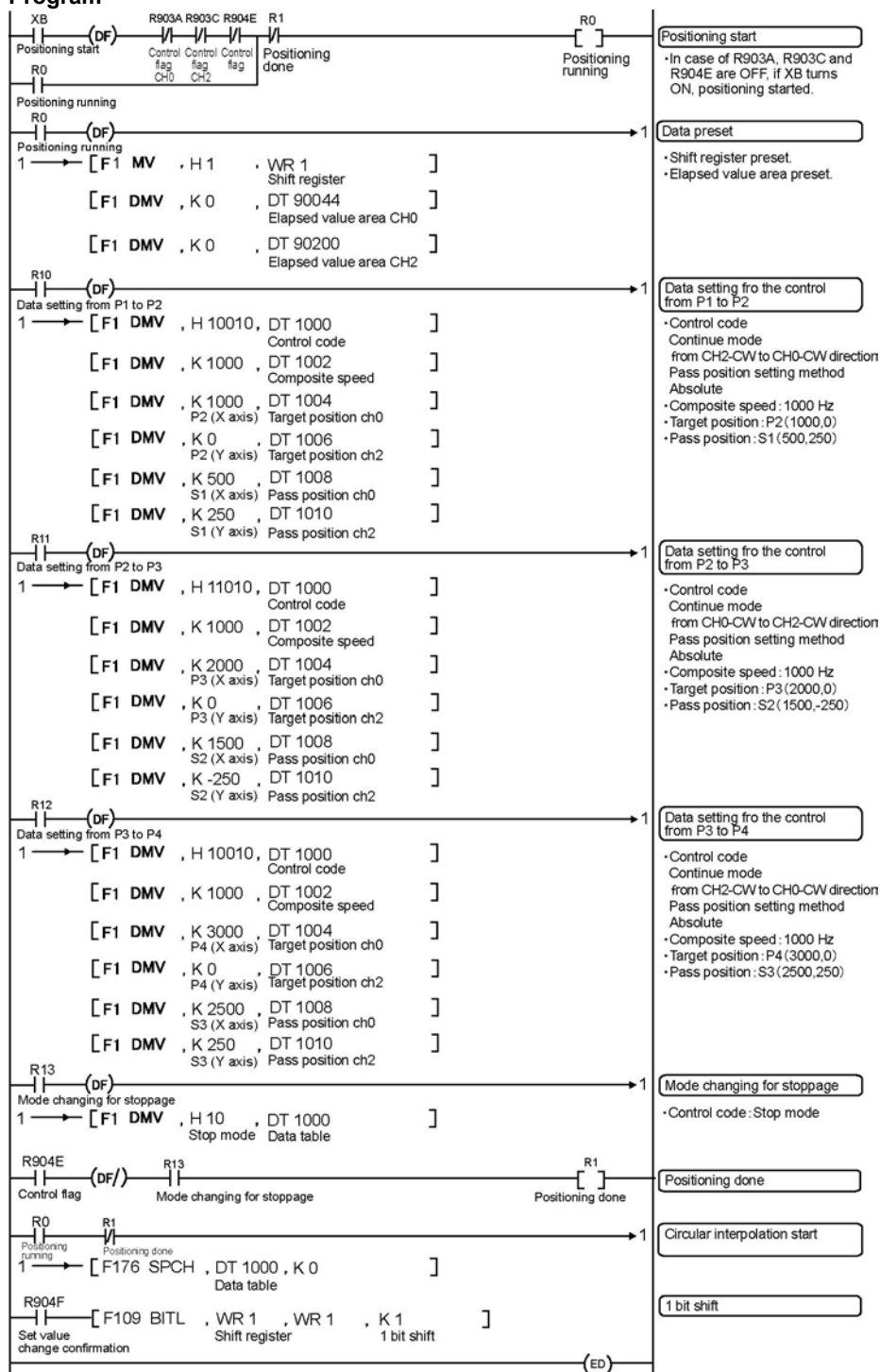
I/O No.	Description	I/O No.	Description
XB	Positioning start	R903A	Control flag (CH0)
R0	Positioning running	R903C	Control flag (CH2)
R1	Positioning done	R904E	Circular interpolation control flag
R10	Data setting for the control from P1 to P2	R904F	Set value change confirmation flag
R11	Data setting for the control from P2 to P3		
R12	Data setting for the control from P3 to P4		
R13	Mode changing for stoppage		

Note) R10 to R13 are used by shift register.

Data register allocation

Item	Data register No.	Details	On this program details
User setting area	DT1000 to 1001	Control code	Continue mode, Absolute Pass position setting method Rotation direction changes according to the control direction.
	DT1002 to 1003	Composite speed	1000 Hz
	DT1004 to 1005	Target position	Target position (X-axis) P2 to P4
	DT1006 to 1007	Target position	Target position (Y-axis) P2 to P4
	DT1008 to 1009	Pass position	Target position (X-axis) S1 to S3
	DT1010 to 1011	Pass position	Target position (Y-axis) S3 to S3
Work area	DT1012 to 1017	Operation result storage area	Parameters calculated due to instruction execution are stored.
Special DT	DT90044 to 90045	Elapsed value area (CH0)	Current position (X-axis) : 0
	DT90200 to 90201	Elapsed value area (CH2)	Current position (Y-axis) : 0

Program



**Key Point:**

- To overwrite the data after startup use the circular interpolation data overwrite permission flag R904F.
- In control that heads toward final point P4, designate by switching the control code to the stop mode.
- In this example, since the rotation direction changes for each positioning point, designation of the control code rotation direction is as follows.

Between P1 and P2: From CH2-CW to CH0-CW direction

Between P2 and P3: From CH0-CW to CH2-CW direction

Between P3 and P4: From CH2-CW to CH0-CW direction

6.5 PWM Output Function

6.5.1 Overview

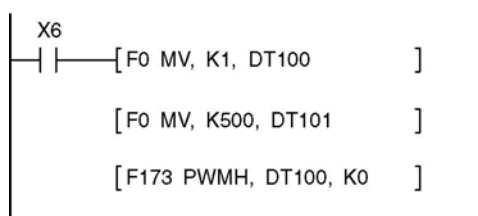
PWM output function

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

System register setting

When using the PWM output function, set the channel CH0 and CH2 with system registers 400 and 401 to "High-speed counter not used".

6.5.2 PWM Output Instruction F173



While X6 is in the on state, a pulse with a period of 502.5 ms and duty ratio of 50% is output from Y0 of specified channel "CH2". When the program runs, the data table will be as shown below.

Data table

DT100	Control code *1	: K1
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	666.67
K1	2.0	502.51
K2	4.1	245.70
K3	6.1	163.93
K4	8.1	122.85
K5	9.8	102.35
K6	19.5	51.20
K7	48.8	20.48
K8	97.7	10.24
K9	201.6	4.96
K10	403.2	2.48
K11	500.0	2.00
K12	694.4	1.44
K13	1.0 k	0.96
K14	1.3 k	0.80
K15	1.6 k	0.64
K16	2.1 k	0.48
K17	3.1 k	0.32
K18	6.3 k	0.16
K19	12.5 k	0.08

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 behind the decimal point are rounded off).



Note:

- If a value outside the specified range is written to the duty area while the instruction is being executed, a frequency corrected to the maximum value is output. If written when instruction execution is started, an operation error is occurred.

Chapter 7

Communication Cassette

7.1 Functions and Types

7.1.1 Functions of Communication Cassette

With the optional communication cassette, the FPΣ offers three different communication modes: computer link, general-purpose serial communication, and PC(PLC) link.

Computer link

- The computer link function is to communicate between a computer and PLCs or between PLC and external devices connected. A proprietary MEWNET protocol called MEWTOCOL-COM is used for communicating with the computer link. MEWTOCOL-COM is also used for the communication between the tool software such as FPWIN-GR and the PLC.
- There are a MEWTOCOL master function and a MEWTOCOL slave function for the computer link. The side that issues commands is called master, and the side that receives the commands, executes the process and sends back responses is called slave.



Note:

It is necessary to set the system register of the communication port to the computer link for using this function.

1. Only the slave function is available for the FPΣ 12k type.
2. Both the master and slave functions are available for the FPΣ 32k type, however, the master function is not available for the TOOL port.

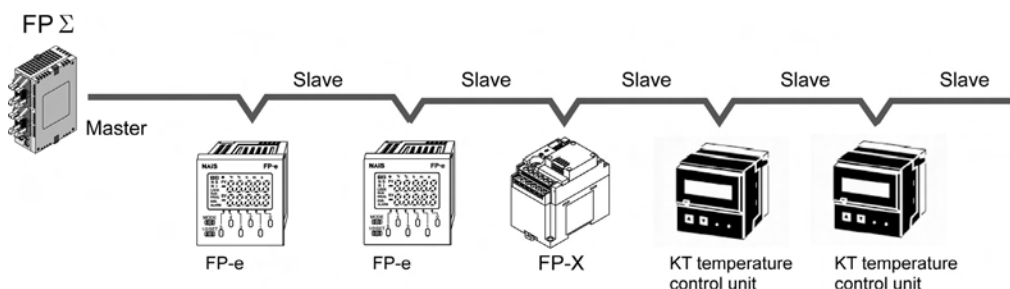
MEWTOCOL master function (32k type only)

- This function is to carry out the communication on the master side (side that issues commands) of the computer link. It is executed with the PLC's instruction F145(SEND) or F146(RECV). It is not necessary to write the response process as a ladder, so the program is easier than the general-purpose communication function.

The 1:1 or 1:N communication is available between our devices equipped with the computer link function and the MEWTOCOL-COM.

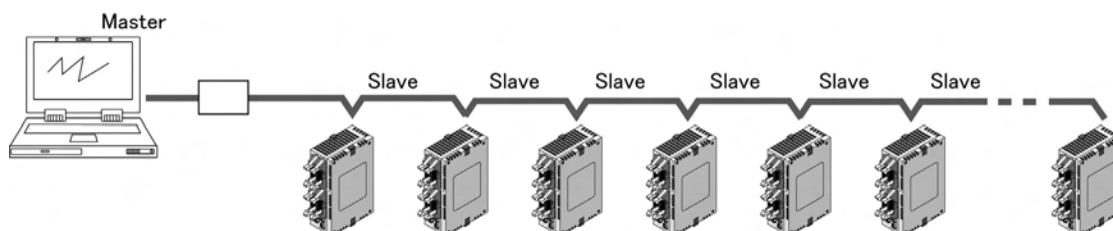
[Our devices (e.g.)] : PLC, IPD, temperature control unit, message runner, eco-power meter

For the MEWTOCOL master function, communication is possible with COM1 port and COM2 port of the 32k type only. Do not execute the F145 (SEND) nor F146 (RECV) instructions when the unit is used as a slave unit.



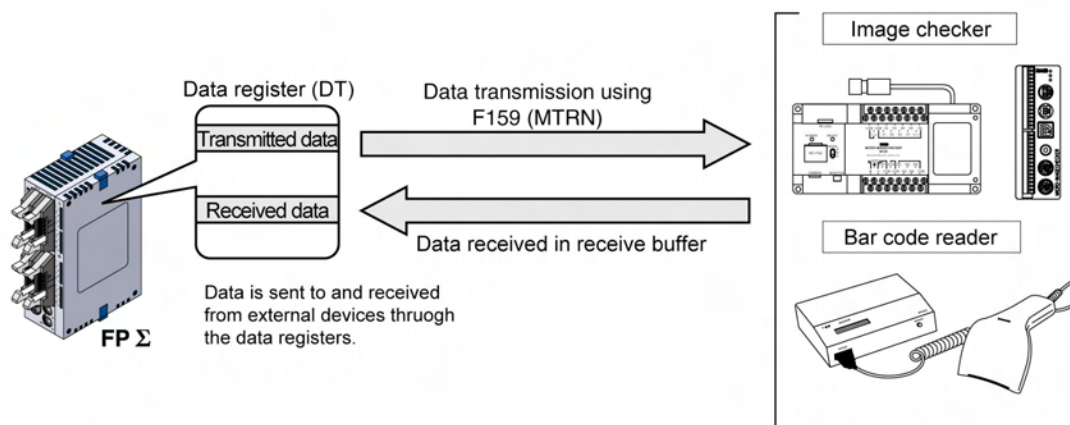
MEWTOCOL slave function

- This function is to receive commands from the computer link, execute the process and send back the results. Any special ladder program is not necessary to use this function. (Set the communication conditions in the system registers.) It enables the 1:1 or 1:N communication with a master computer or PLC.
- The program for the computer side must be written in BASIC or C language according to the MEWTOCOL-COM. MEWTOCOL-COM contains the commands used to monitor and control PLC operation.



General-purpose serial communication

- With general-purpose serial communication, data can 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.



PC(PLC) link

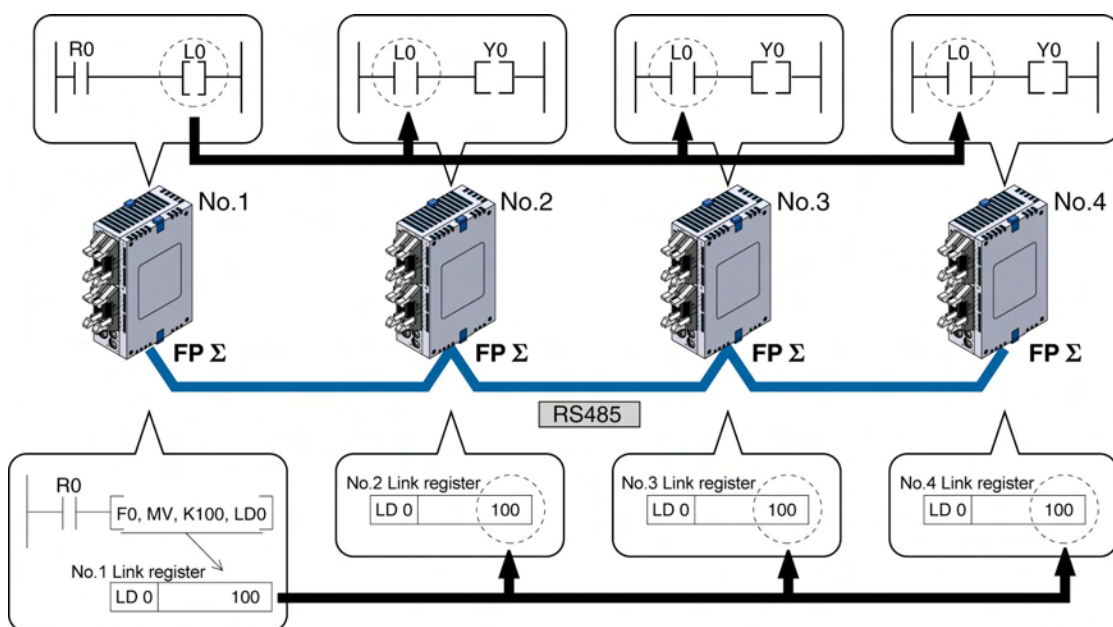
- In a PC(PLC) link, data is shared with all PLCs connected via MEWNET using dedicated internal relays called link relays (L) and data registers called link registers (LD).
- If the link relay contact for one PLC goes on, the same link relay also goes on in each of the other PLCs connected to the network. Likewise, 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.
- The status of the link relays and link registers in any one PLC is 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 the data of all units are updated at the same time.

- Link relay

In the figure below, when link relay L0 of the master station (no.1) turns on, this signal is converted by the programs of the other stations, and Y0 of the other stations is activated.

- Link register

In the figure below, if a constant of 100 is written to LD0 of the master station (no.1), the contents of LD0 in the other stations are also changed to a constant of 100.



MODBUS RTU (32k type only)

Function overview

- The MODBUS RTU protocol enables the communication between the FPΣ and other devices (including our FP-e, Programmable display GT series and KT temperature control unit).
- Enables to have conversations if the master unit sends instructions (command messages) to slave units and the slave units respond (response messages) according to the instructions.
- Enables the communication between the devices of max. 99 units as the master function and slave function is equipped.

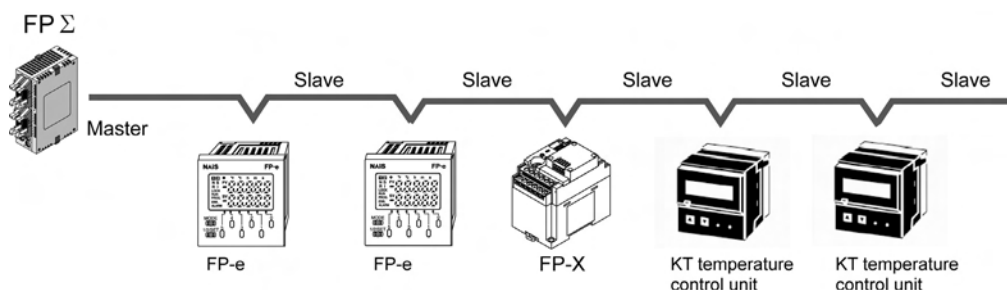
About MODBUS RTU

- The MODBUS RTU communication is a function for the master unit to read and write the data in slave units communicating between them.
- There are ASCII mode and RTU (binary) mode in the MODBUS protocol, however, the FPΣ is supported with the RTU (binary) mode only.

Master function

Writing and reading data for various slaves is available using the F145 (SEND) and F146 (RECV) instructions.

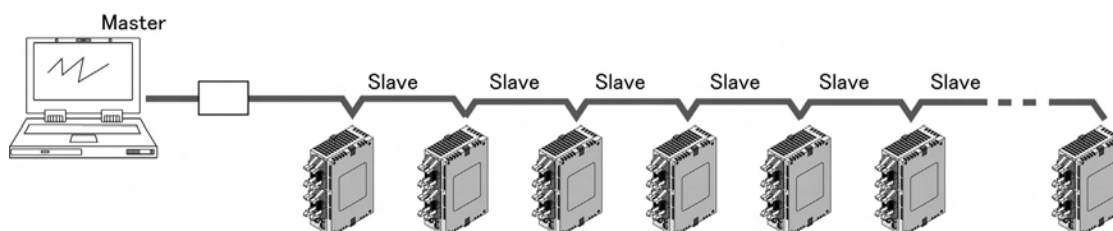
Individual access to each slave and the global transmission is possible.



Slave function

If the slave units receive a command message from the master unit, they send back the response message corresponding to the content.

Do not execute the F145 (SEND) nor F146 (RECV) instructions when the unit is used as a slave unit.



7.1.2 Types of Communication Cassette

There are four types of communication cassettes, each having a particular field of application:

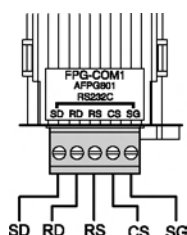


Reference: <7.2 Communication Specifications>

1-channel RS232C type (Product No. AFP801)

This communication cassette is a 1-channel unit with a five-wire RS232C port. RS/CS control is possible.

Terminal layout



Abbreviation	Name	Signal direction	Port
SD	Transmitted Data	FPΣ → External device	COM1 port
RD	Received Data	FPΣ ← External device	
RS	Request to Send	FPΣ → External device	
CS	Clear to Send	FPΣ ← External device	
SG	Signal Ground	—	

Note1) RS (Request to Send) is controllable by the SYS1 instruction.

Note2) Data cannot be sent without the pin CS (Clear to Send). When using with a three-wire port, short-circuit the pin RS and CS.

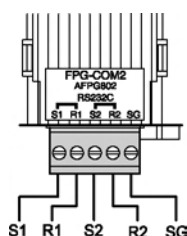
	1:1 communication	1:N communication
Computer link	Available	Not available
General-purpose serial communication	Available	Not available
PC(PLC) link	Available ^{Note)}	
MODBUS RTU	Available	Not available

Note) Number of units is two.

2-channel RS232C type (Product No. AFP802)

This communication cassette is a 2-channel unit with a three-wire RS232C port. Communication with two external devices is possible.

Terminal layout



Abbreviation	Name	Signal direction	Port
S1	Transmitted Data 1	FPΣ → External device	COM1 port
R1	Received Data 1	FPΣ ← External device	
S2	Transmitted Data 2	FPΣ → External device	COM2 port
R2	Received Data 2	FPΣ ← External device	
SG	Signal Ground		COM1 port COM2 port

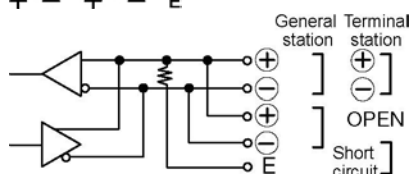
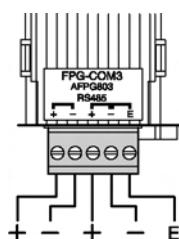
	1:1 communication	1:N communication
Computer link	Available	Not available
General-purpose serial communication	Available	Not available
PC(PLC) link	Available ^{Note)}	
MODBUS RTU	Available	Not available

Note) Number of units is two.

1-channel RS485 type (Product No. AFG803)

This communication cassette is a 1-channel unit with a two-wire RS485 port.

Terminal layout



Abbr.	Name	Signal direction	Port
+	Transmission line (+)	—	COM 1 port
-	Transmission line (-)	—	
+	Transmission line (+)	—	
-	Transmission line (-)	—	
E	Terminal station setting	—	

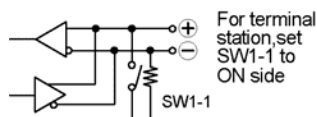
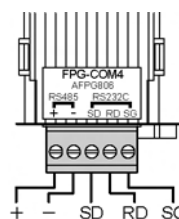
	1:1 communication	1:N communication
Computer link	Not available	Available
General-purpose serial communication	Not available	Available
PC(PLC) link	Available	
MODBUS RTU	Not available	Available

Note) When using this cassette, the data transmission is executed with the STOP2 regardless of the setting for the stop bit. The data reception is available with 1 or 2 regardless of the setting for the stop bit.

1-channel RS485 and 1-channel RS232C combination type (Product No. AFG806)

This communication cassette equips a 1-channel unit with a two-wire RS485 port and 1-channel unit with a three-wire RS232C port.

Terminal layout



Abbr.	Name	Signal direction	Port
+	Transmission line (+)	—	RS485 (COM1 port)
-	Transmission line (-)	—	
SD	Sent Data	FPΣ → External device	RS232C (COM2 port)
RD	Received Data	FPΣ ← External device	
SG	Signal Ground	—	

	1:1 communication	1:N communication
Computer link	Available	Available
General-purpose serial communication	Available	Available
PC(PLC) link	Available ^{Note)}	
MODBUS RTU	Available	Available

Note) PC(PLC) link is available only for RS485.

Communication cassette LED indication

The indication of the control unit is for 2-channel RS232C type. For the other types, refer to the following.

Indication of control unit	AFPG801	AFPG802	AFPG803	AFPG806
COM. 1 ■ S	SD	SD	SD	RS485 SD
■ R	RD	RD	RD	RS485 RD
COM. 2 ■ S	RS	SD	Not used	RS232C SD
COM. 1 ■ S	CS	RD	Not used	RS232C RD

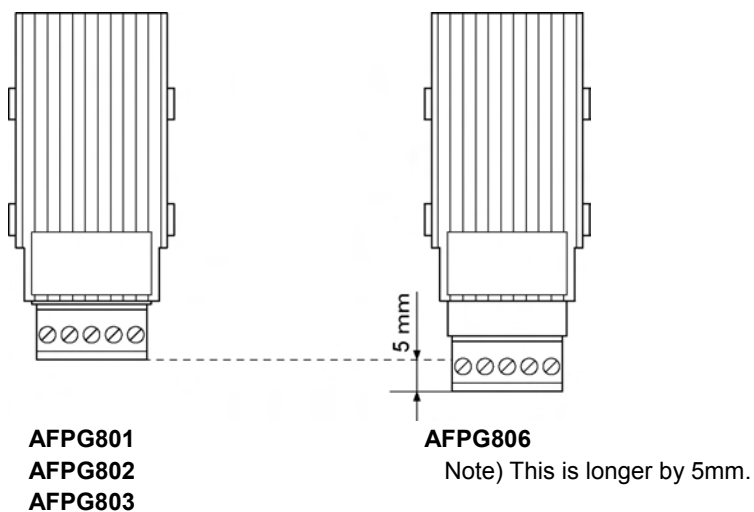
LED Communicating: Flashes

No communication: Lights out

SD: Sent data (output)

RD: Received data (input)

Difference of dimensions



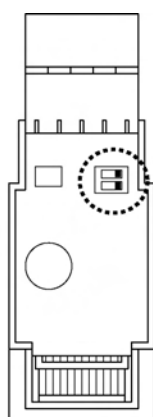
7.1.3 Names and Principle Applications of the Ports

Port name	Port type	Communication function
COM0 port	Standard feature (Mini DIN 5-pin connector)	Computer link General-purpose serial communication (in RUN mode only)
COM1 port	Communication cassette	Computer link MEWTOCOL master General-purpose serial communication PC(PLC) link MODBUS RTU
COM port 2	Communication cassette	Computer link MEWTOCOL master General-purpose serial communication MODBUS RTU

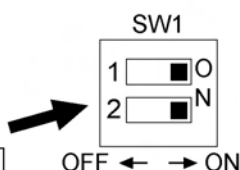
7.1.4 Setting of AFG806 Switch

Only when using RS485 port (COM1)

It is necessary to set the built-in switch and the system register both to set the baud rate.



Backside of cassette



SW1-1 terminal resistance	<input checked="" type="checkbox"/> OFF <input type="checkbox"/> ON	General station (initial value)	<input type="checkbox"/> OFF <input checked="" type="checkbox"/> ON	Terminal station
SW1-2 Baud rate	<input checked="" type="checkbox"/> OFF <input type="checkbox"/> ON	19200 bps	<input type="checkbox"/> OFF <input checked="" type="checkbox"/> ON	115200 bps (initial value)

* RS232C communication is only specified by system registers.

* When using PC(PLC) link, always specify the baud rate at 115200 bps.

7.2 Communication Specifications

Communication Specifications

	Computer link ^{Note1) 9)}		General-purpose serial communication ^{Note1) 9)}		PC(PLC) link	MODBUS RTU ^{Note1)}	
	1:1 communication	1:N communication	1:1 communication	1:N communication		1:1 communication	1:N communication
Interface	RS232C	RS485	RS232C	RS485	RS232C ^{Note2)} RS485	RS232C	RS485
Target items	AFPG-801 AFPG-802 AFPG-806	AFPG-803 AFPG-806	AFPG-801 AFPG-802 AFPG-806	AFPG-803 AFPG-806	AFPG-801 AFPG-802 AFPG-803 AFPG-806	AFPG-801 AFPG-802 AFPG-806	AFPG-803 AFPG-806
Communication method	Half-duplex communication	Two-wire, half-duplex communication	Half-duplex communication	Two-wire, half-duplex communication	Token bus (Floating master)	Half-duplex communication	Two-wire, half-duplex communication

Note1) Although it has adequate tolerance to noise, it is recommendable to make the user program to execute retransmission (in order to improve reliability of the communication when a communication error occurs due to excessive noises or when a receiver equipment cannot receive data temporarily).

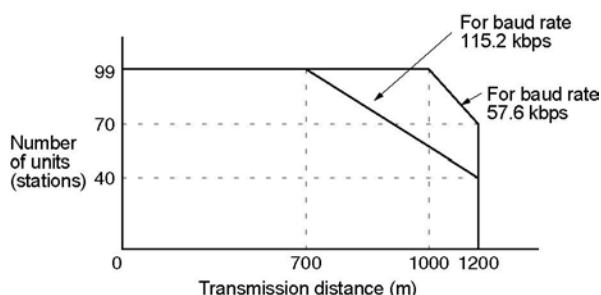
Note2) The number of units of the PC(PLC) link with RS232C is two.

Communication specifications

Item		Specifications	
Interface		RS232C (non-isolated)	RS485 (isolated) ^{Note1) 2)}
Communication mode		1:1 communication	1:N communication
Communication method		Half-duplex communication	Two-wire half-duplex communication
Synchronous method		Start stop synchronous system	
Transmission line		Multicore shielded line	Shielded twisted-pair cable or VCTF
Transmission distance		15 m	Max. 1200 m ^{Note1) 2)}
Baud rate ^{Note3) Note8)} (to be set by system register)		2400, 4800, 9600, 19200, 38400, 57600, 115200 bps	
Trans- mission code	Computer link	ASCII, JIS7, JIS8	
	General-purpose serial communication	ASCII, JIS7, JIS8, Binary	
	MODBUS RTU	Binary	
Communication format (to be set by system register) ^{Note4)}	Data length	7 bits/8 bits	
	Parity	None/Even/Odd	
	Stop bit	1 bit/2 bits	
	Start code	STX/No STX	
	End code	CR/CR+LF/None/ETX	
No. of connected units ^{Note5) 6) 7)}		2 units	Max. 99 units (Max. 32 units when C-NET adapter is connected.)

Note1) 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, transmission distance, and baud rate vary depending on the connected device.

Note2) The values for the transmission distance, baud rate and number of units should be within the values noted in the graph below.



When using a baud rate of 2400 bps to 38400 bps, you can set up to a maximum of 99 units (stations) and maximum transmission distance of 1200 m.

Note3) Only 9600 bps or 19200 bps can be specified when the C-NET adapter is connected with the RS485 interface.

Note4) The start code and end code can be used only in the general-purpose serial communication mode.

Note5) The converter SI-35 manufactured by Lineeye Co., Ltd is recommendable for the RS485 at the computer side. Adjust the response time for the FP-X by the SYS1 instruction if necessary.

Note6) Regarding the setting of unit numbers:

When the unit number setting switch is "0", the system register is effective.

When the unit number setting switch is other than "0", the unit number setting switch is effective, and the unit number setting of the system register is ignored.

(Max. 31 units can be specified with the unit number setting switch.) (When the setting is specified with the unit number setting switch, the COM1 port and the COM2 port has the same unit number.

Note7) Connect the "-" terminal and the "+" terminal with a lead wire to make the termination resistance of the AFG803 effective.

The termination resistance of the AFG806 is specified by the dip switch in the communication cassette.

There is no termination resistance at the RS232C port.

Note8) The RS485 port of the AFG806 is either 19200 bps or 115200 bps only.

Also the baud rate must be identically set by the system register and the dip switch in the communication cassette. The baud rate for the PC(PLC) link mode is fixed at 115200 bps.

The baud rate for the RS232C port of the AFG806 can be set by the system register only.

Note9) The MEWTOCOL master function, MODBUS RTU master function and general-purpose serial communication function at the TOOL port is available only for the FPΣ 32k type.

7.2.1 Precaution When Using RS485 Port

FPG-COM3 (AFPG803), FPG-COM4 (AFPG806)

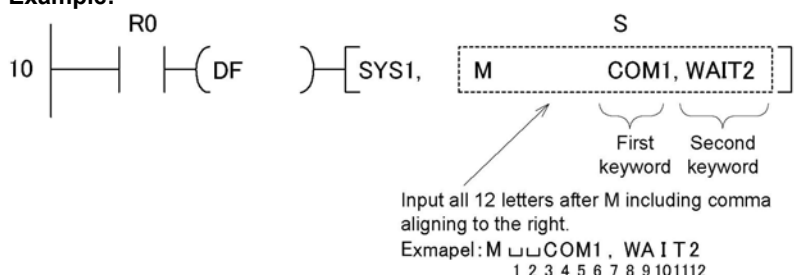
SYS1 instruction is available for FPΣ, which enables to change the time after receiving a command until a response is returned.

With the converter SI-35 manufactured by Lineeye Co., Ltd, adjust the response time by this instruction if necessary.

SYS1 instruction: This is to delay a response for [n] scan time to be specified.

```
|
| |---[ SYS1 M   COM1, WAIT n ]   n=0~999
|
```

Example:



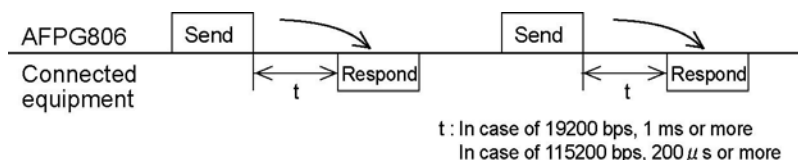
When R0 turns on, the response of COM1 port (RS485 port) delays for two scans. If the scan time is 500μs, it delays for 1 ms.



Reference: <FP series Programming manual>

The RS485 port of AFPG806 (COM4) occupies the communication line for a given time after transmitting data. No transmission is available during this period.

When data is transmitted from FPΣ via the RS485 communication of AFPG806 (COM4), start the transmission of the data to FPΣ after the time mentioned blow passes at a receiver.



Following adjustments are required depending on the types of connected equipment.

1. With FPΣ (when the connected equipment are also the combination of FPΣ and AFG806)

- When PC(PLC) link mode: Adjustment is not required.
- When general communication mode: Adjust timing by ladder program.
- When computer link mode: Adjust timing by SYS1 instruction.

2. With other PLC

- When PC(PLC) link mode: Not used.
- When general communication mode: Adjust timing by ladder program.

3. With computer

- Adjust timing by wait instruction system.

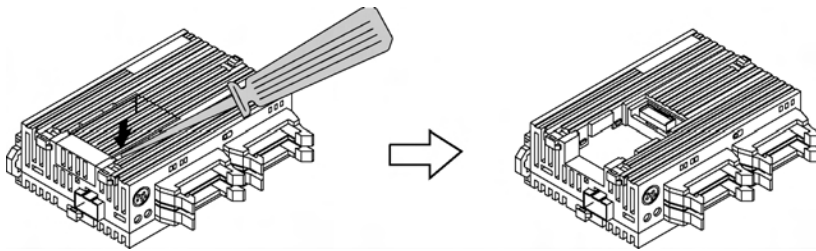
4. With other equipment's

- Confirm the time after receiving data until a transmission starts with makers.
- KT temperature controller and inverters (VF-7E and VF-8X) can be used without any adjustment, as the time taken up to a response is more than 1 ms.
- GT series indicator cannot be used.
- With GV series indicator, set the transmission delay time (communication parameter) to 1 ms or more.

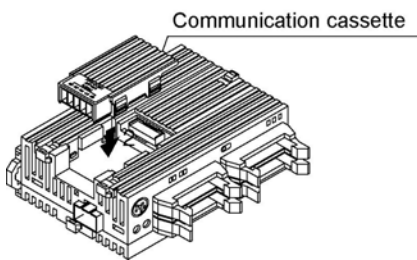
7.3 Installation and Wiring

7.3.1 Installation of Communication Cassette

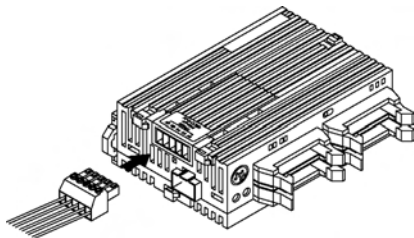
1. Turn off the power supply to the control unit before installing the communication cassette.
2. Remove cover using screwdriver.



3. Install communication cassette.



4. Plug in communication connector.

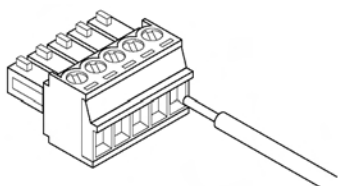


7.3.2 Wiring

Accessory communication connector/Suitable wire

The communication cassette is supplied with a communication connector, which has a screw-type terminal block.

Use the following items for wiring.



Accessory communication connector

If additional connectors are needed, use the communication connector manufactured by Phoenix Contact.

Number of pins	Phoenix Contact product ID	
	Model No.	Product No.
5 pins	MC1, 5/5-ST-3, 5	1840395

Suitable wire (twisted wire)

Number of wires	Size	Cross-sectional area
1	AWG#28 to 16	0.08mm ² to 1.25 mm ²
2	AWG#28 to 18	0.08mm ² to 0.75 mm ²

Use the above wires shielded.

It is recommended to ground the shielded part.

Pole terminals with compatible insulation sleeve

If you wish to use pole terminals, Phoenix Contact offers the following models.

Manufacturer	Cross-sectional area	Size	Product number
Phoenix Contact	0.25 mm ²	AWG#24	AI 0, 25-6 YE
	0.50 mm ²	AWG#20	AI 0, 5-6 WH
	0.75 mm ²	AWG#18	AI 0, 75-6 GY
	1.00 mm ²	AWG#18	AI 1-6 RD
	0.5 mm ² x 2	AWG#20 x 2 pcs	AI-TWIN 2x 0, 5-8 WH

Pressure welding tool for pole terminals

Manufacturer	Phoenix Contact product ID	
	Model No.	Product No.
Phoenix Contact	CRIMPFOX UD6	1204436

Screwdriver for terminal block

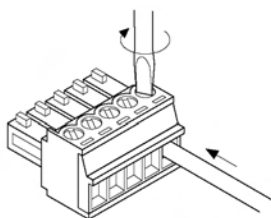
To tighten the terminals of the communication connector, use a screwdriver by Phoenix Contact (product no. 1205037, blade size 0.4 x 2.5, model no. SZS 0,4 x 2,5) or Matsushita Electric Works (part no. AFP0806). The tightening torque should be 0.22 to 0.25 Nm (2.3 kgfcm to 2.5 kgfcm).

Wiring method

1. Remove 7 mm of the wire's insulation.

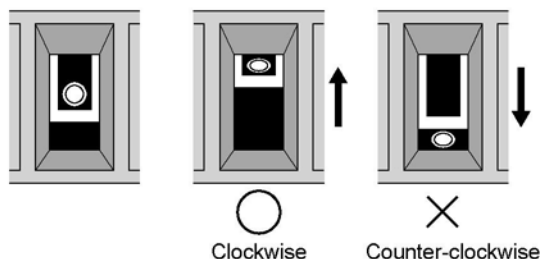


2. Insert wire into terminal hole until it stops. Tighten screw clockwise to fix wire in place. (Tightening torque: 0.22 Nm to 0.25 Nm (2.3 kgfcm to 2.5 kgfcm))



Notes for wiring

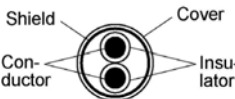
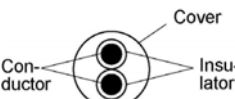
- When removing the wire's insulation, be careful not to scratch the core wire.
- Do not twist the wires to connect them.
- Do not solder the wires to connect them. The solder may break due to vibration.
- After wiring, make sure stress is not applied to the wire.
- In the terminal block socket construction, if the wire is fastened upon counter-clockwise rotation of the screw, the connection is faulty. Disconnect the wire, check the terminal hole, and then re-connect the wire.
- If two wires are connected to the plus terminal and minus terminal of the RS485 of AFPG806 (COM4), use the wires of the same cross-sectional area which is 0.5 to 0.75 mm².



7.3.3 Cables

Please use the following cables for systems using RS485 type communication cassettes.

Appropriate electrical cables (twisted cables)

Type	Cross-sectional view	Conductor		Insulator		Cable diam.	Sample appropriate cable
		Size	Resistance (at 20°C)	Material	Thickness		
Shielded twisted pair		1.25 mm ² (AWG16) or greater	Max. 16.8 Ω/km	Polyethylene	Max. 0.5 mm	Approx. 8.5 mm	Belden 9860 Hitachi Cable, Ltd. KPEV-S1.25 mm ² x 1P
		0.5 mm ² (AWG20) or greater	Max. 33.4 Ω/km	Polyethylene	Max. 0.5 mm	Approx. 7.8 mm	Belden 9207 Hitachi Cable, Ltd. KPEV-S0.5 mm ² x 1P
VCTF		0.75 mm ² (AWG18) or greater	Max. 25.1 Ω/km	Polychlorinated biphenyl	Max. 0.6 mm	Approx. 6.6 mm	VCTF-0.75 mm ² x 2C(JIS)



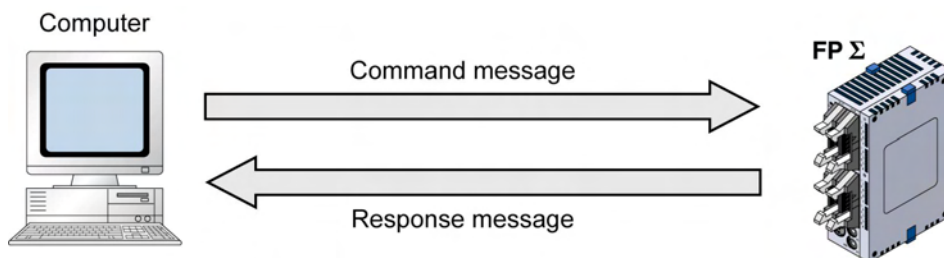
Note:

- Use shielded twisted pair cables.
- Use only one type of transmission cable. Do not mix more than 1 type.
- Twisted pair cables are recommended in noisy environments.
- When using shielded cable with crossover wiring for the RS485 transmission line, grounded one end.
- If two wires are connected to the plus terminal and minus terminal of the RS485 of AFPG806 (COM4), use the wires of the same cross-sectional area which is 0.5 to 0.75 mm².

7.4 Communication Function 1: Computer Link

7.4.1 Computer Link

Overview



Computer link

- The computer link function is to communicate between a computer and PLCs or between PLC and external devices connected. A proprietary MEWNET protocol called MEWTOCOL-COM is used for communicating with the computer link. MEWTOCOL-COM is also used for the communication between the tool software such as FPWIN-GR and the PLC.
- There are a MEWTOCOL master function and a MEWTOCOL slave function for the computer link. The side that issues commands is called master, and the side that receives the commands, executes the process and sends back responses is called slave.



Note:

It is necessary to set the system register of the communication port to the computer link for using this function.

3. Only the slave function is available for the FPΣ 12k type.
4. Both the master and slave functions are available for the FPΣ 32k type, however, the master function is not available for the TOOL port.

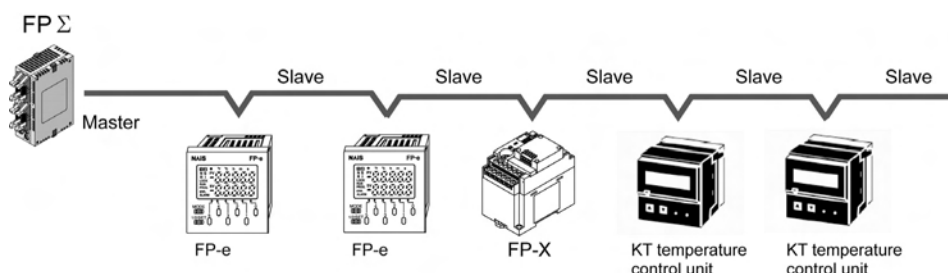
MEWTOCOL master function (32k type only)

- This function is to carry out the communication on the master side (side 0 that issues commands) of the computer link. It is executed with the PLC's instruction F145(SEND) or F146(RECV). It is not necessary to write the response process as a ladder, so the program is easier than the general-purpose communication function.

The 1:1 or 1:N communication is available between our devices equipped with the computer link function and the MEWTOCOL-COM.

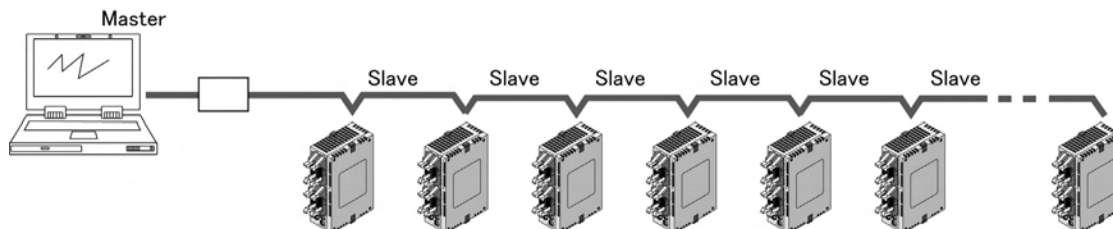
[Our devices (e.g.)] : PLC, IPD, temperature control unit, message runner, eco-power meter

For the MEWTOCOL master function, communication is possible with COM1 port and CCOM2 port of the 32k type only. Do not execute the F145 (SEND) nor F146 (RECV) instructions when the unit is used as a slave unit.



MEWTOCOL slave function

- This function is to receive commands from the computer link, execute the process and send back the results. Any special ladder program is not necessary to use this function. (Set the communication conditions in the system registers.) It enables the 1:1 or 1:N communication with a master computer or PLC.
- The program for the computer side must be written in BASIC or C language according to the MEWTOCOL-COM. MEWTOCOL-COM contains the commands used to monitor and control PLC operation.



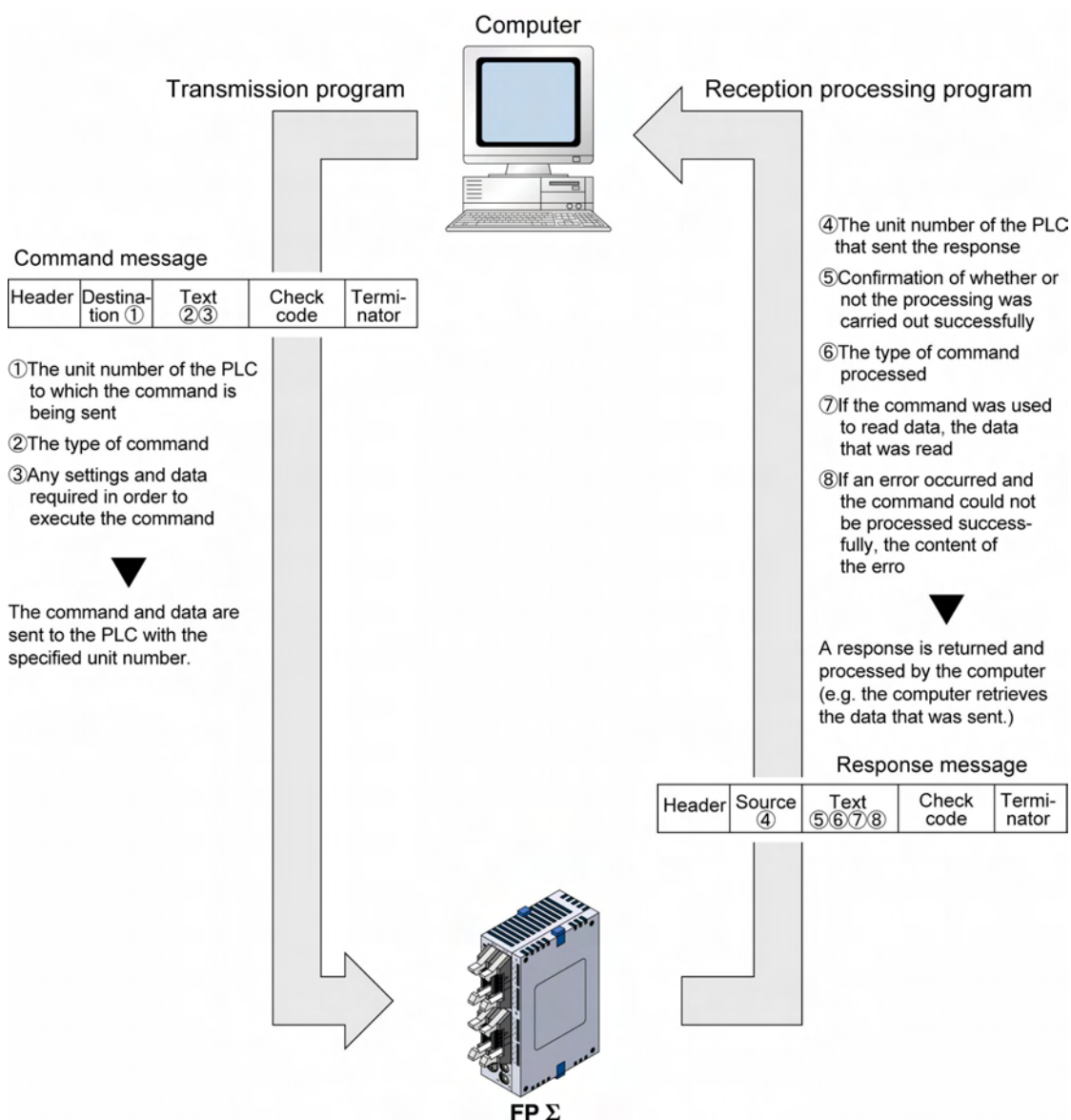
Outline of operation when using computer link (MEWTOCOL slave)

Command and response

- Instructions issued by the computer to the PLC are called commands. 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.

MEWTOCOL-COM sketch

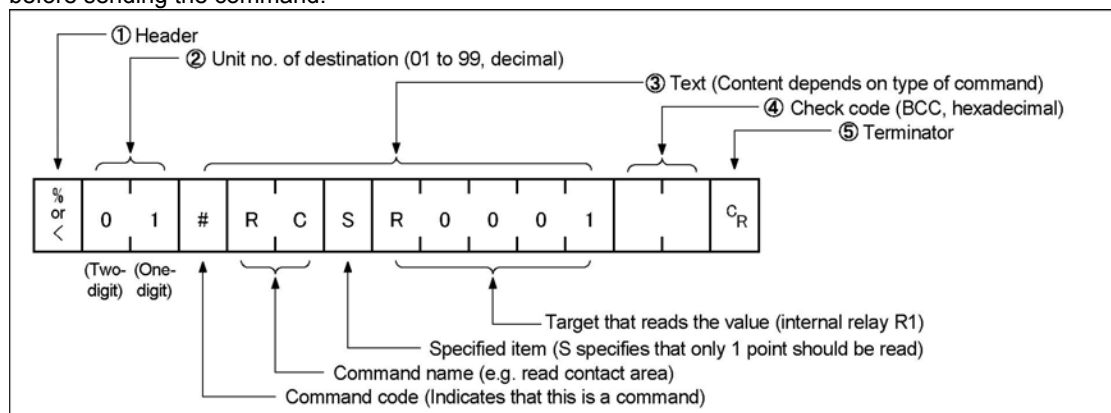
- Communication is carried out in a conversational format, based on the MEWTOCOL-COM communication procedures.
- Data is sent in ASCII format.
- The computer has the first right of transmission. The right of transmission shifts back and forth between the computer and the PLC each time a message is sent.



Format of command and response

Command message

All command-related items should be noted in the text segment. The unit number must be specified before sending the command.



1. Header (start code)

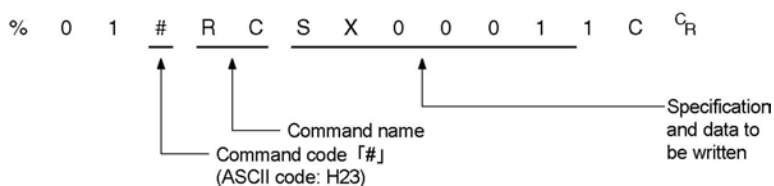
Commands must always have a “%” (ASCII code: H25) or a “<” (ASCII code: H3C) at the beginning of a message.

2. Unit number

The unit number of the PLC to which you want to send the command must be specified. In 1:1 communication, the unit number “01” (ASCII code: H3031) 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 the particular command.



4. Check code

BCC (block check code) for error detection using horizontal parity. The BCC should be created so that it targets all of the text data from the header to the last text character. The BCC starts from the header 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. Terminator (end code)

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

**Note:**

- 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.

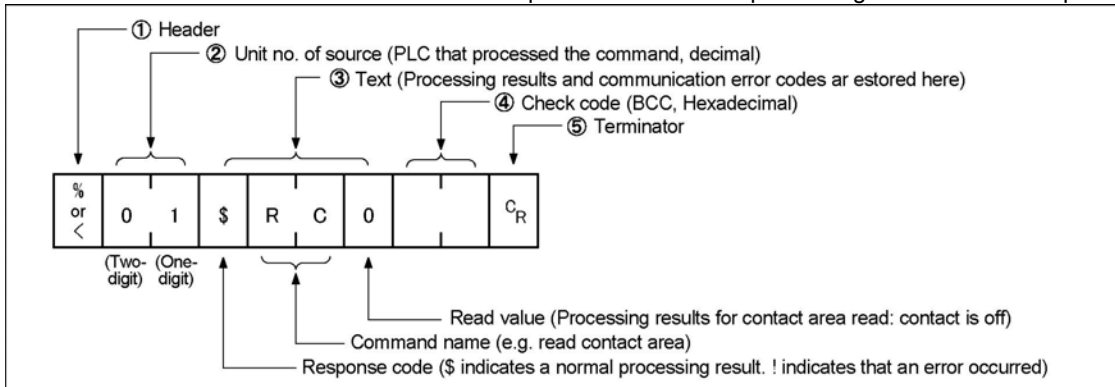
**Key Point:**

- With the FPΣ, an expansion header "<" is supported to send single frames of up to 2048 characters as well as general "%".

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

Response message

The PLC that received the command in the example above sends the processing results to the computer.

**1. Header (start code)**

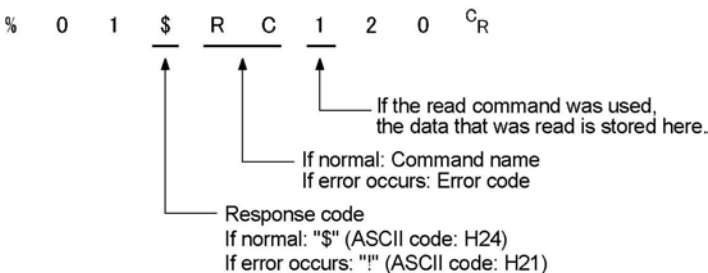
A "%" (ASCII code: H25) or "<" (ASCII code: H3C) must be at the beginning of a message. The response must start with the same header that was at the beginning of the command.

2. Unit number

The unit number of the PLC that processed the command is 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.



BCC (block check code) for error detection using horizontal parity. The BCC starts from the header and checks each character in sequence, using the exclusive OR operation, and replaces the final result with character text.

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



-
- Diagram illustrating the relationship between Command and Response fields:
- | | | | | | | | | | |
|----------|---|---|---|----|---|---|--|--|-------|
| Command | % | 0 | 1 | # | R | C | | | C_R |
| Response | % | 0 | 1 | \$ | R | C | | | C_R |
- Annotations:
- Brackets under "0 1" in Command and Response are connected by a double-headed arrow labeled "Same".
 - Brackets under "R C" in Command and Response are connected by a double-headed arrow labeled "Same".

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 MD and MC.
Preset contact area (fill command)	SC	Embeds the area of a specified range in a 16-point on and off pattern.
Preset data area (fill command)	SD	Writes the same contents to the data area of a specified range.
Read system register	RR	Reads the contents of a system register.
Write system register	WR	Specifies the contents of a system register.
Read the status of PLC	RT	Reads the specifications of the programmable controller and error codes if an error occurs.
Remote control	RM	Switches the operation mode of the programmable controller.
Abort	AB	Aborts communication.

Setting communication parameters

Setting for Baud rate and communication format

The settings for baud rate and communication format of the COM port are entered using the FPWIN GR. Select "Options" in the menu bar, and then select "PLC Configuration". Double-click "COM Port". There are separate settings for COM1 and COM2 .

Note) Also, select "Computer Link" when using the MEWTOCOL master function. (FP Σ 32k type only)

Dialog box of PLC system register setting

The screenshot shows the 'PLC Configuration - Untitle1' dialog box. It has several tabs: 'Hold/Non-hold 1', 'Hold/Non-hold 2', 'Action on Error', 'Time', 'Link', 'High Speed Counter', 'Interrupt Input', 'Tool Port', 'COM1 Port', and 'COM2 Port'. The 'COM1 Port' tab is selected. Inside this tab, there are settings for 'No. 410 Unit No.' (set to 1), 'No. 412 Comm. Mode' (set to 'Computer Link'), 'Modem Enabled' (unchecked), 'No. 413 Communication Format' (Char. Bit: 8 Bits, Terminator: CR, Parity: Odd, Header: STX not exist, Stop Bit: 1), 'No. 415 Baudrate' (set to 9600 bps), 'No. 416 Starting address for data received of serial data communication mode' (set to 0), and 'No. 417 Buffer capacity setting for data received of serial data communication mode' (set to 2048). On the right side of the dialog, there are buttons for 'OK', 'Cancel', 'Read PLC', 'Initialize', and 'Help'.

No. 410 unit number


The unit number can be set within a range of 1 to 99. However, if the unit no. setting switch of the FP Σ has been set to the numbers other than 0, the setting of the unit no. setting switch becomes effective.

In this case, the same number is given to the port 1 and port 2.

When specifying the number by a system register, set the unit no. setting switch to "0".

No. 412 Communication mode

Select the COM port operation mode:

Click on , and select "Computer Link".

No. 413 (for COM1 port), No. 414 (for COM2 port) Communication Format setting


Default setting:

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

To change the communication format to match an external device connected to the COM port, enter the settings for the various items.

No. 415 Baud rate (communication speed) setting

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

Click on , and select one of the values from 2400, 4800, 9600, 19200, 38400, 57600 and 115200 bps.

Restrictions

- The two ports of the communication cassette can be used independently. They can be set to computer link mode or general-purpose serial communication
- There is no restriction when multiple ports are used.

7.4.2 1:1 Communication (Computer link)

System register settings

Settings for COM1 port (AFPG801, AFPG802)

No.	Name	Set Value
No. 410	COM1 port unit number	1
No. 412 ^{Note)}	COM1 port selection of communication mode	Computer link
No. 413	Communication format for COM1 port	Data length: 7 bits/8 bits Parity check: None/Odd/Even Stop bit: 1 bit/2 bit Terminator: CR Header: STX not exist
No. 415 ^{Note)}	Baud rate setting for COM1 port	2400 to 115200 bps

Settings for COM2 port (AFPG802, AFPG806)

No.	Name	Set Value
No. 411	COM2 port unit number	1
No. 412 ^{Note)}	COM2 port selection of communication mode	Computer link
No. 414	Communication format for COM2 port	Data length: 7 bits/8 bits Parity check: None/Odd/Even Stop bit: 1 bit/2 bit Terminator: CR Header: STX not exist
No. 415 ^{Note)}	Baud rate setting for COM2 port	2400 to 115200 bps

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

Note) They are set in different bit positions of the same system register no., so the different settings are possible for port 1 and port 2.

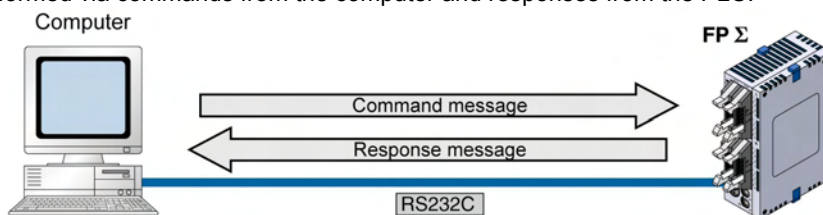
Programming

- For a computer link, a program should be created that allows command messages to be sent and response messages to be received on the computer side. The PLC automatically sends back a response to a command. 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 easily be read and written without having to think about the MEWTOCOL-COM protocol

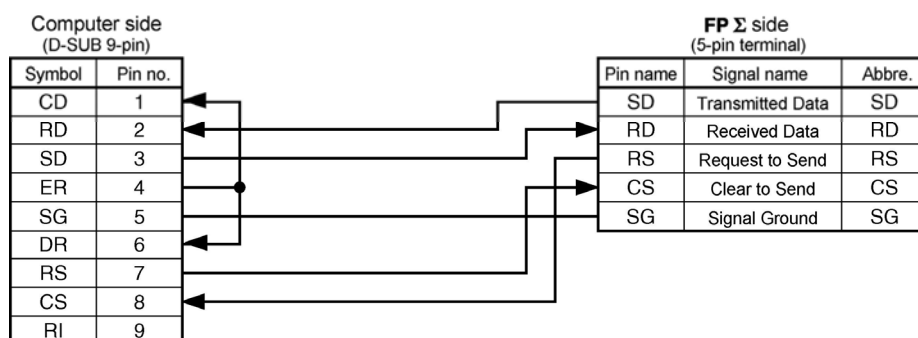
Connection to the computer <1:1 communication>

Overview

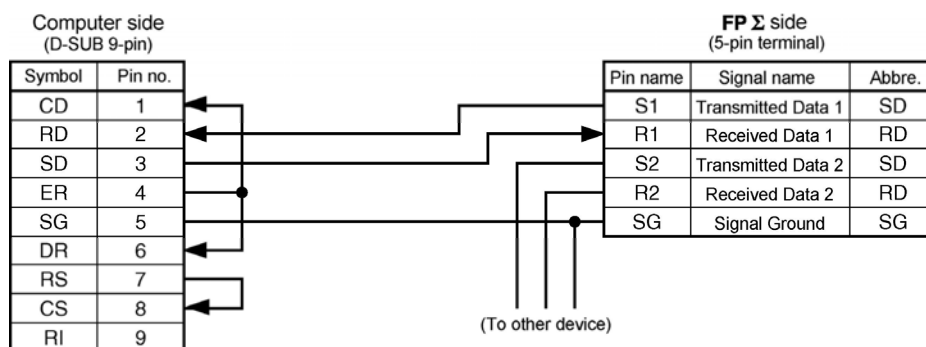
For a 1:1 computer link between the FPΣ and a computer, an RS232C cable is needed. Communication is performed via commands from the computer and responses from the PLC.



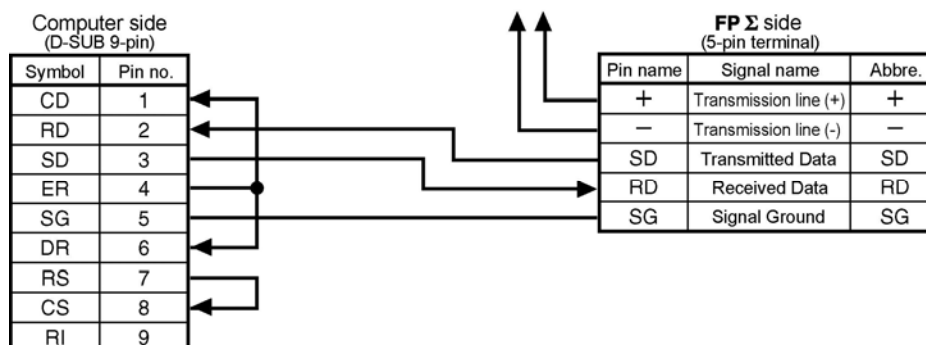
<Using AFP801 (1-channel RS232C type communication cassette)>



<Using AFP802 (2channel RS232C type communication cassette)>



<Using AFP806(Combination of 1-channel RS485 type and 1-channel RS232C type)>



1:1 communication with programmable display GT10/GT30

Overview

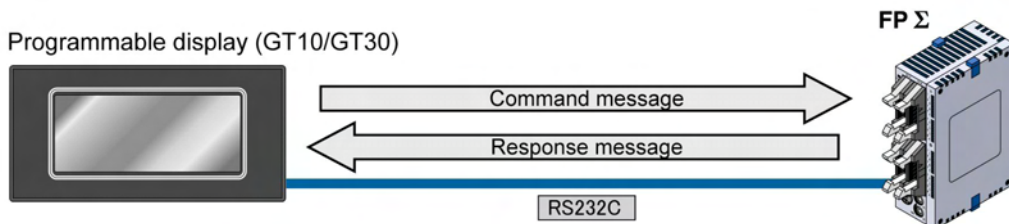
A 1:1 computer link with a programmable display GT10/GT30 connects the FPΣ and the programmable display using an RS232C cable. Communication is performed via commands from the programmable display and responses from the PLC.

No program is required for communication. Simply set the mutual communications settings to operate the PLC via the programmable display.

Note) It is recommended to connect the programmable display (GT01) with a tool port.



Reference: <GT01 Technical Manual>



<Using AFIG801 (1-channel RS232C type communication cassette)>

GT10/GT30 side (5-pin terminal)

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

FP Σ side (5-pin terminal)

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

<Using AFIG802 (2-channel RS232C type communication cassette)>

GT10/GT30 side (5-pin terminal)

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

FP Σ side (5-pin terminal)

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

(To other device)

<Using AFIG806(Combination of 1-channel RS485 type and 1-channel RS232C type)>

GT10/GT30 side (5-pin terminal)

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

FP Σ side (5-pin terminal)

Pin name	Signal name	Abbre.
+	Transmission line (+)	+
-	Transmission line (-)	-
SD	Transmitted Data	SD
RD	Received Data	RD
SG	Signal Ground	SG

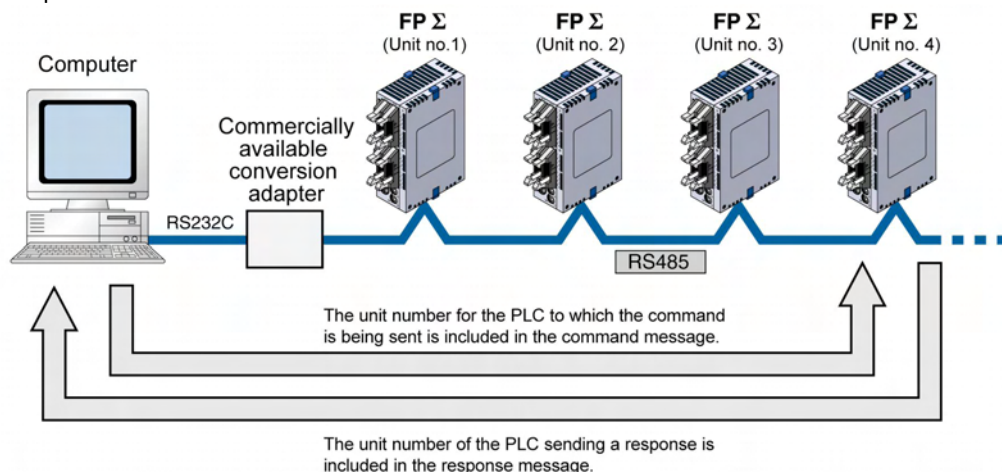


Reference: <GT10/GT30 Technical Manual ARCT1F340>

7.4.3 1:N Communication (Computer Link)

Overview

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. The computer and the PLC communicate via commands and responses: The computer sends a command specifying the unit number, and the PLC with that unit number sends a response back to the computer.



When data is transmitted from FPΣ via the RS485 communication of AFIG806 (COM4), start the transmission of the data to FPΣ after the time mentioned below passes at a receiver.

In case of 19200 bps: 1 ms In case of 115200 bps: 200μs

Note) Lineeye SI-35 is recommended to be used as a conversion adapter.

Setting system registers

Setting of COM1 port

No.	Name	Set value
No. 410	COM1 port unit number	1 to 99 (Set the desired unit number) (With a C-NET adapter, a maximum of 32 units (stations) can be specified.)
No. 412	COM1 port selection of communication mode	Computer link
No. 413	Communication format for COM1 port	Data length: 7 bits/8 bits Parity check: None/Odd/Even Stop bit: 1 bit/2 bit Terminator: CR Header: STX not exist
No. 415	Baud rate setting for COM1 port	2400 to 115200 bps

Note1) The communication format and baud rate (communication speed) should be set to match the connected computer.

Note2) The RS485 port of the AFIG806 is either 19200 bps or 115200 bps only.
Also the baud rate must be identically set by the system register and the dip switch in the communication cassette.



Reference: <7.1.4 Setting of AFIG806 Switch>

Note3) Setting the unit number setting switch to 0 makes the system register settings valid.

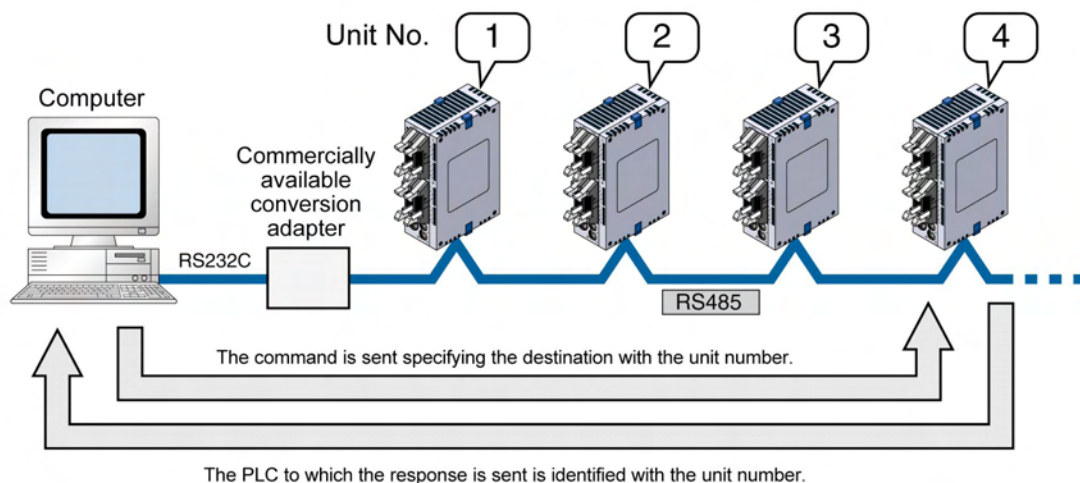
Note4) Connect the “-” terminal and the “E” terminal with a lead wire to make the termination resistance of the AFIG803 effective.

The termination resistance of the AFIG806 is specified by the dip switch located in the communication cassette.

Setting of unit numbers

By default, the unit number for each communication port is set to 1 in the system register settings. There is no need to change this for 1:1 communication, but if 1:N communication is used to connect multiple PLCs to the transmission line (e.g. in a C-NET), the unit number must be specified so that the destination of the command can be identified.

The unit number is specified either by using **the unit number setting switch** or **the system register**.



When the unit number setting switch is "0", the system register is valid.

When the unit number setting switch is "other than 0", the unit number setting switch is valid, and the unit number setting of the system register is ignored. In this case, the same number is given to the port 1 and port 2.



Note:

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

Setting unit numbers with the setting switch

The unit number setting switch is located underneath the cover on the left side of the FPΣ control unit. By setting the selector switch and the dial, a unit number between 1 and 31 can be set.

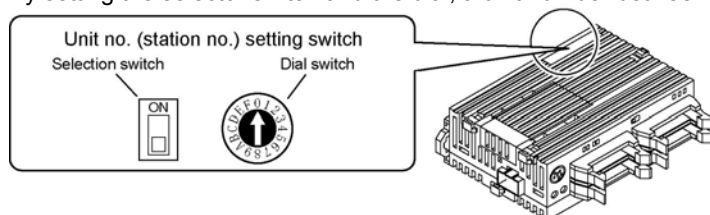


Table of switch settings and related unit numbers

Unit No.	Selection switch	Dial switch	Unit No.	Selection switch	Dial switch
※	OFF	0	16	ON	0
01	OFF	1	17	ON	1
02	OFF	2	18	ON	2
03	OFF	3	19	ON	3
04	OFF	4	20	ON	4
05	OFF	5	21	ON	5
06	OFF	6	22	ON	6
07	OFF	7	23	ON	7
08	OFF	8	24	ON	8
09	OFF	9	25	ON	9
10	OFF	A	26	ON	A
11	OFF	B	27	ON	B
12	OFF	C	28	ON	C
13	OFF	D	29	ON	D
14	OFF	E	30	ON	E
15	OFF	F	31	ON	F

- A unit number between 1 and 31 can be set.
- Set the unit number setting switch to "0" to make the system register valid.
- The same unit number is given to the COM1 port and COM2 port when using the unit number setting switch. (Use the system register setting to set the unit number individually for the COM1 port and COM2 port.)

Setting unit numbers with the system register

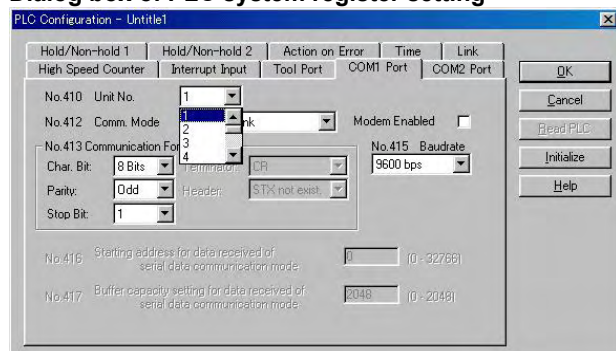
A unit number between 1 and 99 can be set with the system register.

Setting the unit number setting switch to 0 makes the system register settings valid.

To set unit numbers with the FPWIN GR programming software:

Select "Options" in the menu bar, and then select "PLC Configuration". Double-click "COM Port". There are separate settings for COM1 and COM2 .

Dialog box of PLC system register setting



No. 410 (for COM1 port), No. 411 (for COM2 port) unit number settings

Click on , and select a unit number from 1 to 99.

Note) With a C-NET adapter, a maximum of 32 units (stations) can be specified.

Connection with external devices

AFPG803

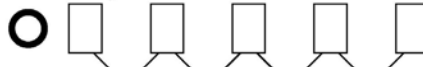
Connection diagram

FP Σ side (5-pin terminal)

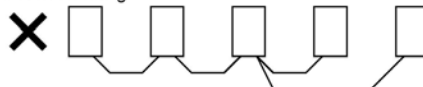
Pin name	Signal name	Abbre.
+	Transmission line 1 (+)	+
-	Transmission line 1 (-)	-
+	Transmission line 2 (+)	+
-	Transmission line 2 (-)	-
E	Terminal station setting	E

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

• Correct wiring



• Incorrect wiring



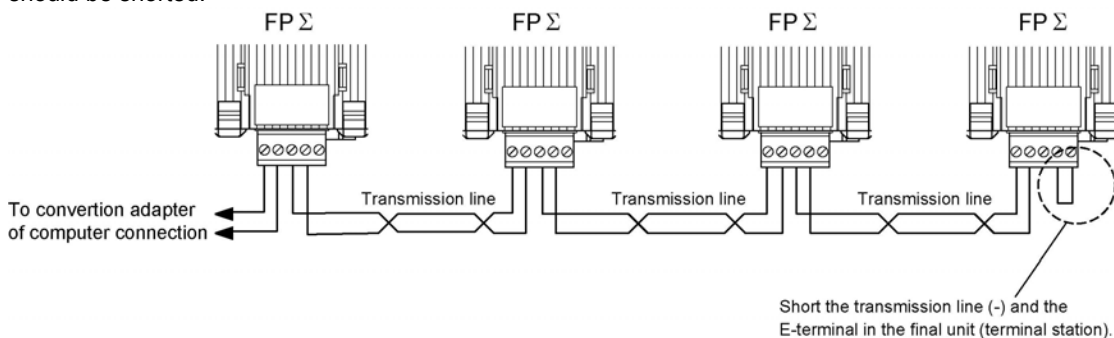
To external device
with RS485 port

To external device
with RS485 port

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 COM1 port.

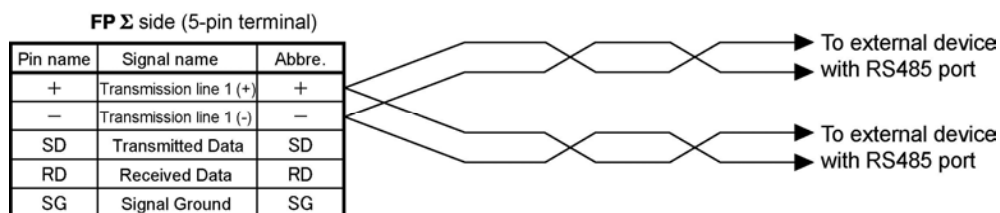
Setting of terminal station

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



AFPG806

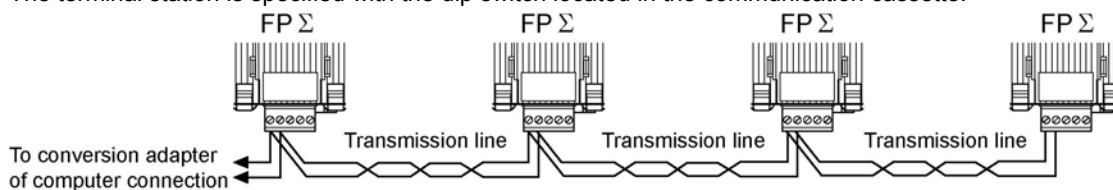
Connection diagram



In case of using the AFPG806, connect two cables each to the (+) terminal and (-) terminal. Use the wires of the same cross-sectional area which should be 0.5 to 0.75 mm².

Setting of terminal station

The terminal station is specified with the dip switch located in the communication cassette.

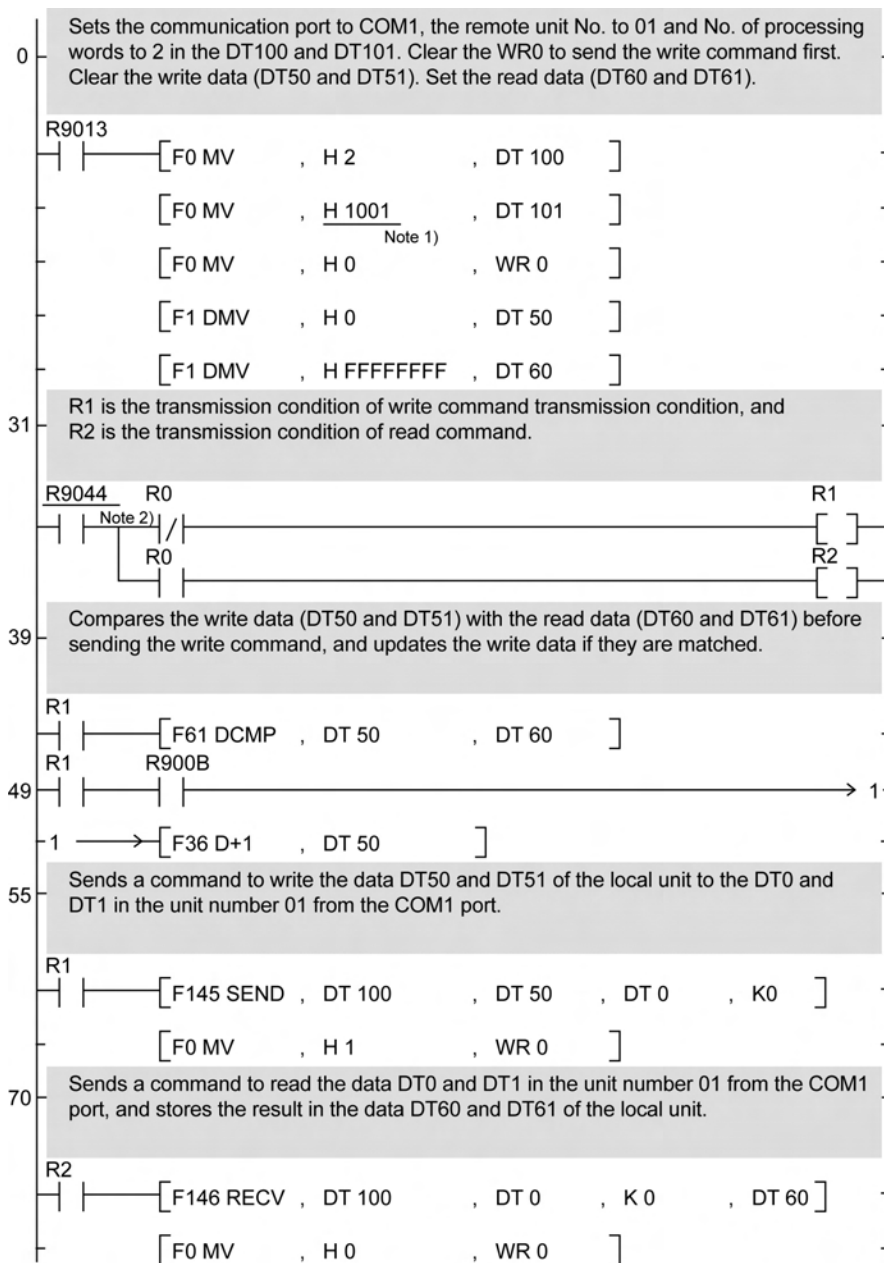


Reference: <7.1.4 Setting of AFPG806 switch>

7.4.4 MEWTOCOL Master (Sample Program) (Available For 32k Type Only)

Use the F145 (SEND) "Data send" or F146 (RECV) "Data receive" instruction to use the MEWTOCOL master function.

Sample program



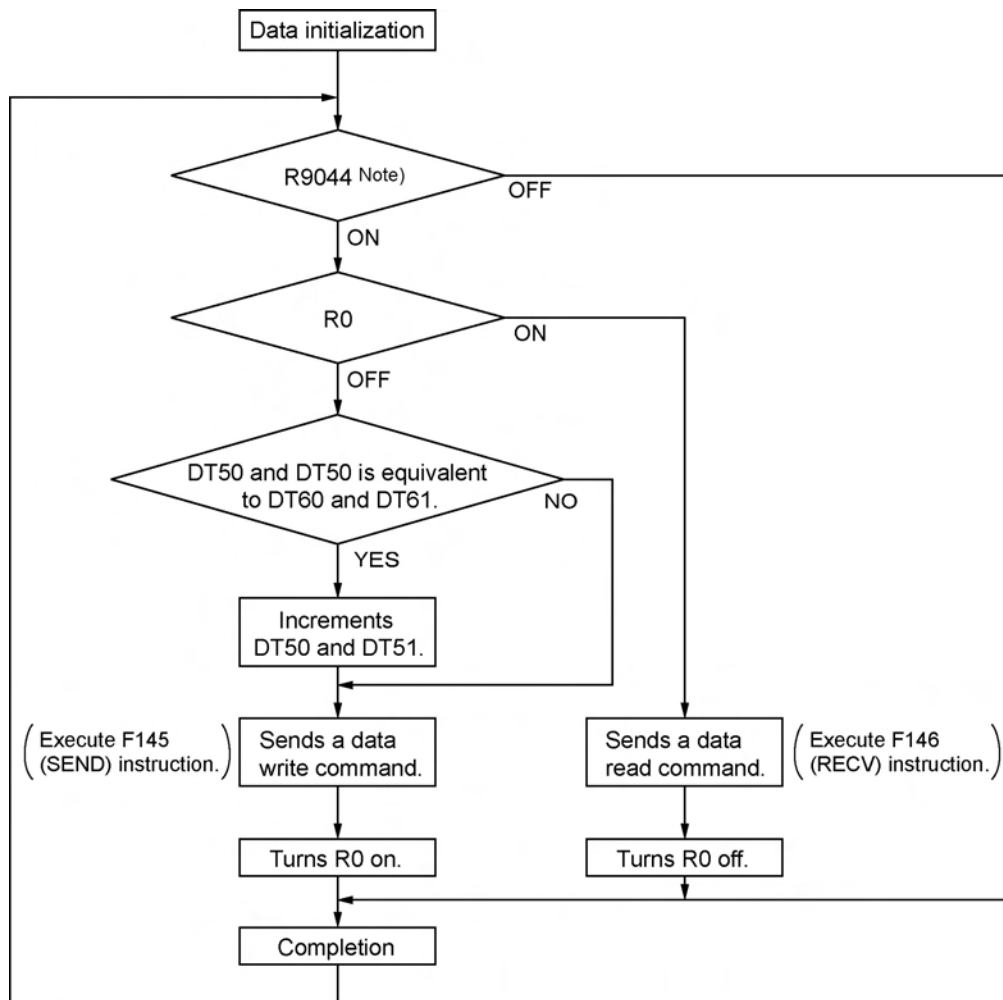
Note1) It is H2001 for COM2 port.

Note2) It is R904A for COM2 port.



Reference: For the information on the F145(SEND) and F146(RECV) instructions, <Programming Manual ARCT1F313E>

Flow chart



Note) It is R904A for COM2 port.

The above program executes the operation 1 to 3 repeatedly.

1. Updates the write data if the write data (DT50 and DT51) and the read data (DT60 and DT61) are matched.
2. Writes the DT50 and DT51 of the local unit into the data DT0 and DT1 in the unit number 1 from the COM1 port.
3. Reads the data DT0 and dT1 in the unit number 1 into the data DT60 and DT61 of the local unit from the COM1 port.

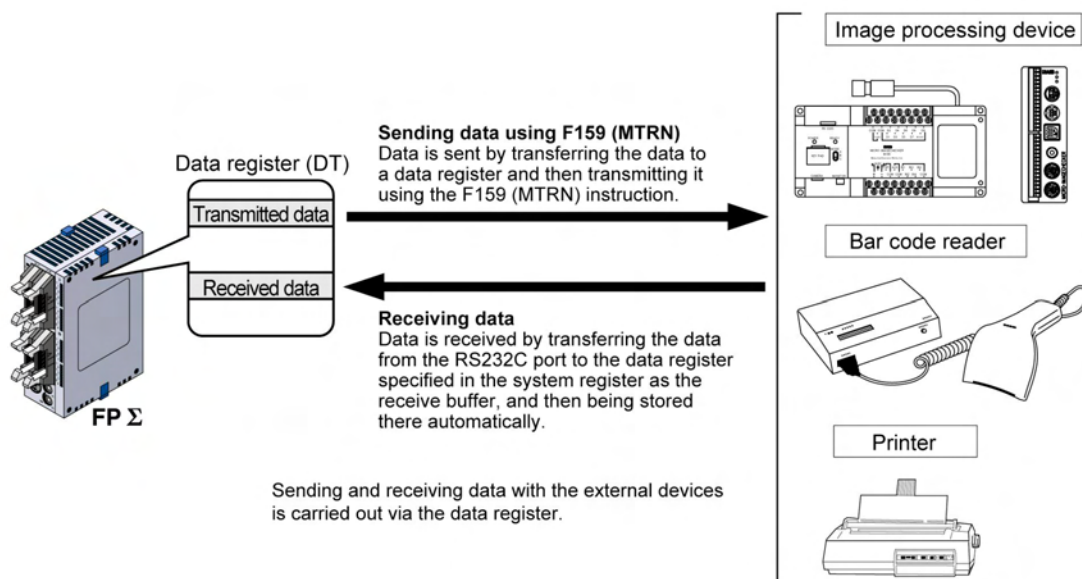
Note) The above COM1 port will be COM2 port for the COM2 port.

7.5 Communication Function: General-purpose Serial Communication

7.5.1 General-purpose Serial Communication

Overview

- In general-purpose serial communication, data is sent and received over the COM ports to and from an external device such as an image processing device or a bar code reader.
- Data is read from and written to an external device connected to the COM port by means of an FPΣ program and the FPΣ data registers.

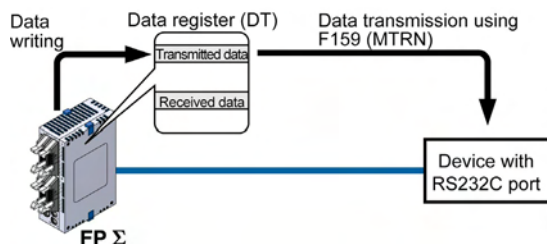


Outline of operation

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.

Sending data

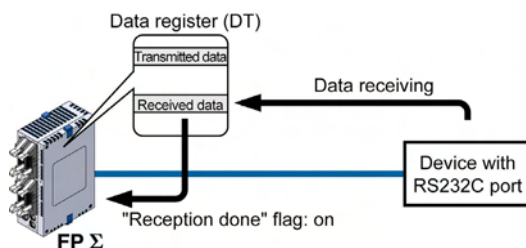
Data to be transmitted from the PLC is stored in the data register used as the send buffer (DT). When F159 (MTRN) is executed, the data is output from the COM port.



- The terminator specified in the system register is automatically added to the data that has been sent.
- The maximum volume of data that can be sent is 2048 bytes.

Receiving data

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



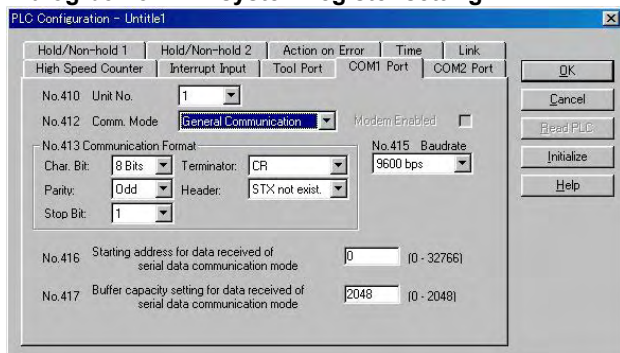
- When data is being received, the “reception done” flag is controlled by the F159 (MTRN) instruction.
- No terminator is included in the stored data.
- The maximum volume of data that can be received is 4096 bytes.

Setting Baud rate, communication format

By default, the COM port is set to "Computer link". System register settings should be entered for the following items.

The settings for baud rate and communication format are made using the FPGWIN GR programming tool. Select "Options" in the menu bar, and then select "PLC Configuration". Double-click "COM Port". There are separate settings for COM1 and COM2 .

Dialog box of PLC system register setting



No. 412 Communication Mode

Select the COM port operation mode:

Click on  and select "General Communication".

No. 413 (for COM1 port), No. 414 (for COM2 port) Communication Format setting


Default setting:

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

Enter the appropriate settings to match the communication format of the external device connected to the COM port..

No. 415 Baud rate (communication speed) setting

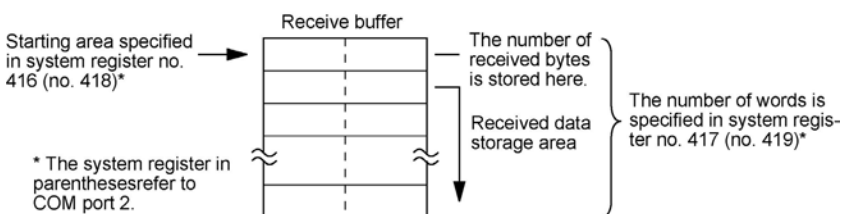
The default setting for the communication speed for the various ports is 9600 bps. Change the value to match the external device connected to the COM port:

Click on , and select one of the values from 2400, 4800, 9600, 19200, 38400, 57600 and 115200 bps.

No. 416 (for COM1 port), No. 418 (for COM2 port) Starting address for data received

No. 417 (for COM1 port), No. 419 (for COM2 port) Buffer capacity setting for data received

To use general-purpose serial communication, the receive buffer must be specified. By default, the entire data register area is defined as the receive buffer. To change this area, specify the starting address using system register no. 416 (no. 418 for COM2 port) and the volume (number of words) using no. 417 (no. 419 for COM2 port). The receive buffer layout is shown below.



7.5.2 Communication with External Devices

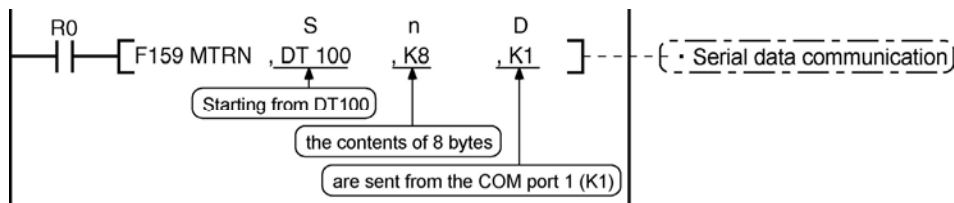
Programming example of general-purpose serial communication

The F159 (MTRN) instruction is used to send and receive data via the specified COM port. F159 (MTRN) is only used with the FPΣ. It is an updated version of F144 (TRNS) and allows multiple communication ports to be accommodated.

F144 (TRNS) is not available with the FPΣ.

F159 (MTRN) instruction

Data is sent and received via the specified COM port .



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

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

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

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 header and terminator automatically attached. A maximum of 2048 bytes can be sent. When the above program is run, the eight bytes of data contained in DT101 to DT104 and stored in the send buffer starting from DT100 are sent from COM1 port.

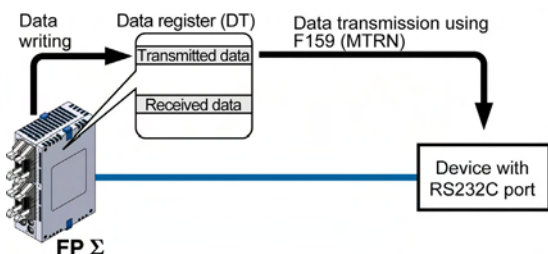
Reception of data

Reception of data is controlled by turning the “reception done” flags R9038/R9048 on and off. The received data is stored in the receive buffer specified in the system register. Data can be received when F159 (MTRN) turns the “reception done” flag off. When the reception of the data is completed (the terminator is received), the “reception done” flag turns on, and subsequently, receiving data is prohibited. To receive the next data, execute the F159 (MTRN) instruction and turn the “reception done” flag off to clear the number of received bytes to 0. To receive data continuously without sending data, clear the number of transmitted bytes to 0 (set “n” to “K0”), and then execute the F159 (MTRN) instruction.

Sending data to external devices

Communication with external devices is handled through the data registers.

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



Data table for transmission (send buffer)

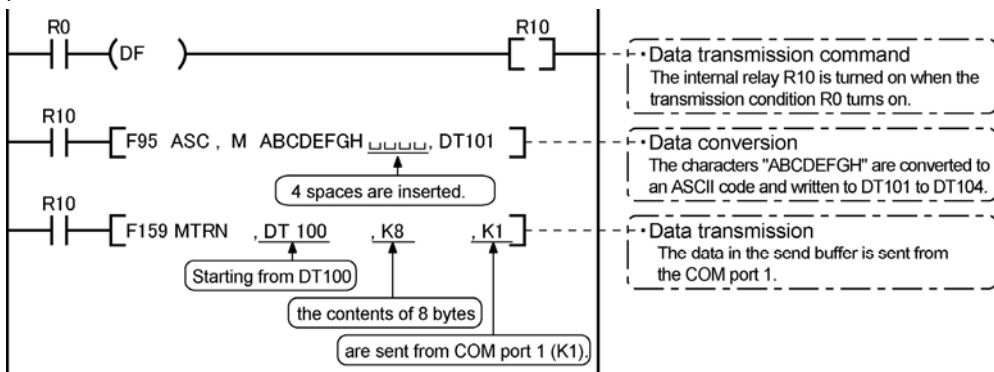
DT100	K8	When transmission begins: K8 is set. 0 is set when transmission completed. (Ver 3.10 or later)
DT101	H42(B) : H41(A)	When transmission ends: K0
DT102	H44(D) : H43(C)	
DT103	H46(F) : H45(E)	
DT104	H48(H) : H47(G)	

Data is transmitted in order from the low order byte.

Data table before transmission

Sample program for sending data

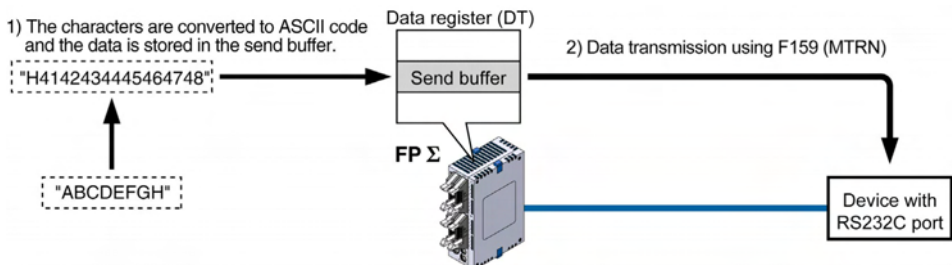
The following program transmits the characters "ABCDEFGH (Hex)" to an external device using COM1 port.



The program described above is executed in the following sequence.

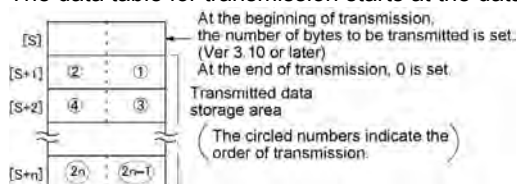
- 1) "ABCDEFGH" is converted to an ASCII code and stored in a data register.
- 2) The data is sent from COM1 port using the F159 (MTRN) instruction.

Explanatory diagram



Explanation of data table

The data table for transmission starts at the data register specified in S.

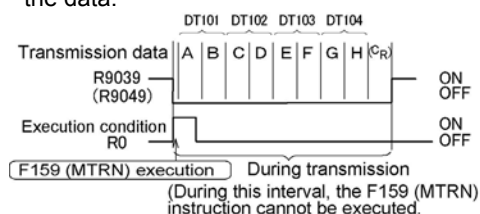


- Use an F0 (MV) or F95 (ASC) instruction to write the data to be transmitted to the transmission data storage area specified in S.

Transmission process

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

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 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.



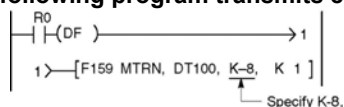
3. When all of the specified quantity of data has been transmitted, the S value is cleared to 0 and the “transmission done” flag R9039/R9049 turns on.

When you do not wish to add the terminator (end code) during transmissions:

- Specify the number of bytes to be transmitted using a negative number.
- If you also do not wish to add a terminator to received data, set system register 413 or 414 to “Terminator - None”.

Programming example:

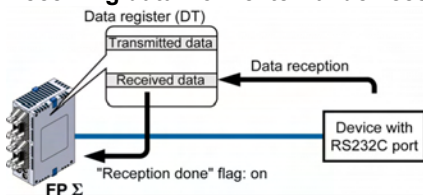
The following program transmits 8 bytes of data without adding the terminator.



Key Point:

- Do not include the terminator (end code) in the transmission data. The terminator is added automatically.
- When “STX exist” is specified for the header (start code) in system register 413 or 414, do not add the header to the transmission data. The header 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.
- The contact numbers in parentheses refer to COM2 port.

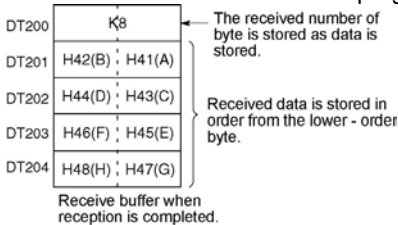
Receiving data from external devices



Data input from the COM port is stored in the receive 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.

Data table for reception (receive buffer)

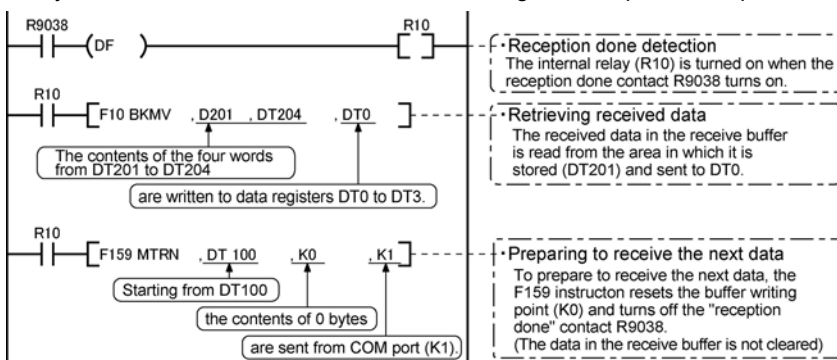
This is the state when the above program is executed.



- DT200 to DT204 are used as the receive buffer. System register settings are as follows:
 - System register 416: K20
 - System register 417: K5

Sample program for receiving data

10-byte data received in the receive buffer through COM1 port are copied to DT0.



The program described above is executed in the following sequence.

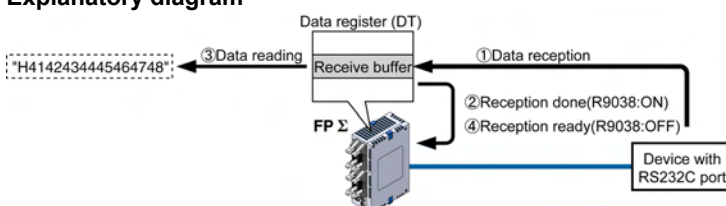
- 1) Data is received from the RS232C device to the receive buffer.
 - 2) The “reception done” contact R9038 (R9048) is turned on.
 - 3) The received data is sent from the receive buffer to the area starting with data register DT0.
 - 4) The F159 (MTRN) instruction is executed with no data to reset the buffer writing point and to turn off the reception done” contact R9038 (R9048).
- The system is now ready to receive the next data.
(The data in the receive buffer is not cleared.)



Note:

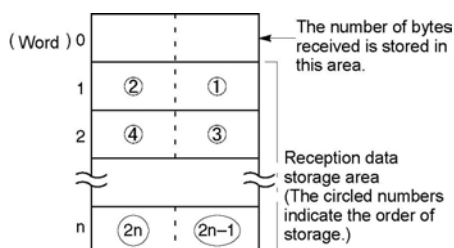
- Be aware that the “reception done” flag R9038 or R9048 changes even while a scan is in progress (e.g., if the “reception done” flag is used multiple times as an input condition, there is a possibility of different statuses existing within the same scan.) To prevent multiple read access to the special internal relay you should generate a copy of it at the beginning of the program.

Explanatory diagram



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 receive buffer.

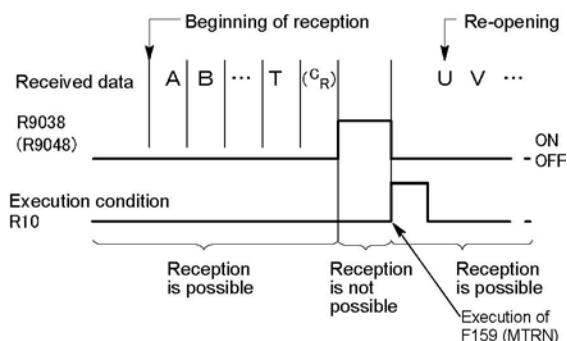


- Specify the data registers in system register 416 to 419.
- The number of bytes of data received is stored in the starting address of the receive buffer. The initial value is 0.
- Received data is stored in the received data storage area in order from the lower-order byte.

Reception process

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) flag 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 receive buffer. Header and terminator (start and end codes) are not stored.

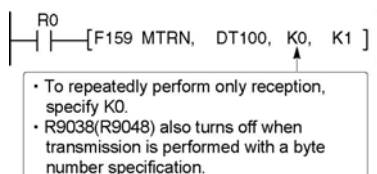


2. When the terminator (end code) is received, the “reception done” flag R9038 (R9048) turns on. Reception of any further data is prohibited.
3. When an F159 (MTRN) instruction is executed, the “reception done” flag R9038 (R9048) turns off, the number of received bytes is cleared, and subsequent data is stored in order from the lower-order byte.

For repeated reception of data, perform the following steps:

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

Prepare for 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 the F159 (MTRN) instruction to turn off the “reception done” flag R9038 (R9048).



Key Point:

- The contact numbers in parentheses refer to COM2 port.

Data to be sent/received with FPΣ

Remember the following when accessing data in the FPΣ send and receive buffers:

- If a header has been chosen in the communication format settings, the code STX (H02) will automatically be added at the beginning of the data begin sent.
- The data without the Code STX at the reception is stored in the receive buffer, and the “reception done” flag turns on when the terminator (end code) is received.
However, if the code STX is added in the middle of the data, the number of received byte is cleared to 0, and the data is stored from the beginning of the receive buffer.
- A terminator is automatically added to the end of the data being sent.
- There is no terminator on the data stored in the receive buffer.

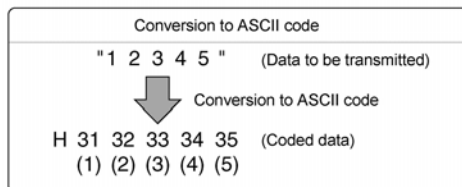
Sending data:

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

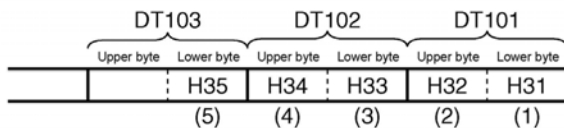
Example:

The data “12345” is transmitted as an ASCII code to a device with RS232C port.

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



2. If DT100 is being used as the send 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 and the lower byte.



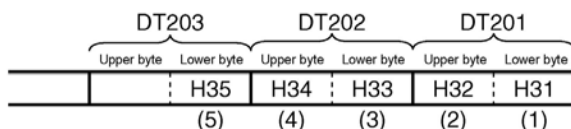
Receiving data:

The data of the receive area being read is ASCII code data.

Example:

The data “12345_C” is transmitted from a device with RS232C port.

- If DT200 is being used as the receive 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.

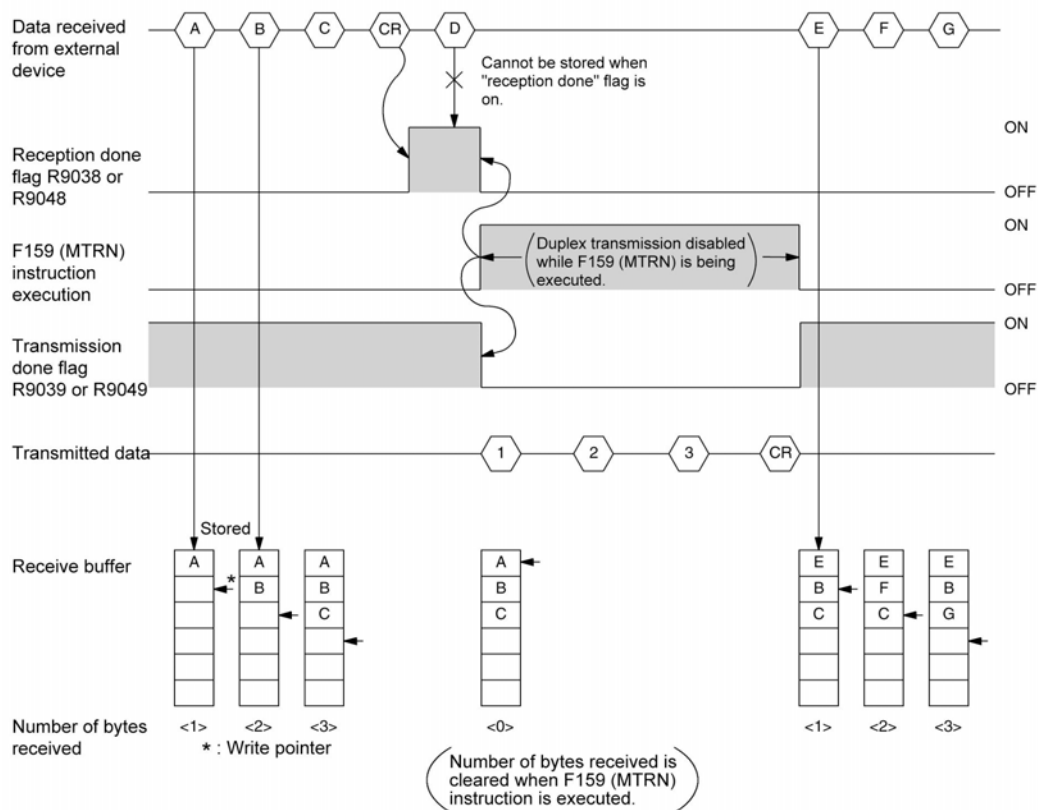


Flag operation in serial communication

Header: No-STX, Terminator: CR

Receiving data:

The “reception done” flag, the “transmission done” flag, and the F159 (MTRN) instruction are related as follows:



- For general-purpose serial communication, half-duplex transmission must be used.
- Reception is disabled when the “reception done” flag R9038 or R9048 is on.
- When F159 (MTRN) is executed, the number of bytes received is cleared, and the address (write pointer) in the receive buffer is reset to the initial address.
- Also, when F159 (MTRN) is executed, the error flag R9037 or R9047, the “reception done” flag R9038 or R9048 and the “transmission done” flag R9039 or R9049 goes off.
- Duplex transmission is disabled while F159 (MTRN) is being executed. The “transmission done” flag R9039 or R9049 must be observed.
- Reception continues even if the error flag R9037 turns on. To resume reception, execute the F159 (MTRN) instruction, which turns off the error flag.



Note:

- Be aware that the “reception done” flag R9038 or R9048 changes even while a scan is in progress (e.g., if the “reception done” flag is used multiple times as an input condition, there is a possibility of different statuses existing within the same scan.) To prevent multiple read access to the special internal relay you should generate a copy of it at the beginning of the program.



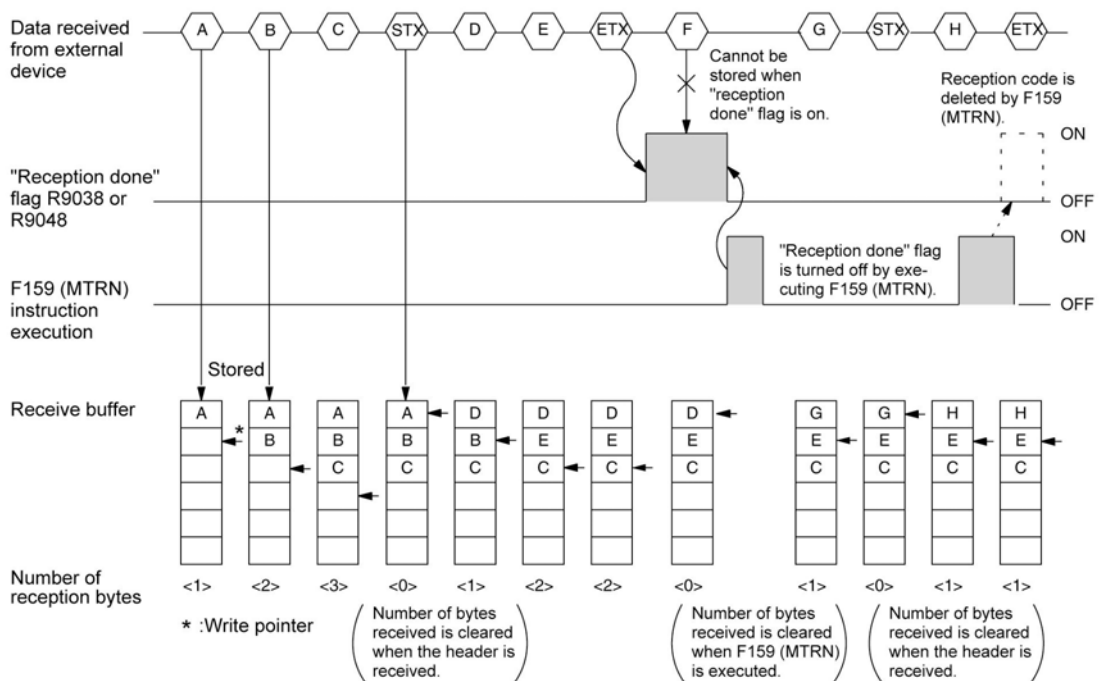
Key Point:

- The contact numbers in parentheses refer to COM2 port.

Header: STX, Terminator: ETX

Receiving data:

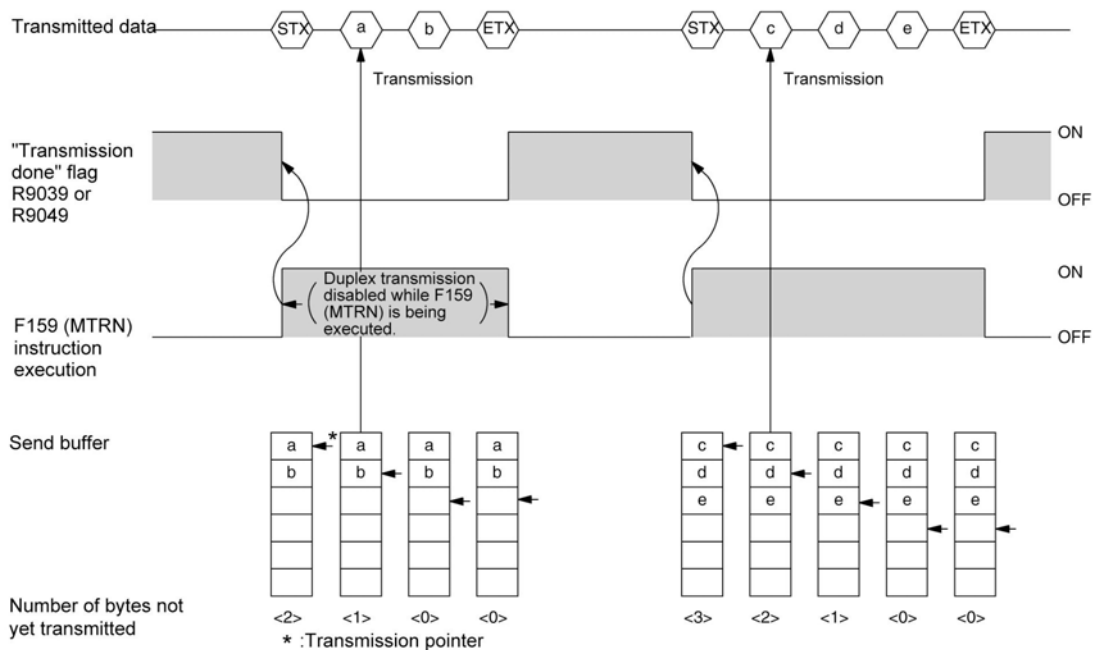
The "reception done" flag, the "transmission done" flag, and the F159 (MTRN) instruction are related as follows:



- The data is stored in the receive buffer in sequential order. When the header is received, the number of bytes received is cleared, and the address (write pointer) in the receive buffer is reset to the initial address.
- Reception is disabled while the "reception done" flag R9038 or R9048 is on.
- Also, When F159 (MTRN) is executed, the number of bytes received is cleared, and the address (write pointer) in the receive buffer is reset to the initial address.
- If there are two headers, data following the second header overwrites the data in the receive buffer.
- The "reception done" flag R9038 or R9048 is turned off by the F159 (MTRN) instruction. Therefore, if F159 (MTRN) is executed at the same time the terminator is received, the "reception done" flag will not be detected.

Sending data:

The “reception done” flag, the “transmission done” flag, and the F159 (MTRN) instruction are related as follows:



- Header (STX) and terminator (ETX) are automatically added to the data being transmitted. The data is transmitted to an external device.
- When the F159 (MTRN) instruction is executed, the “transmission done” flag R9039 or R9049 goes off.
- Duplex transmission is disabled while F159 (MTRN) is being executed. The “transmission done” flag R9039 or R9049 must be observed.



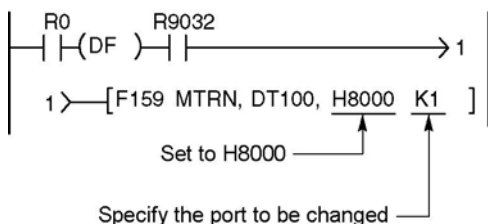
Key Point:

- The contact numbers in parentheses refer to COM2 port.

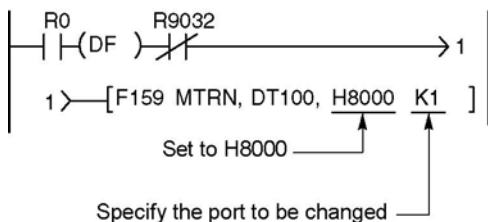
Changing communication mode of COM port

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

Changing from “general-purpose” to “computer link”



Changing from “computer link” to “general-purpose”



The RS232C port selection flag in R9032 or R9042 turns on when general-purpose serial communication mode is selected.



Note:

- When the power is turned on, the operating mode selected in system register no. 412 takes effect.

7.5.3 Connection with 1:1 Communication (General-purpose serial communication)

System register settings

Settings for COM1 port (AFPG801, AFPG802)

No.	Name	Set Value
No. 412	COM1 port selection of communication mode	General-purpose serial communication
No. 413	Communication format for COM1 port	Data length: 7 bits/8 bits Parity check: None/Odd/Even Stop bit: 1 bit/2 bits Terminator: CR/CR+LF/None/ETX Header: No STX/STX
No. 415	Baud rate setting for COM1 port	2400 to 115200 bps
No. 416	Starting address for receive buffer for COM1 port	DT0 to DT32764 (Initial value: DT0)
No. 417	Receive buffer capacity for COM1 port	0 to 2048 words (Initial value: 2048 words)

Settings for COM2 port (AFPG802, AFPG806)

No.	Name	Set Value
No. 412	COM2 port selection of communication mode	General-purpose serial communication
No. 414	Communication format for COM2 port	Data length: 7 bits/8 bits Parity check: None/Odd/Even Stop bit: 1 bit/2 bits Terminator: CR/CR+LF/None/ETX Header: No STX/STX
No. 415	Baud rate setting for COM2 port	2400 to 115200 bps
No. 418	Starting address for receive buffer for COM2 port	DT0 to DT32764 (Initial value: DT2048)
No. 419	Receive buffer capacity for COM2 port	0 to 2048 words (Initial value: 2048 words)

Settings for TOOL port (FPΣ 32k type only)

No.	Name	Set Value
No. 412	TOOL port selection of communication mode	General-purpose serial communication
No. 413	Communication format for TOOL port	Data length: 7 bits/8 bits Parity check: None/Odd/Even Stop bit: 1 bit/2 bits Terminator: CR/CR+LF/None/ETX Header: No STX/STX
No. 415	Baud rate setting for TOOL port	2400 to 115200 bps
No. 420	Starting address for receive buffer for TOOL port	DT0 to DT32764 (Initial value: DT0)
No. 421	Receive buffer capacity for TOOL port	0 to 2048 words (Initial value: 0 words)



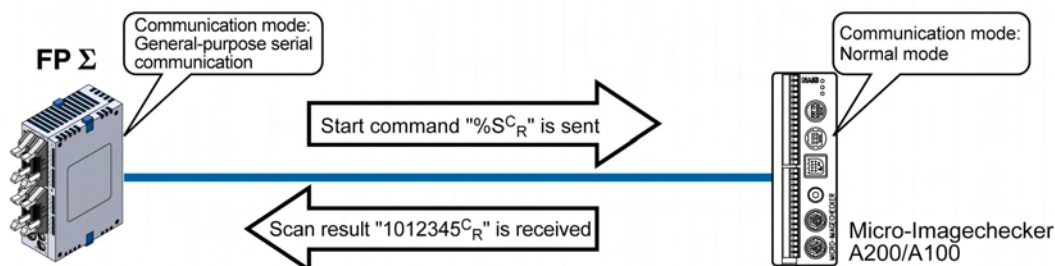
Note:

The TOOL port becomes the computer link automatically in the PROG. mode even if the general-purpose serial communication has been set. (It is always possible to communicate with the tool software such as FPWIN GR in the PROG. mode)

1:1 communication with Micro-Imagechecker

Overview

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



- After the scan start code “%S_CR” has been sent from the FPΣ side, the scan result is returned from the Micro-Imagechecker as the response.

Communication format settings for Micro-Imagechecker

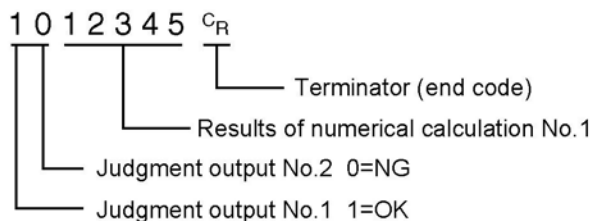
To set the communication mode and communication format settings for the Micro-Imagechecker, select “5: communication” under “5: ENVIRONMENT” on the main menu, and the set the following items.

No.	Name	Set Value
No. 51	Communication mode	Normal mode
No. 52	Serial settings	Baud rate: 9600 bps Bit length: 8 bits Stop bit: 1 bit Parity : None/Odd Flow control: None
No. 53	Serial output settings	Output digit: 5 column Invalid Digit: Repl. 0 Read End: None Process End: None Numerical calculation: Output Judgment: Output



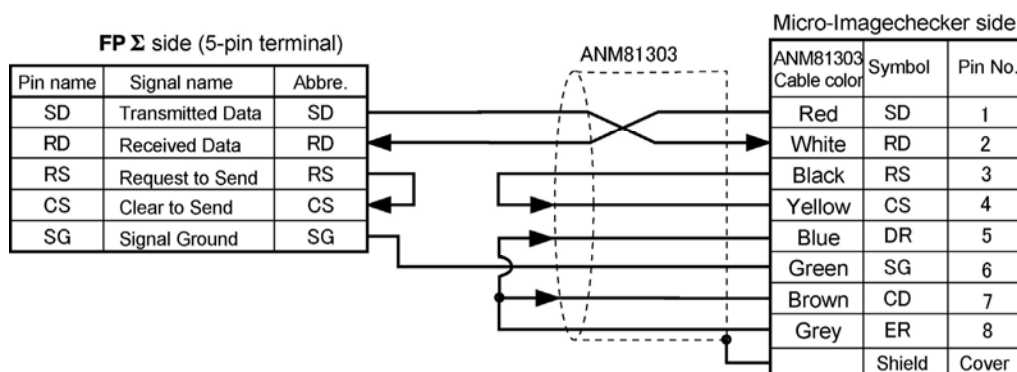
Key Point:

- 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.
- With the above settings, the following data will be output from the Micro-Imagechecker.

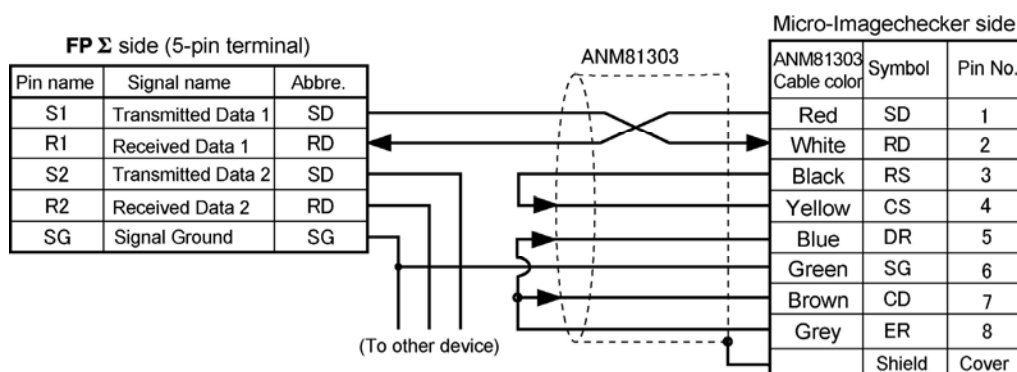


Connection to Micro-Imagechecker A200/A100

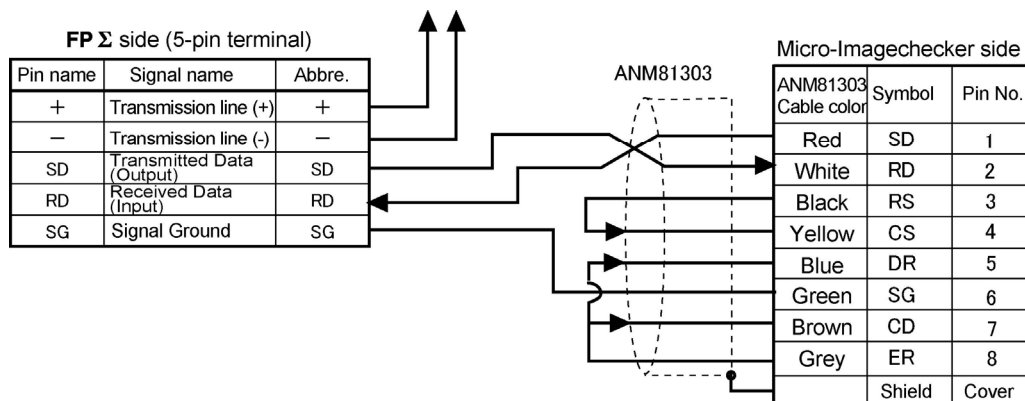
<Using AFPG801, 1-channel RS232C type communication cassette>



<Using AFPG802, 2-channel RS232C type communication cassette>

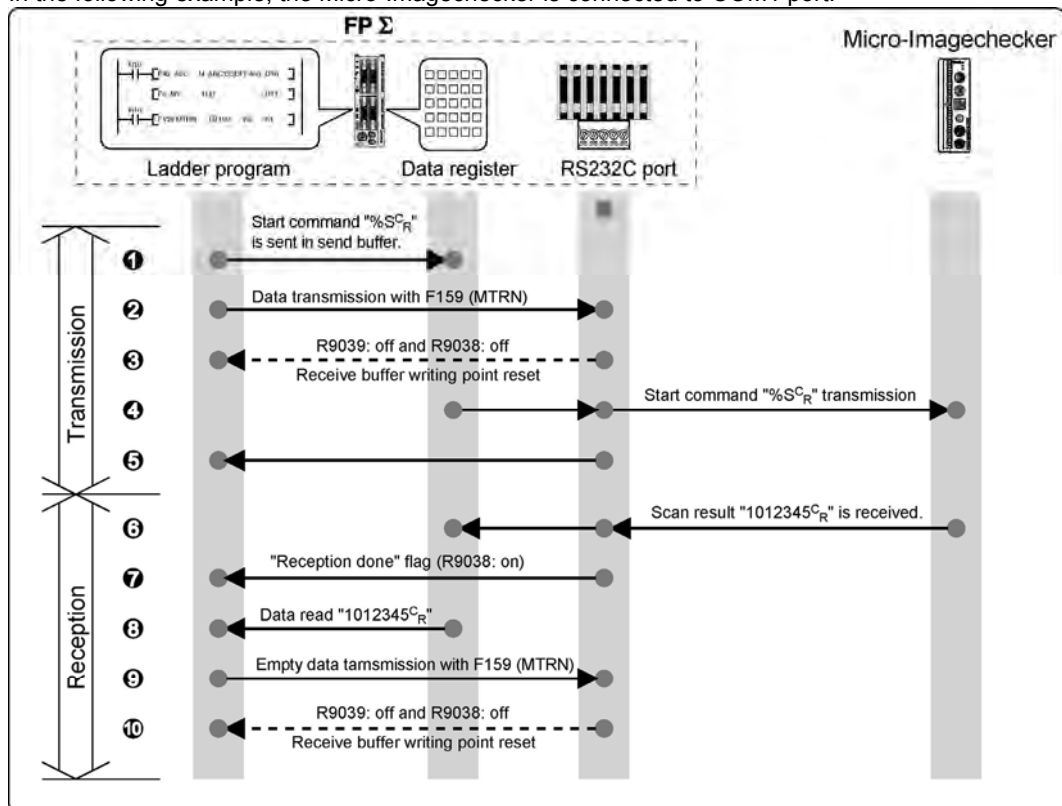


<Using AFPG806, 1-channel RS485 type and 1-channel RS232C type in combination>



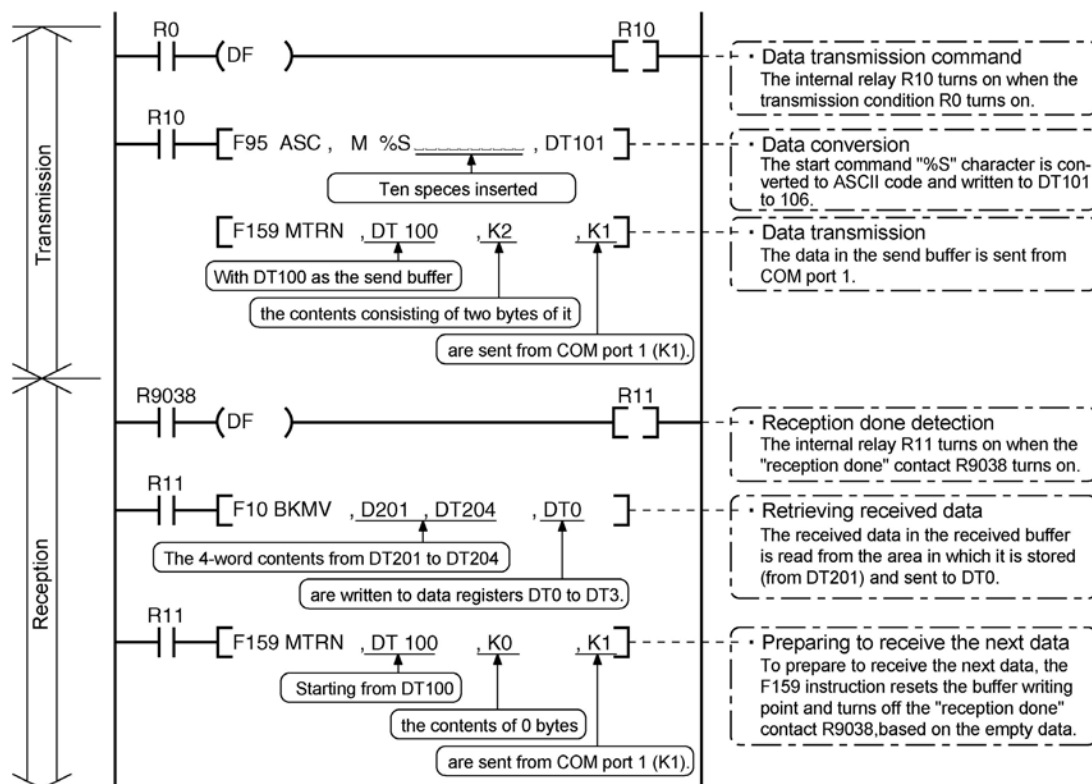
Procedure of communication

In the following example, the Micro-Imagechecker is connected to COM1 port.



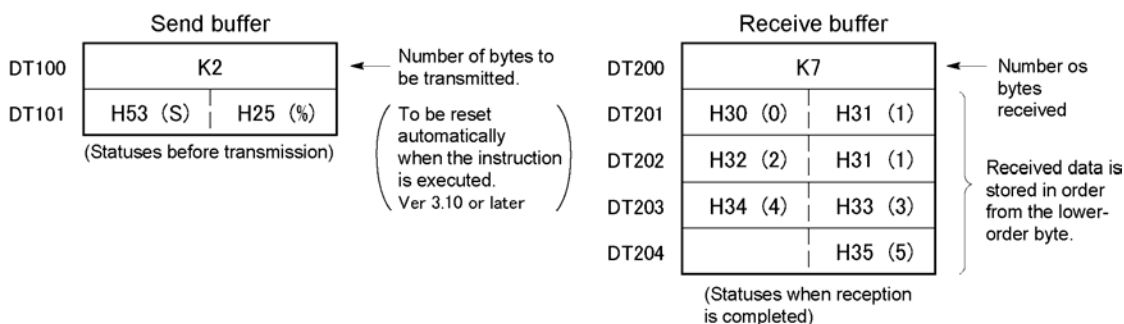
Sample program

In the following example, the Micro-Imagechecker is connected to COM1 port.



Buffer statuses

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



1:1 communication with FP Series PLC

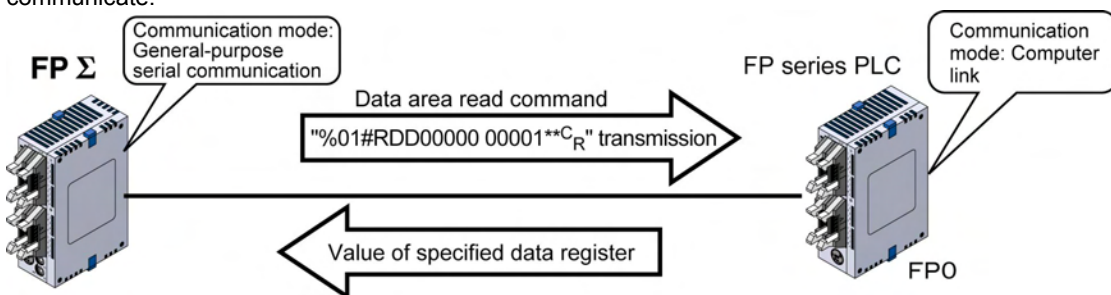
Overview

Connect the FPΣ and another FP series PLC using the RS232C interface and the MEWTOCOL-COM communication protocol.



Note:

For the FPΣ 32k type, the MEWTOCOL-COM function of computer link is recommended as it is easy to communicate.



- 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!○○**C_R" is returned (○○ is the error code).
- In addition to data area read and write commands, MEWTOCOL-COM also provides contact area read and write as well as many other commands.

System register settings of FP series PLCs (FP1, FP1 side)

In the default settings, the COM port is set not to be used. For 1:1 general-purpose serial communication, the system registers should be set as shown below.

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

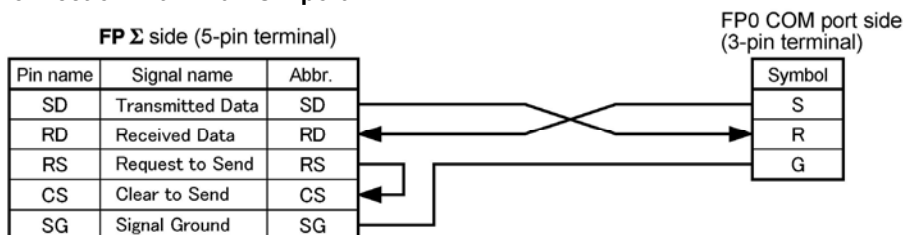
No.	Name	Set Value
No. 412	COM1 port selection of communication mode	Computer link
No. 413 *	Communication format for COM port	Data length: 8 bits Parity check: Odd Stop bit: 1 bit Terminator: CR Header: No STX
No. 414 *	Baud rate setting for COM port	19200 bps

* These settings should be the same as the settings of the connected FPΣ.

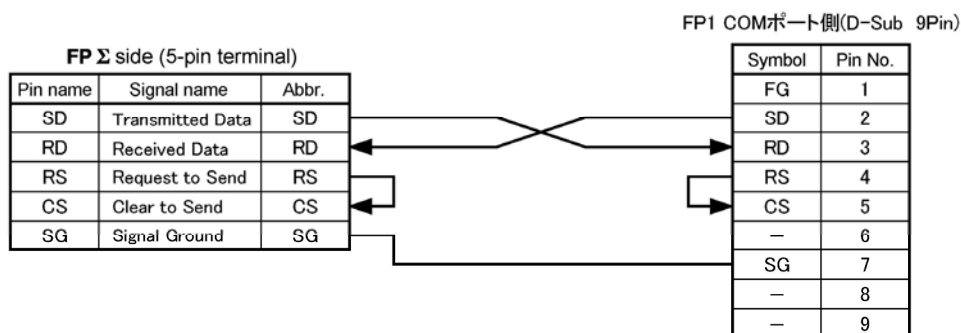
Connection to FP series PLCs (FP0, FP1)

<Using AFIG801, 1-channel RS232C type communication cassette>

- Connection with FP0 COM port

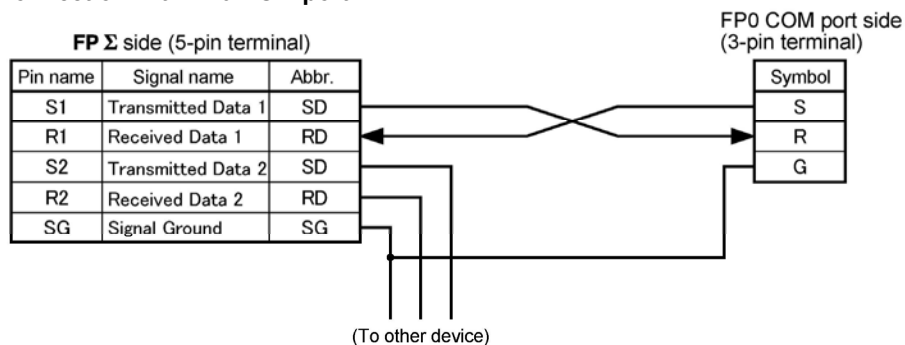


- Connection with FP1 COM port

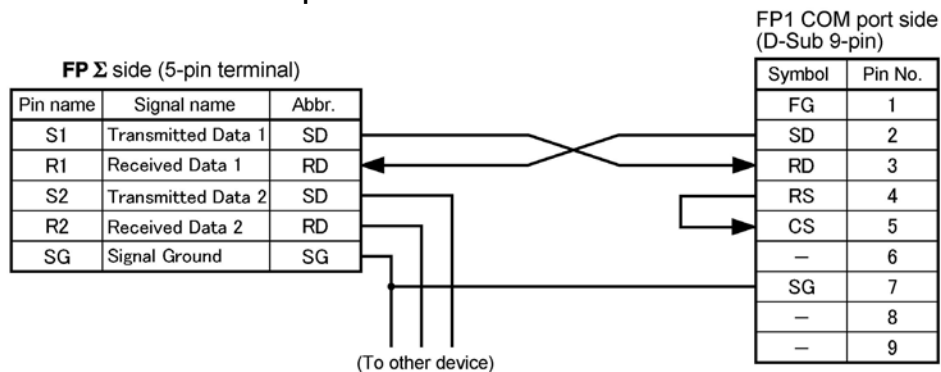


<Using AFP802, 2-channel RS232C type communication cassette>

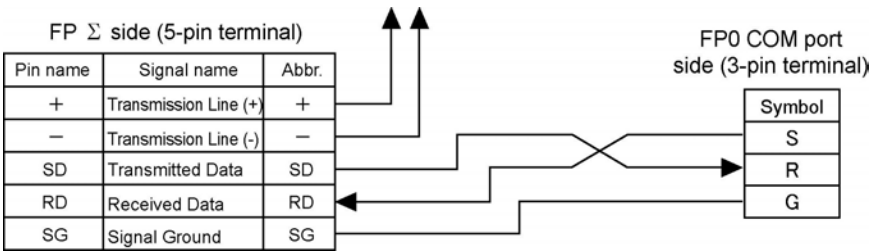
- Connection with FP0 COM port



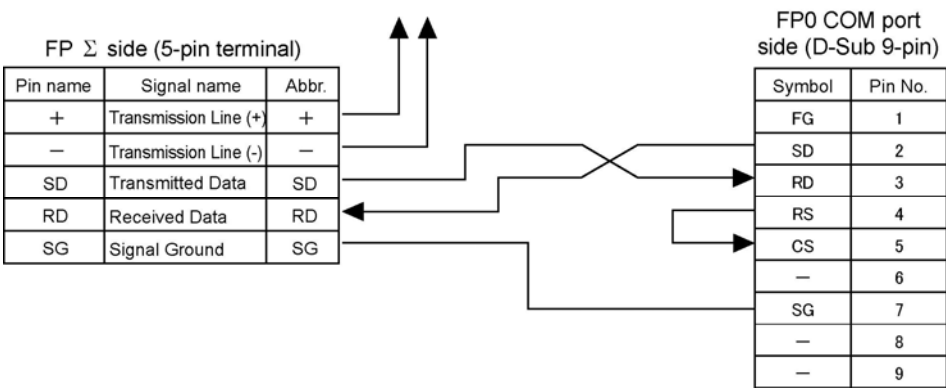
- Connection with FP1 COM port



<Using AFG806, 1-channel RS485 type and 1-channel RS232C type in combination>
 - Connection with FP0 COM port

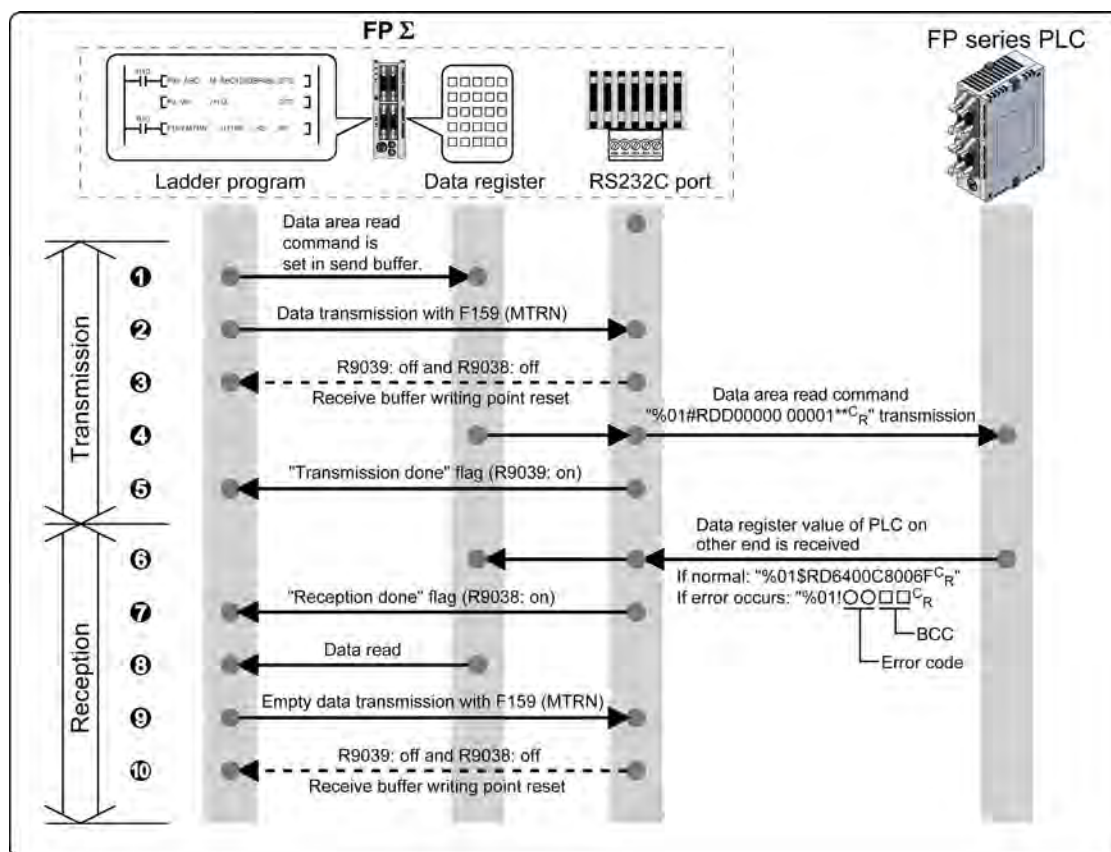


- Connection with FP1 COM port



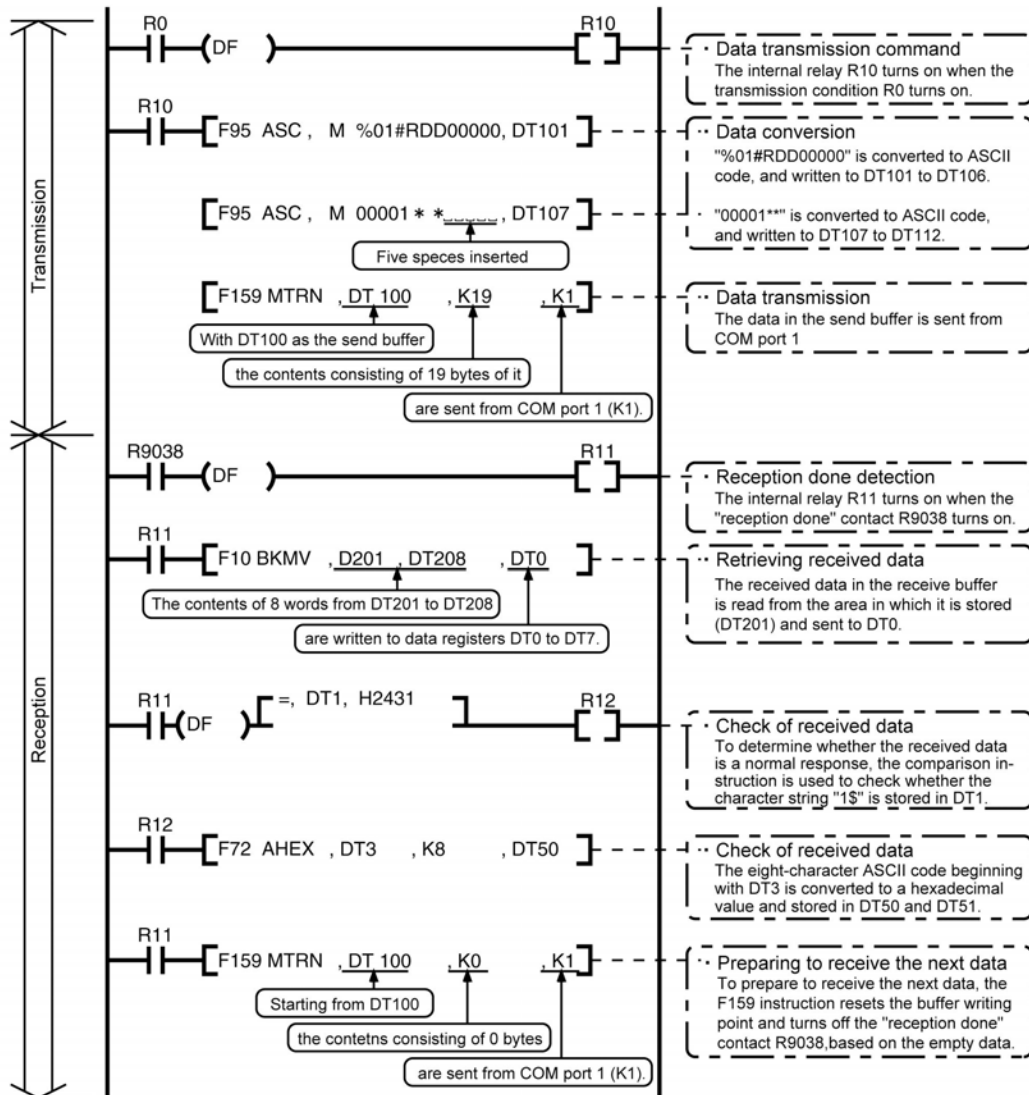
Procedure of communication

In this example, an FP series PLC is connected to COM1 port. K100 and K200 are respectively being stored in DT0 and DT1 of the PLC on the other end.



Sample program

In the following example, the FP series PLC is connected to COM1 port.



Buffer statuses

The tables below show the statuses of the send and receive buffers when the sample program is run.

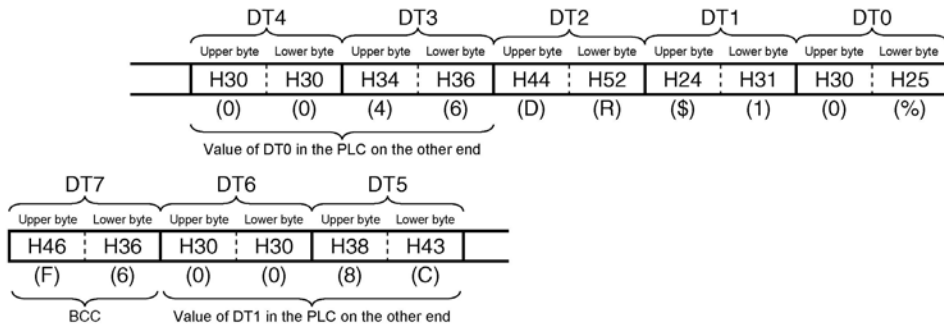
Send buffer				Receive buffer			
DT100	K19		← Number of bytes to be transmitted. (Set automatically when the instruction is executed. Ver 3.10 or later)	DT200	K16		← Number of bytes received Received data is stored in order from the lower-order byte.
DT101	H30 (0)	H25 (%)		DT201	H30 (0)	H25 (%)	
DT102	H23 (#)	H31 (1)		DT202	H24 (\$)	H31 (1)	
DT103	H44 (D)	H52 (R)		DT203	H44 (D)	H52 (R)	
DT104	H30 (0)	H44 (D)		DT204	H34 (4)	H36 (6)	
DT105	H30 (0)	H30 (0)		DT205	H30 (0)	H30 (0)	
DT106	H30 (0)	H30 (0)		DT206	H38 (8)	H43 (C)	
DT107	H30 (0)	H30 (0)		DT207	H30 (0)	H30 (0)	
DT108	H30 (0)	H30 (0)		DT208	H46 (F)	H36 (6)	
DT109	H2A (*)	H31 (1)		(Statuses when reception is completed)			
DT110		H2A (*)					
(Statuses before transmission)							



Key Point:

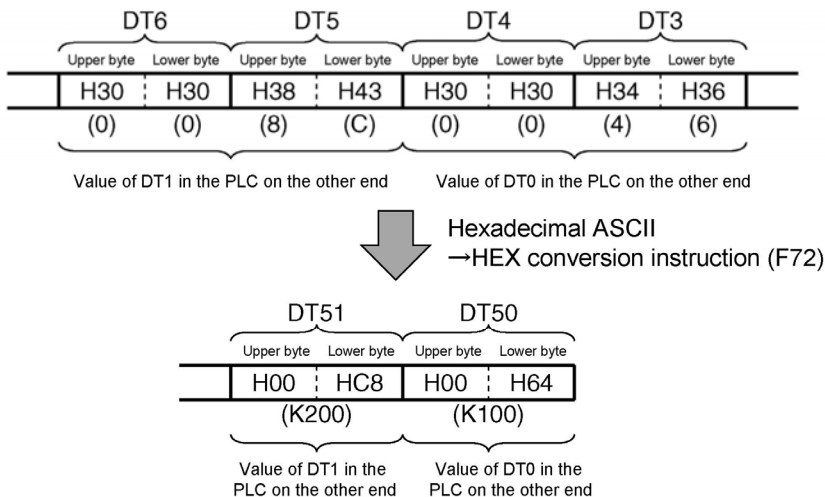
Contents of the response:

If K100 is stored in DT0 and K200 is stored in DT1 of the FP series PLC on the other end, “%01\$RD6400C8006FC_R” is returned from the FP series PLC on the other end 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 end

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



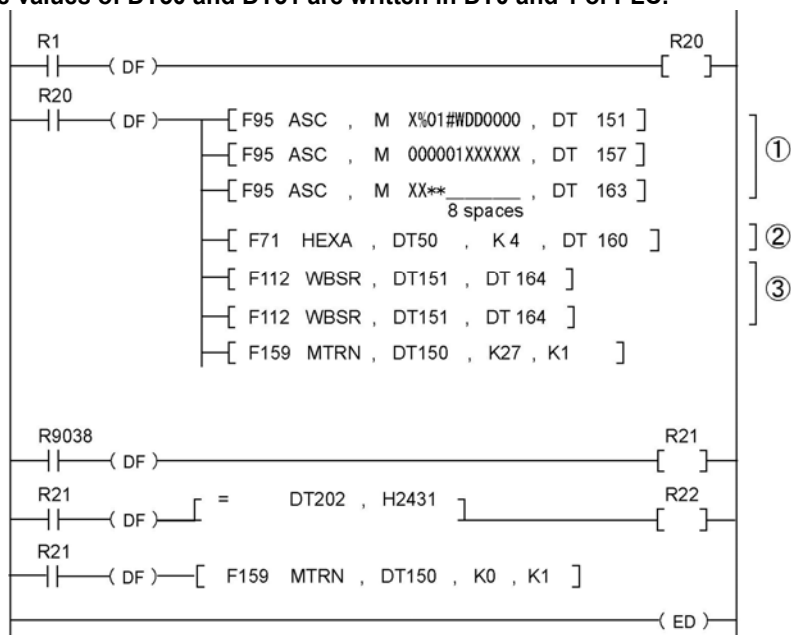
If an error occurs, “%01!○○□□_C_R” is returned as the response (○○ is the error code and □□ is the BCC).



Note:

For the FPΣ 32k type, the MEWTOCOL-COM function of computer link is recommended as it is easy to communicate.

The values of DT50 and DT51 are written in DT0 and 1 of PLC.



- ① Shifted for 1 byte to execute the HEX→ASCII conversion instruction (F71) easily.

DT151	%	X
DT152	1	0
DT153	W	#
DT154	D	D
DT155	0	0
DT156	0	0
DT157	0	0
DT158	0	0
DT159	1	0
DT160	X	X
DT161	X	X
DT162	X	X
DT163	X	X
DT164	*	*

③
F112 instruction
Shift to right for
2 digits

DT151	0	%
DT152	#	1
DT153	D	W
DT154	0	D
DT155	0	0
DT156	0	0
DT157	0	0
DT158	0	0
DT159	6	1
DT160	0	4
DT161	C	0
DT162	0	8
DT163	*	0
DT164		*

Note) When K100(H0064)
is in DT50 and K200
(H00C8) is in DT51

Normal response %01\$WD C_R
 └ BCC

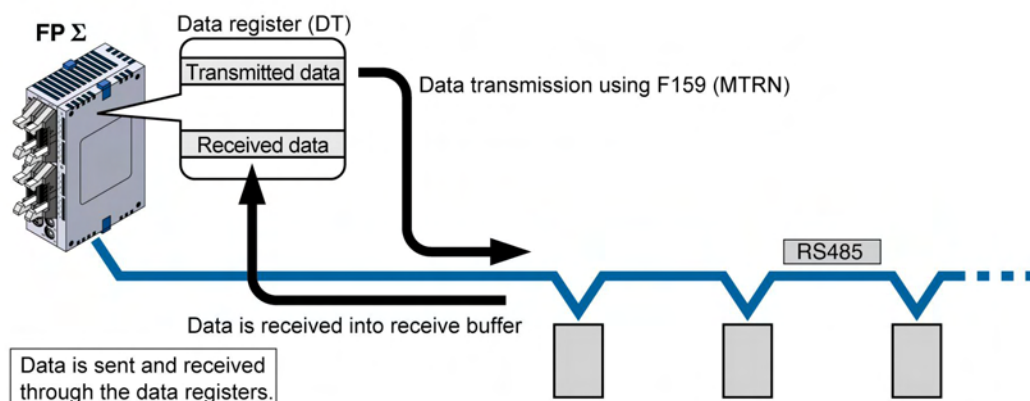
Abnormal response %01 ! ○○□□^C_R

└──┬─┘ BCC
 └─┘ Error code

7.5.4 1:N Communication (General-purpose Serial Communication)

Overview

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



When data has been sent from FPΣ via the RS485 communication of AFPG806, start sending data to FPΣ side after the time mentioned below passed at the receiver.

In case of 19200 bit/s: 1 ms In case of 115200 bit/s: 200μs



Reference: <7.2.1 Precaution When Using RS485 Port>

System register settings

- In the default settings, the COM port is set to computer link mode.

Settings for COM1 port

No.	Name	Set Value
No. 412	COM1 port selection of communication mode	General-purpose serial communication
No. 413	Communication format for COM1 port	Data length: 7 bits/8 bits Parity check: None/Odd/Even Stop bit: 1 bit/2 bits Terminator: CR/CR+LF/None/ETX Header: No STX/STX
No. 415	Baud rate setting for COM1 port	2400 to 115200 bps
No. 416	Starting address for receive buffer for COM1 port	DT0 to DT32764 (Initial value: DT0)
No. 417	Receive buffer capacity for COM1 port	0 to 2048 words (Initial value: 2048 words)

Note1) The communication format and baud rate should be set to match the connected devices.

Note2) The RS485 port of the AFPG806 is either 19200 bps or 115200 bps only.

Also the baud rate (communication speed) must be identically set by the system register and the dip switch in the communication cassette.



Reference: <7.1.4 Setting of AFPG806 Switch>

Note3) Connect the “-” terminal and the “E” terminal with a lead wire to make the termination resistance of the AFPG803 effective.

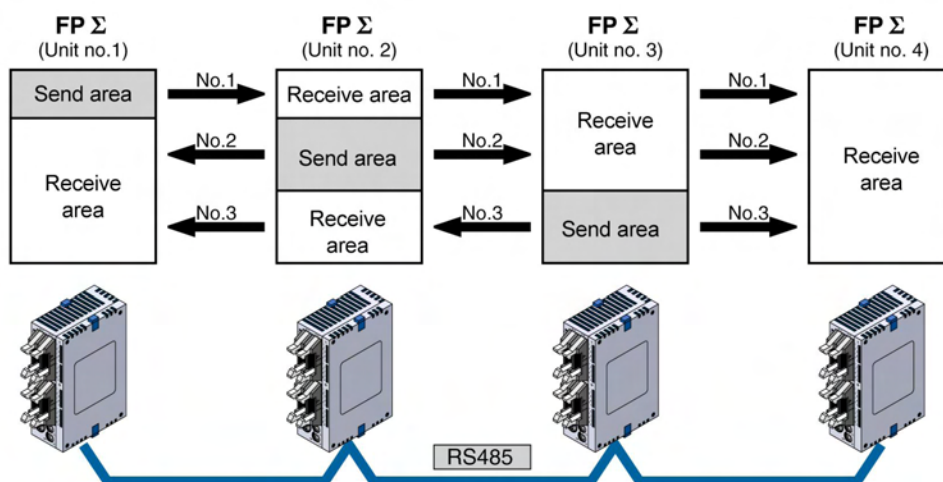
The termination resistance of the AFPG806 is specified by the dip switch located in the communication cassette.

7.6 Communication Function 3: PC(PLC) link

7.6.1 PC(PLC) link

Overview

- The PC(PLC) link is an economic way of linking PLCs, using a twisted-pair cable.
- Data is shared between the PLCs using link relays (L) and link registers (LD).
- The statuses of the link relays and link registers of one PLC are automatically fed back to the other PLCs on the same network.
- PC(PLC) link is not the default setting. Therefore, the setting of system register no. 412 must be changed to "PC(PLC) link" in order to use this function.
- Unit numbers and link areas are allocated using the system registers.



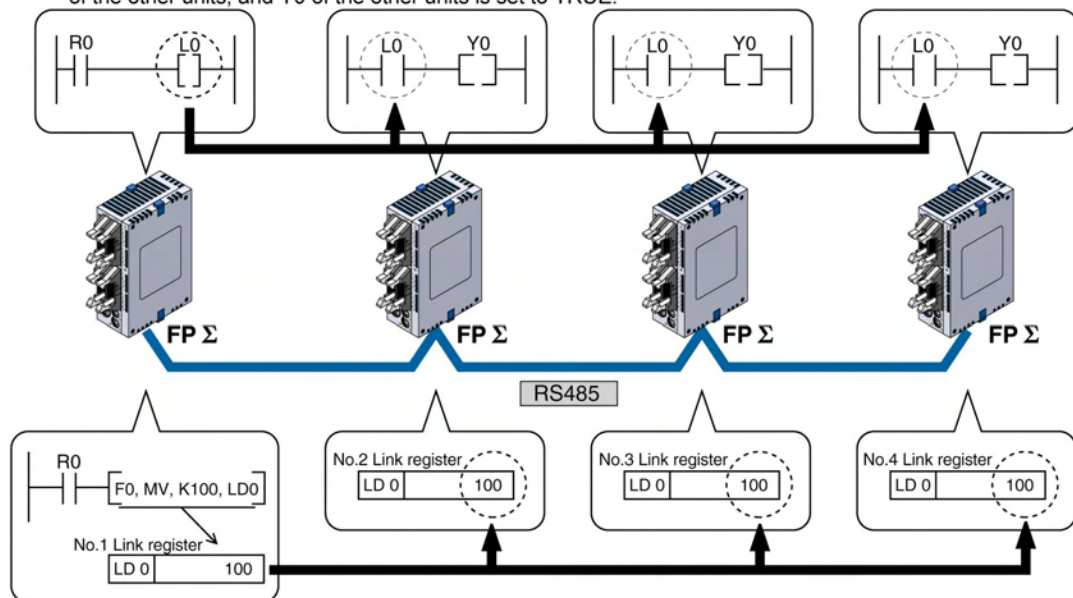
The link relays and link registers of the PLCs contain areas for sending and areas for receiving data. These areas are used to share data among the PLCs.

Operation of PC(PLC) link

- Turning on a link relay contact in one PLC turns on the same link relay in all other PLCs on the same network.
- Likewise, if the contents of a link register in one PLC are changed, the values of the same link register are changed in all PLCs on the same network.

●Link relay

Link relay L0 for unit no. 1 is turned on. The status change is fed back to the programs of the other units, and Y0 of the other units is set to TRUE.



●Link register

A constant of 100 is written to link register LD0 of unit no. 1.

The contents of LD0 in the other units are also changed to a constant of 100.

7.6.2 Setting Communication Parameters

Setting of communication mode

In the default settings, the COM port is set to computer link mode.

Set the communication mode using the FPWIN GR programming tool. Select “PLC Configuration” under “Options”, and then select “COM1 port” tab. (The PC(PLC) link is available for COM1 port only.)

Dialog box of PLC system register setting

PLC Configuration - Untitled1

Hold/Non-hold 1 Hold/Non-hold 2 Action on Error Time Link

High Speed Counter Interrupt Input Tool Port COM1 Port COM2 Port

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 Baudrate: 115200 bps


No.416 Starting address for data received of serial data communication mode: 0 (0 - 32768)

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

OK Cancel Read PLC Initialize Help

No. 412 Communication Mode

Select the COM port operation mode:

Click on , and select “PC Link”.



Key Point:

- When using a PC(PLC) link, the communication format and baud rate are fixed:

No.	Name	Set Value
No. 413	Communication format for COM1 port	Data length: 8 bits Parity check: Odd Stop bit: 1 bit Terminator: CR Header: No STX
No. 415	Baud rate setting for COM1 port	115200 bps

Note1) Connect the “-” terminal and the “E” terminal with a lead wire to make the termination resistance of the AFG803 effective.

The termination resistance of the AFG806 is specified by the dip switch located in the communication cassette.

Note2) The baud rate of the AFG806 must be identically set to 115200 bps by the system register and the dip switch located in the communication cassette.

Setting of unit numbers

By default, the unit number for the communication port is set to 1 in the system registers.

In a PC(PLC) link that connects multiple PLCs on the same transmission line, the unit number must be set in order to identify the different PLCs.

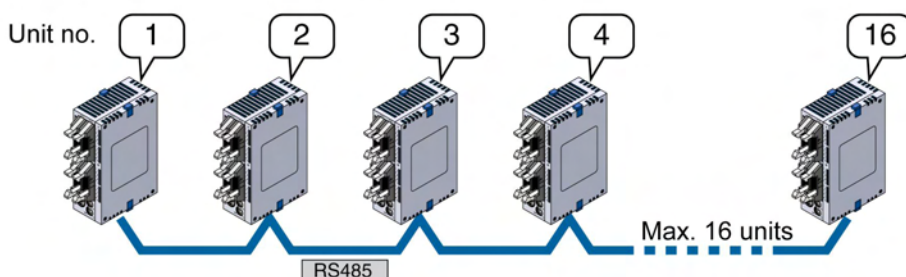
The unit number is specified either by using **the unit number setting switch, SYS1 instruction or the system register**.

Note1) The priority order for station number settings is as follows:

1. Unit number settings switch
2. SYS1 instruction
3. System registers

Note2) 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 longer.

Note3) If fewer than 16 units are linked, the transmission time can be shortened by setting the largest station number in system register no. 47.



Unit numbers are the numbers to identify the different PLCs on the same network. The same number must not be used for more than one PLC on the same network.

If unit number setting switch is 0, SYS1 instruction and the system register is valid.

If unit number setting switch is a number other than 0, the unit number setting switch is valid, and the unit number setting with the system register is ignored. The same unit number is given to both COM1 port and COM2 port.



Note:

When using the PC(PLC) link with the RS232C, the number of units is 2.

Setting unit numbers with the setting switch

The unit number setting switch is located underneath the cover on the leftside 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. (With the RS232C, a maximum of 2 unit number can be set.

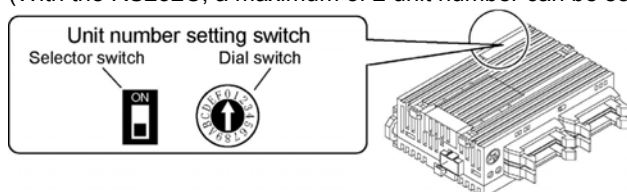


Table of switch settings and related unit numbers

Unit No.	Selector switch	Dial switch	Unit No.	Selector switch	Dial switch
※	OFF	0	16	ON	0
01	OFF	1	17	Not available	
02	OFF	2	18		
03	OFF	3	19		
04	OFF	4	20		
05	OFF	5	21		
06	OFF	6	22		
07	OFF	7	23		
08	OFF	8	24		
09	OFF	9	25		
10	OFF	A	26		
11	OFF	B	27		
12	OFF	C	28		
13	OFF	D	29		
14	OFF	E	30		
15	OFF	F	31		

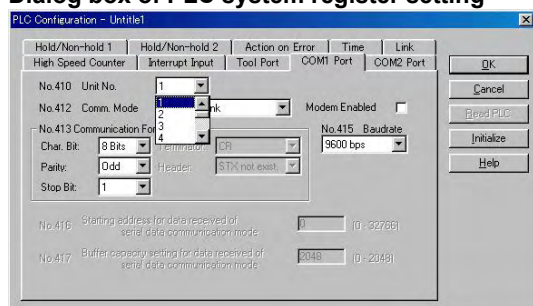
- The numbers in a range of 1 to 16 can be set using the unit number setting switch. With the RS232C, set it to 1 or 2.
- Set the unit number setting switch to 0 to make the system register setting valid. (Individual settings are possible using the system register setting.)

Setting with the system register

Setting the unit number setting switch to 0 makes the system register settings valid.

Set the unit numbers using the FPCWIN GR programming tool. Select “PLC Configuration” under “Options”, and then select “COM1 port” tab.

Dialog box of PLC system register setting



No. 410 (for COM1 port) Unit number setting

Select the COM port operation mode:

Click on and select a unit number between 1 and 16.

Note1) 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 longer.

Note2) If fewer than 16 units are linked, the transmission time can be shortened by setting the largest station number in system register no. 47.

Setting with SYS instruction

Setting the unit number setting switch to 0 makes the SYS instruction settings valid.



Reference: <FP series Programming Manual ARCT1F353>.

Link area allocation

- The link relays and link registers to be used in the PC(PLC) link are allocated in the link area of the CPU unit. Link area allocations are specified by setting the system registers of the CPU unit.



Note:

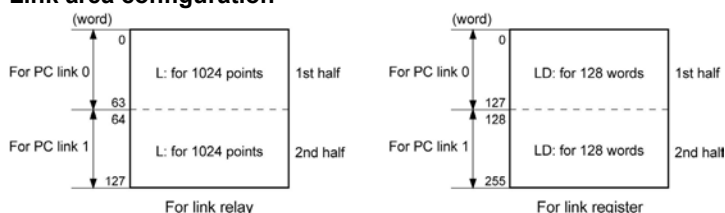
The PC(PLC) link 1 is available for the FPΣ 32k type only.
Set the system register 46 to "Reverse" to use the PC(PLC) link 1.

System registers

No.	Name	Default value	Set value
For PC (PLC) link 0	40	Range of link relays used for PC(PLC) link	0
	41	Range of link data registers used for PC(PLC) link	0
	42	Starting number for link relay transmission	0
	43	Link relay transmission size	0
	44	Starting number for link data register transmission	0
	45	Link data register transmission size	0
	46	PC(PLC) link switch flag	Normal
For PC (PLC) link 1	47	Maximum unit number setting for MEWNET-W0 PC(PLC) link	16
	46	PC(PLC) link switch flag	Normal
	50	Range of link relays used for PC(PLC) link	0
	51	Range of link data registers used for PC(PLC) link	0
	52	Starting number for link relay transmission	64
	53	Link relay transmission size	0
	54	Starting number for link data register transmission	128
	55	Link data register transmission size	0
	57	Maximum unit number setting for MEWNET-W0 PC(PLC) link	0

Note1) The same maximum unit number should be specified for all the PLCs connected in the PC(PLC) link.

Link area configuration



- Link areas consist of link relays and link registers, and are divided into areas for PC(PLC) link 0 and PC(PLC) link 1 and used with those units.
- The link relay which can be used in an area for either PC(PLC) link 0 or PC(PLC) link 1 is maximum 1024 points (64 words), and the link register is maximum 128 words.



Note:

The PC link 1 can be used to connect with the second PC link W0 of the FP2 Multi Communication Unit (MCU). At that time, the link relay number and link register number for the PC link can be the same values as the FP2 (from WL64, from LD128).



Reference:

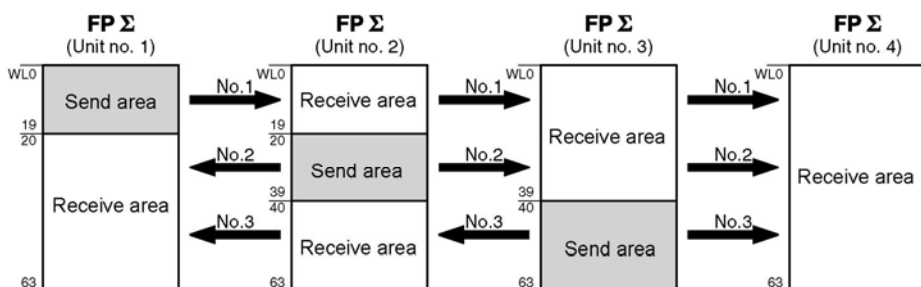
For the information on FP2-MCU, <Chapter 5 Communication Function PC(PLC) Link in FP2 Multi Communication Unit Technical Manual ARCT1F396E>.

[Example]

The PC(PLC) link areas are divided into send and receive areas. The link relays and link registers are transmitted from the send area to the receive area of a different FPΣ. The link relays and registers in the receive area on the receiving side must be within the same area as on the sending side.

For PC(PLC) link 0

Link relay allocation

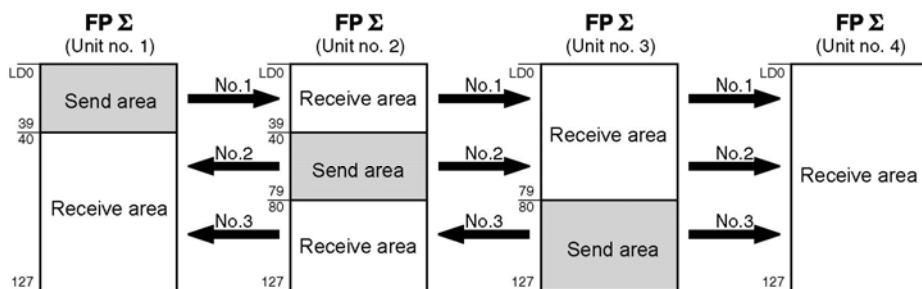


System registers

No.	Name	Set value of various control units			
		No. 1	No. 2	No. 3	No. 4
No. 40	Range of link relays used for PC(PLC) link	64	64	64	64
No. 42	Start address of link relay send area	0	20	40	0
No. 43	Size of link relay send area	20	20	24	0

Note) No. 40 (range of link relays) must be set to the same range for all the units.

System register allocation



System registers

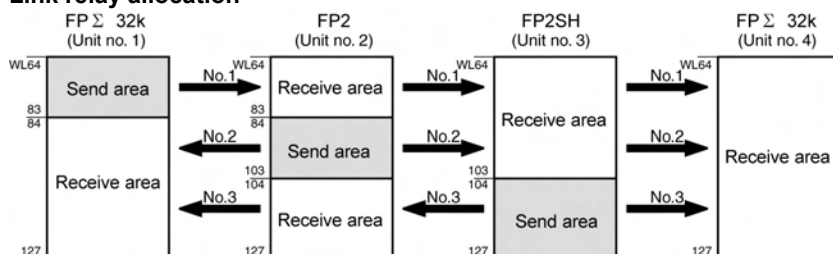
No.	Name	Set value of various control units			
		No. 1	No. 2	No. 3	No. 4
No. 41	Range of link registers used for PC(PLC) link	128	128	128	128
No. 44	Start address of link register send area	0	40	80	0
No. 45	Size of link register send area	40	40	48	0

Note) No. 41 (range of link registers) must be set to the same range for all the units.

When link areas are allocated as shown above, the send area of unit no. 1 can be transmitted to the receive areas of units no. 2, 3 and 4. Also, the receive area of unit no. 1 can receive data from the send areas of units no. 2 and 3. Unit no. 4 is allocated as a receive area only and can receive data from units no. 1, 2 and 3, but cannot send data to other units.

For PC(PLC) link 1 (For FPΣ 32k type only)

Link relay allocation

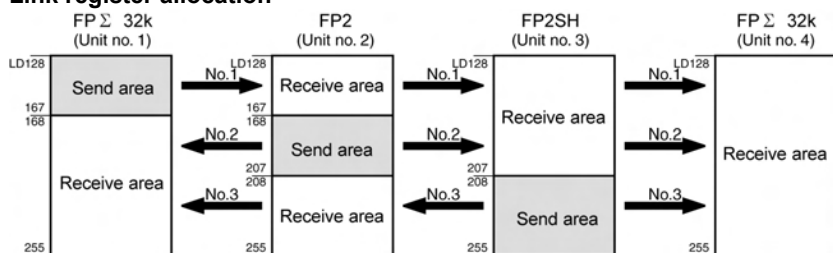


System registers

No.	Name	Setting for various units			
		No. 1	No. 2	No. 3	No. 4
50	Range of link relays used	64	64	64	64
52	Starting No. of word for link relay transmission	64	84	104	64
53	Link relay transmission size	20	20	24	0

Note) No. 50 (range of link relays used) must be set to the same range for all the units.

Link register allocation



System registers

No.	Name	Setting for various units			
		No. 1	No. 2	No. 3	No. 4
51	Range of link registers used	128	128	128	128
54	Starting No. for link register transmission	128	128	208	128
55	Link register transmission size	40	40	48	0

Note) No. 51 (range of link registers used) must be set to the same range for all the units.

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



Note:

The PC link 1 can be used to connect with the second PC link W0 of the FP2 Multi Communication Unit (MCU). At that time, the link relay number and link register number for the PC link can be the same values as the FP2 (from WL64, from LD128).

Set the system register 46 to "Reverse" to use the PC(PLC) link 1(the second half of link relays and link registers).



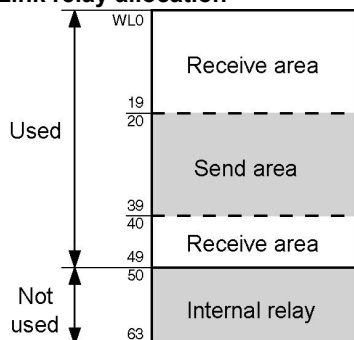
Reference:

For the information on FP2-MCU, <Chapter 5 Communication Function PC(PLC) Link in FP2 Multi Communication Unit Technical Manual ARCT1F396E>.

Partial use of link areas

In the link areas available for PC(PLC) link, link relays with a total of 1024 points (64 words) and link registers with a total of 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.

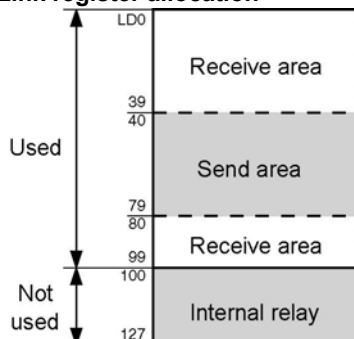
Link relay allocation



No.	Name	No.
No. 40	Range of link relays used for PC(PLC) link	50
No. 42	Start address of link relay send area	20
No. 43	Size of link relay send area	20

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

Link register allocation



No.	Name	No.
No. 41	Range of link registers used for PC(PLC) link	100
No. 44	Start address of link register send area	40
No. 45	Size of link register send area	40

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



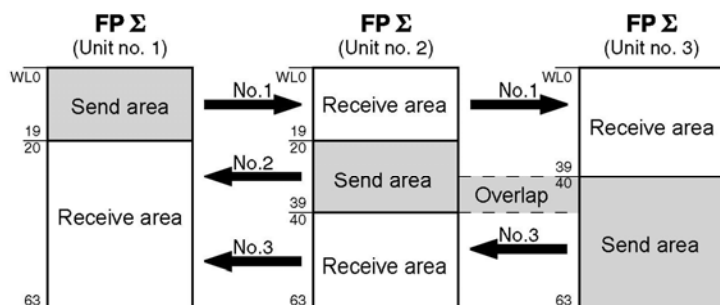
Note: Precautions for link area allocation

A mistake in the link area allocation will cause an error, and communication will be disabled.

Avoid overlapping send areas

When sending data from the send area to receive area of another FPΣ, send and receive areas must match. In the example shown below, there is an overlapping area between units no. 2 and 3, and this will cause an error, so that communication cannot be carried out.

Link relay allocation



System registers

No.	Name	Set value of various control units		
		No. 1	No. 2	No. 3
No. 40	Range of link relays used for PC(PLC) link	64	64	64
No. 42	Start address of link relay send area	0	20	30
No. 43	Size of link relay send area	20	20	34

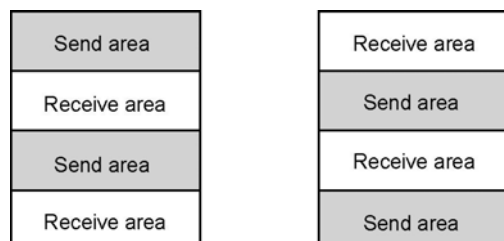
Invalid allocations

The allocations shown below are not possible, neither for link relays nor for link registers:

- Send area is split



- Send and receive areas are split into multiple segments



Setting the largest unit number for a PC(PLC) link

The largest unit number can be set using system register no. 47 (using system register no. 57 for PC(PLC) link 1 (for FPΣ 32k type only)).

[Sample setting]

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



Note:

- Unit numbers should be set sequentially and consecutively, starting from 1, with no breaks between them. If there is a missing unit number, the transmission time will be longer.
- For all PLCs which are linked, the same value should be set for the largest unit number.
- If there are fewer than 16 units linked and the largest unit number has not been set (default=16), or the largest unit number has been set but the unit number settings are not consecutive, or the unit number settings are consecutive but there is a unit for which the power supply has not been turned on, the response time for the PC(PLC) link (the link transmission cycle) will be longer.



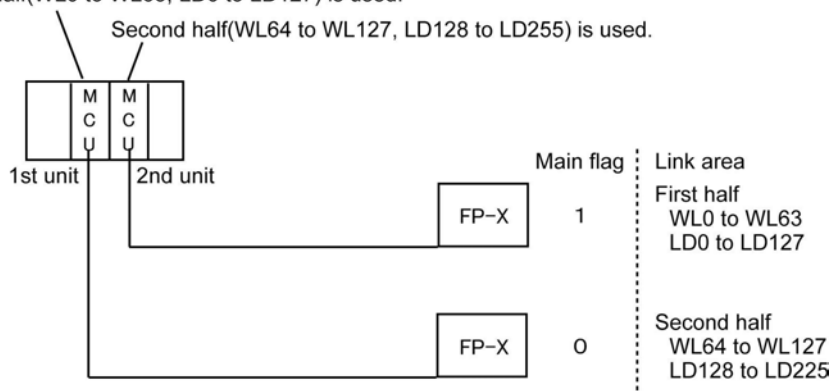
Reference: <7.6.5 PC(PLC) Link Response Time>.

Setting PC(PLC) link switching flag (For FPΣ 32k type only)

PC(PLC) link switching flag can be set using system register no. 46.

If it is set to 0 (default value), the first half of the link relays and registers are used. If it is set to 1, the second half of the link relays and registers are used.

First half(WL0 to WL63, LD0 to LD127) is used.



7.6.3 Monitoring

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

Transmission assurance relays

For PC(PLC) link 0: R9060 to R906F (correspond to unit no. 1 to 16)

For PC(PLC) link 1: R9070 to R907F (correspond to unit no. 1 to 16) (For FPΣ 32k type only)

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

Relay no.	R9060	R9061	R9062	R9063	R9064	R9065	R9066	R9067	R9068	R9069	R906A	R906B	R906C	R906D	R906E	R906F
Unit 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 relays

For PC(PLC) link 0: R9070 to R907F (correspond to unit no. 1 to 16)

For PC(PLC) link 1: R9080 to R908F (correspond to unit no. 1 to 16) (For FPΣ 32k type only)

The operation modes (RUN/PROG.) can be checked for any given PLC.

Relay no.	R9070	R9071	R9072	R9073	R9074	R9075	R9076	R9077	R9078	R9079	R907A	R907B	R907C	R907D	R907E	R907F
Unit 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															

PC(PLC) link transmission error relay R9050

This relay goes on if a problem is detected during transmission.

Relay no.	R9050															
Unit 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 the unit is in the PROG. mode															



Key Point: Monitoring the PC(PLC) link status

In FPCWIN GR, the PC(PLC) link status items, such as the transmission cycle time and the number of times that errors have occurred, can be monitored by selecting the PC(PLC) link switch on the FPCWIN GR Status Monitor screen.



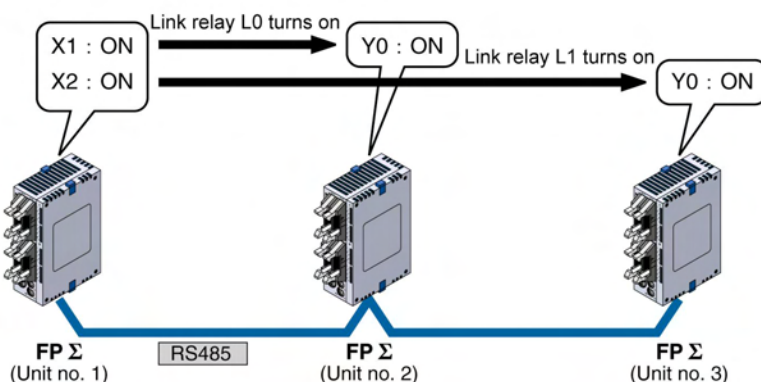
Note:

Remote programming of the linked PLCs is not possible.

7.6.4 Connection Example of PC(PLC) link

When using three PLCs

The following example demonstrates how the PLC can be connected to two other FPΣ PLCs using a PC(PLC) link connection. In the example shown here, link relays are used. When X1 of control unit no. 1 turns on, Y1 of unit no. 2 turns on. When X2 of unit no. 1 turns on, Y1 of unit no. 3 turns on.



System register settings

When using a PC(PLC) link, the communication format and baud rate are fixed.

No.	Name	Set Value
No. 413	Communication format for COM1 port	Data length: 8 bits Parity check: Odd Stop bit: 1 bit Terminator: CR Header: No STX
No. 415	Baud rate setting for COM1 port	115200 bps

Note) The baud rate of the AFPG806 must be identically set to 115200 bps by the system register and the dip switch located in the communication cassette.



Reference: <7.1.4 Setting of AFPG806 Switch>.

Unit no. and communication mode settings

- Setting for unit no. 1

No.	Name	Set value
No. 410	COM1 port unit no.	1
No. 412	COM1 port selection of communication mode	PC(PLC) link

- Setting for unit no. 2

No.	Name	Set value
No. 410	COM1 port unit no.	2
No. 412	COM1 port selection of communication mode	PC(PLC) link

- Setting for unit no. 3

No.	Name	Set value
No. 410	COM1 port unit no.	3
No. 412	COM1 port selection of communication mode	PC(PLC) link

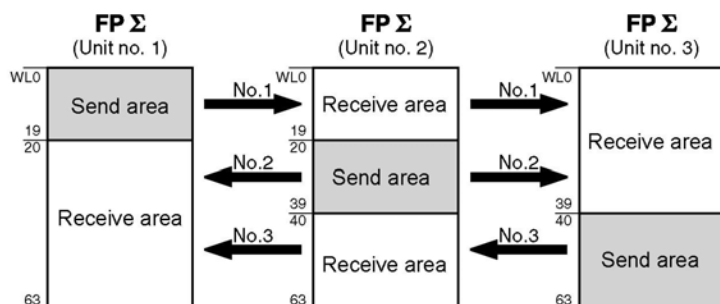


Key Point:

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

Link area allocation

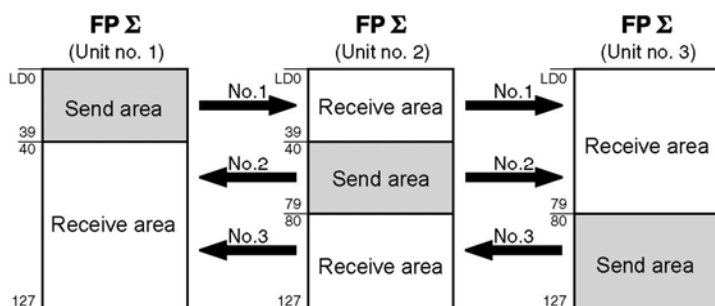
- Link relay allocation



System registers

No.	Name	Set value of various control units		
		No. 1	No. 2	No. 3
No. 40	Range of link relays used for PC(PLC) link	64	64	64
No. 42	Start address of link relay send area	0	20	40
No. 43	Size of link relay send area	20	20	24

- Link register allocation



System registers

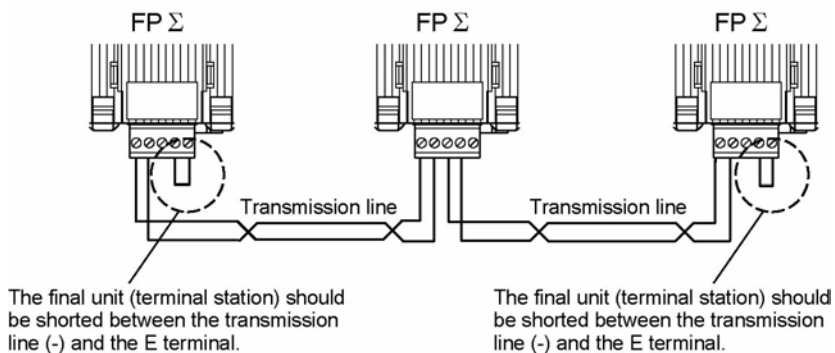
No.	Name	Set value of various control units		
		No. 1	No. 2	No. 3
No. 41	Range of link registers used for PC(PLC) link	128	128	128
No. 44	Start address of link register send area	0	40	80
No. 45	Size of link register send area	40	40	48

Setting the largest unit number

No.	Name	Set value
No. 47	Largest unit number setting for PC(PLC) link	3

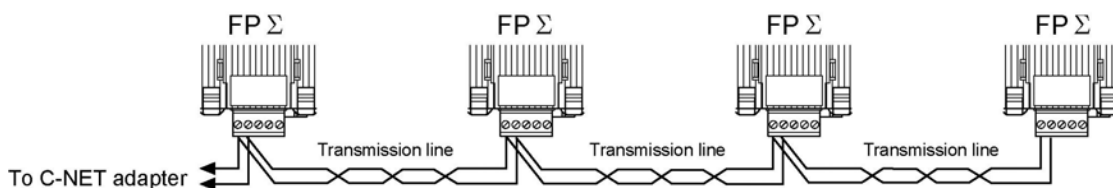
Connection diagram

<AFPG803>



<AFPG806>

In case of using the AFPG806, connect two cables each to the (+) terminal and (-) terminal. Use the wires of the same cross-sectional area which should be 0.5 to 0.75 mm². The terminal station is specified with the dip switch located in the communication cassette.

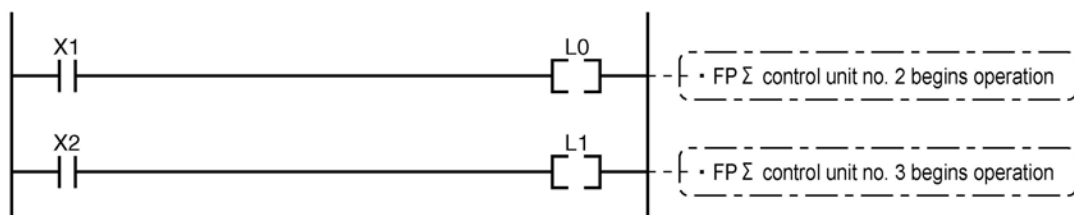


Reference: <7.1.4 Setting of AFPG806 Switch>.

Sample program

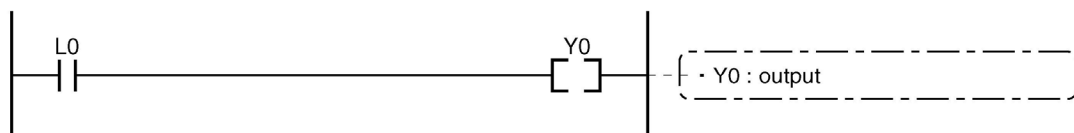
- Unit no. 1

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



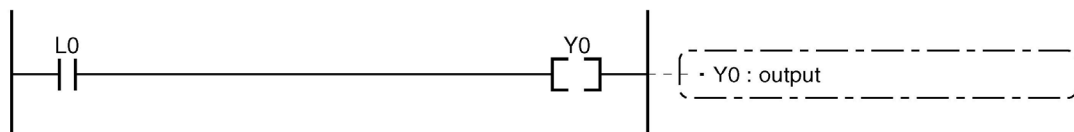
- Unit no. 2

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



- Unit no. 3

When L1 of the link relay goes on, Y1 is output.



7.6.5 PC(PLC) link Response Time

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

$$T_{\max} = \underbrace{Ts_1 + Ts_2 + \dots + Ts_n}_{\text{① } Ts \text{ (transmission time per station)}} + \underbrace{Tlt}_{\text{② } Tlt \text{ (link table sending time)}} + \underbrace{Tso}_{\text{③ } Tso \text{ (master station scan time)}} + \underbrace{Tlk}_{\text{④ } Tlk \text{ (link addition processing time)}}$$

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

① Ts (transmission time per station)

$Ts = \text{scan time} + Tpc \text{ (PC(PLC) link sending time)}$

$Tpc = Ttx \text{ (sending time per byte)} \times Pcm \text{ (PC(PLC) link sending size)}$

$Ttx = 1/(\text{baud rate} \times 1000) \times 11 \text{ ms} \dots \text{Approx. } 0.096 \text{ ms at } 115.2 \text{ kbps}$

$Pcm = 23 + (\text{number of relay words} + \text{number of register words}) \times 4$

② Tlt (link table sending time)

$Tlt = Ttx \text{ (sending time per byte)} \times Ltm \text{ (link table sending size)}$

$Ttx = 1/(\text{baud rate} \times 1000) \times 11 \text{ ms} \dots \text{Approx. } 0.096 \text{ ms at } 115.2 \text{ kbps}$

$Ltm = 13 + 2 \times n \text{ (n = number of stations being added)}$

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.

$Tlk = Tlc \text{ (link addition command sending time)} + Twt \text{ (addition waiting time)} + Tls \text{ (sending time for command to stop transmission if link error occurs)} + Tso \text{ (master station scan time)}$

$Tlc = 10 \times Ttx \text{ (sending time per byte)}$

$Ttx = 1/(\text{baud rate} \times 1000) \times 11 \text{ ms} \dots \text{Approx. } 0.096 \text{ ms at } 115.2 \text{ kbps}$

$Twt = \text{Initial value } 400 \text{ ms (can be changed using SYS1 system register instruction)}$

$Tls = 7 \times Ttx \text{ (sending time per byte)}$

$Ttx = 1/(\text{baud rate} \times 1000) \times 11 \text{ ms} \dots \text{Approx. } 0.096 \text{ ms at } 115.2 \text{ kbps}$

$Tso = \text{Master station scan time}$

Calculation example 1

When all stations have 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 PLCs is 1 ms.

$Ttx = 0.096$ Each $Pcm = 23 + (4 + 8) \times 4 = 71 \text{ bytes}$ $Tpc = Ttx \times Pcm = 0.096 \times 71 \div 6.82 \text{ ms}$

Each $Ts = 1 + 6.82 = 7.82 \text{ ms}$ $Tlt = 0.096 \times (13 + 2 \times 16) = 4.32 \text{ ms}$

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

$T_{\max} = 7.82 \times 16 + 4.32 + 1 = 130.44 \text{ ms}$

Calculation example 2

When all stations have 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 $Pcm = 23 + (4 + 8) \times 4 = 71 \text{ bytes}$ $Tpc = Ttx \times Pcm = 0.096 \times 71 \div 6.82 \text{ ms}$

Each $Ts = 5 + 6.82 = 11.82 \text{ ms}$ $Tlt = 0.096 \times (13 + 2 \times 16) = 4.32 \text{ ms}$

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

$T_{\max} = 11.82 \times 16 + 4.32 + 5 = 198.44 \text{ ms}$

Calculation example 3

When all but one station have 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.

$$T_{tx} = 0.096 \quad \text{Each } T_s = 5 + 6.82 = 11.82 \text{ ms}$$

$$T_{lt} = 0.096 \times (13 + 2 \times 15) \div 4 = 4.13 \text{ ms}$$

$$T_{lk} = 0.96 + 400 + 0.67 + 5 \div 407 \text{ ms}$$

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:

$$T_{\text{max.}} = 11.82 \times 15 + 4.13 + 5 + 407 = 593.43 \text{ ms}$$

Calculation example 4

When all stations have been added to an 8-unit link, the largest station number is 8, relays and register have been evenly allocated, and the scan time for each PLC is 5 ms.

$$T_{tx} = 0.096 \quad \text{Each } P_{cm} = 23 + (8 + 16) \times 4 = 119 \text{ bytes}$$

$$T_{pc} = T_{tx} \times P_{cm} = 0.096 \times 119 \div 4 = 11.43 \text{ ms}$$

$$\text{Each } T_s = 5 + 11.43 = 16.43 \text{ ms} \quad T_{lt} = 0.096 \times (13 + 2 \times 8) \div 4 = 2.79 \text{ ms}$$

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

$$T_{\text{max.}} = 16.43 \times 8 + 2.79 + 5 = 139.23 \text{ ms}$$

Calculation example 5

When all stations have 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.

$$T_{tx} = 0.096 \quad \text{Each } P_{cm} = 23 + (32 + 64) \times 4 = 407 \text{ bytes}$$

$$T_{pc} = T_{tx} \times P_{cm} = 0.096 \times 407 \div 4 = 39.072 \text{ ms}$$

$$\text{Each } T_s = 5 + 39.072 = 44.072 \text{ ms} \quad T_{lt} = 0.096 \times (13 + 2 \times 2) \div 4 = 1.632 \text{ ms}$$

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

$$T_{\text{max.}} = 44.072 \times 2 + 1.632 + 5 = 94.776 \text{ ms}$$

Calculation example 6

When all stations have been added to a 2-unit link, the largest station number is 2, 32 relays and 2 register words have been evenly allocated, and the scan time for each PLC is 1 ms.

$$T_{tx} = 0.096 \quad \text{Each } P_{cm} = 23 + (1 + 1) \times 4 = 31 \text{ bytes}$$

$$T_{pc} = T_{tx} \times P_{cm} = 0.096 \times 31 \div 4 = 2.976 \text{ ms}$$

$$\text{Each } T_s = 1 + 2.976 = 3.976 \text{ ms} \quad T_{lt} = 0.096 \times (13 + 2 \times 2) \div 4 = 1.632 \text{ ms}$$

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

$$T_{\text{max.}} = 3.976 \times 2 + 1.632 + 1 = 10.584 \text{ ms}$$



Note:

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

Reducing the transmission cycle time when there are stations that have not been added

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

$$T_{\text{max.}} = Ts1 + Ts2 + \dots + Tsn + Tlt + Tso + \underline{Tlk}$$

$$\underline{Tlk} = Tlc \text{ (link addition command sending time)} + \underline{Twt \text{ (addition waiting time)}} + Tls \text{ (link error stop command sending time)} + Tso \text{ (master station scan time)}$$

With the SYS1 instruction, the link addition waiting time Twt in the above formula can be reduced. Thus, SYS1 can be used to minimize the increase in the transmission cycle time.

<Programming example of SYS1 instruction>

(SYS1, M PCLK1T0, 100)^{Noe}

Function:

Setting SYS1 to change the waiting time for a link to be added to the PC(PLC) link from the default value of 400 ms to 100 ms.

Keywords:

Setting for key word no. 1: PCLK1T0

Permissible range for key word no. 2: 10 to 400 (10 ms to 400 ms)

Note) Enter one space after M and then enter 12 characters to be aligned to the right.

If the second keyword is 2 digits, put 2 spaces, and if it is 3 digits, put one space.



Note:

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 problem.

- The SYS1 instruction should be executed at the beginning of the program, at the rise of R9014. The same waiting time should be set for all linked PLCs.
- The waiting time should be set to a value of at least twice the maximum scan time for any of the PLCs connected to the link.
- If a short waiting time has been set, there may be PLCs that cannot be added to the link even if their power supply is on. (The shortest time that can be set is 10 ms.)

Error detection time for transmission assurance relays

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

<Programming example of SYS1 instruction>

(SYS1, M PCLK1T1, 100) ^{Note)}

Function:

Setting SYS1 to change the time that the PC(PLC) link transmission assurance is off from the default value of 6400 ms to 100 ms.

Keywords:

Setting for key word no. 1: PCLK1T1

Permissible range for key word no. 2: 100 to 6400 (100 ms to 6400 ms)

Note) Enter one space after M and then enter 12 characters to be aligned to the right.

If the second keyword is 3 digits, put 2 spaces, and if it is 4 digits, no space is needed.



Note:

The setting should not be changed as long as a longer transmission assurance relay detection time does not cause any problems.

- The SYS1 instruction should be executed at the beginning of the program, at the rise of R9014. The same time should be set for all linked PLCs.
- The time should be set to a value of at least twice the maximum transmission cycle time when all of the PLCs are connected to the link.
- If short time has been set, the transmission assurance relay may not function properly. (The shortest time that can be set is 100 ms.)

7.7 Communication Function 4: MODBUS RTU Communication

7.7.1 MODBUS RTU Communication

Function overview

- This function is available for the 32k type only.
- The MODBUS RTU protocol enables the communication between the FPΣ and other devices (including our FP-e, Programmable display GT series and KT temperature control unit).
- Enables to have conversations if the master unit sends instructions (command messages) to slave units and the slave units respond (response messages) according to the instructions.
- Enables the communication between the devices of max. 99 units as the master function and slave function is equipped.

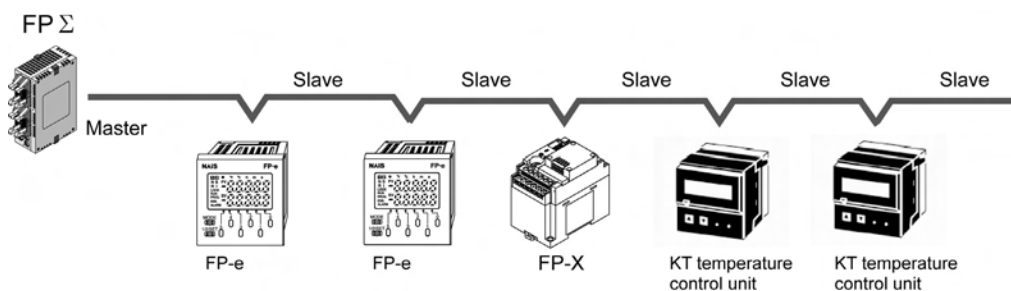
About MODBUS RTU

- The MODBUS RTU communication is a function for the master unit to read and write the data in slave units communicating between them.
- There are ASCII mode and RTU (binary) mode in the MODBUS protocol, however, the FPΣ is supported with the RTU (binary) mode only.

Master function

Writing and reading data for various slaves is available using the F145 (SEND) and F146 (RECV) instructions.

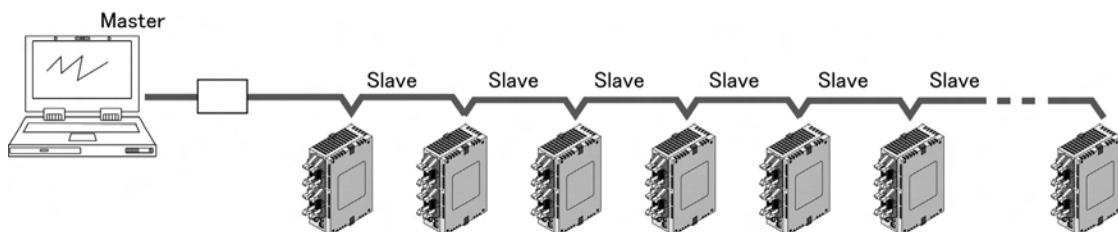
Individual access to each slave and the global transmission is possible.



Slave function

If the slave units receive a command message from the master unit, they send back the response message corresponding to the content.

Do not execute the F145 (SEND) or F146 (RECV) instructions when the unit is used as a slave unit.



MODBUS RTU command message frame

START	ADDRESS	FUNCTION	DATA	CRC CHECK	END
3.5-character time	8 bits	8 bits	n*8 bits	16 bits	3.5-character time

ADDRESS (Unit No.)	8 bits, 0 to 99 (decimal) Note1) 0= Broadcast address Note2) Slave unit No. is 1 to 99 (decimal) Note3) For MODBUS, 0 to 247 (decimal)
FUNCTION	8 bits
DATA	Varies depending on commands.
CRC	16 bits
END	3.5-character time (Differs depending on baud rate. Refer to reception judgement time.)

Response in normal status

The same message as a command is returned for single write command.

A part of a command message (6 bytes from the beginning) is returned for multiple write command.

Response in abnormal status

In case a parameter disabled to be processed is found in a command (except transmission error)

Slave address (unit number) Function code + 80H Error code CRC	One of either 1, 2 or 3
---	-------------------------

Error code contents

1: Function code error
2: Device number error (out of range)
3: Device quantity error (out of range)

Reception done judgment time

The process for receiving a message completes when the time that is exceeding the time mentioned below has passed after the final data was received.

Baud rate	Reception done judgment time
2400	Approx. 13.3 ms
4800	Approx. 6.7 ms
9600	Approx. 3.3 ms
19200	Approx. 1.7 ms
38400	Approx. 0.8 ms
57600	Approx. 0.6 ms
115200	Approx. 0.3 ms

Note) The reception done judgment time is an approx. 32-bit time.

Supported commands

Executable instructions for master	Code (decimal)	Name (MODBUS original)	Name for FPΣ	Remarks (Reference No.)
F146 (RECV)	01	Read Coil Status	Read Y and R Coils	0X
F146 (RECV)	02	Read Input Status	Read X Input	1X
F146 (RECV)	03	Read Holding Registers	Read DT	4X
F146 (RECV)	04	Read Input Registers	Read WL and LD	3X
F145 (SEND)	05	Force Single Coil	Write Single Y and R	0X
F145 (SEND)	06	Preset Single Register	Write DT 1 Word	4X
Cannot be issued	08	Diagnostics	Loopback Test	
F145 (SEND)	15	Force Multiple Coils	Write Multiple Ys and Rs	0X
F145 (SEND)	16	Preset Multiple Registers	Write DT Multiple Words	4X
Cannot be issued	22	Mask Write 4X Register	Write DT Mask	4X
Cannot be issued	23	Read/Write 4X Registers	Read/Write DT	4X

Note) The items shown in the shaded area are not supported with the FPΣ.

Table for MODBUS reference No. and FPΣ device No.

MODBUS reference No.		Data on BUS (hexadecimal)	FPΣ device No.
Coil	000001-001184	0000-049F	Y0-Y73F
	002049-006144	0800-17FF	R0-R255F
Input	100001-101184	0000-049F	X0-X73F
Holding register ^{Note)}	400001-432765	0000-7FFC	DT0-DT32764
Input register	300001-300128	0000-007F	WL0-WL127
	302001-302256	07D0-08CF	LD0-LD255

Setting using FPCWIN GR

1. Change the display to the "Online monitor" by selecting "Online Edit Mode" under "Online" in the menu bar or pressing [CTRL] and [F2] keys at the same time.
2. Select "Options" in the menu bar, and then select "PLC Configuration". Click "COM Port". There are separate tabs for setting the COM1 and COM2 .

Dialog box of MODBUS RTU setting

The screenshot shows the "PLC Configuration - Untitle1" dialog box. The "COM1 Port" tab is selected. The "Unit No." is set to 1. The "Comm. Mode" dropdown menu is open, showing options: "PC Link", "Computer Link", "General Communication", "PC Link", and "MODBUS RTU" (which is highlighted). The "Baudrate" is set to 115200 bps. The "Communication Format" section shows: "Char. Bit: 8 Bits", "Parity: Odd", "Stop Bit: 1", "Terminator: CR", and "Header: STX not exist.". The "Starting address for data received of serial data communication mode" (No.416) is set to 0 (range 0 - 32764). The "Buffer capacity setting for data received of serial data communication mode" (No.417) is set to 2048 (range 0 - 2048). Buttons on the right include "OK", "Cancel", "Read PLC", "Initialize", and "Help".

For the details on the MODBUS RTU communication function, refer to the exclusive specifications manual.



Reference: <MODBUS RTU Specifications>
It can be downloaded from our website.
<http://www.mew.co.jp/ac/e/fasys/plc/>

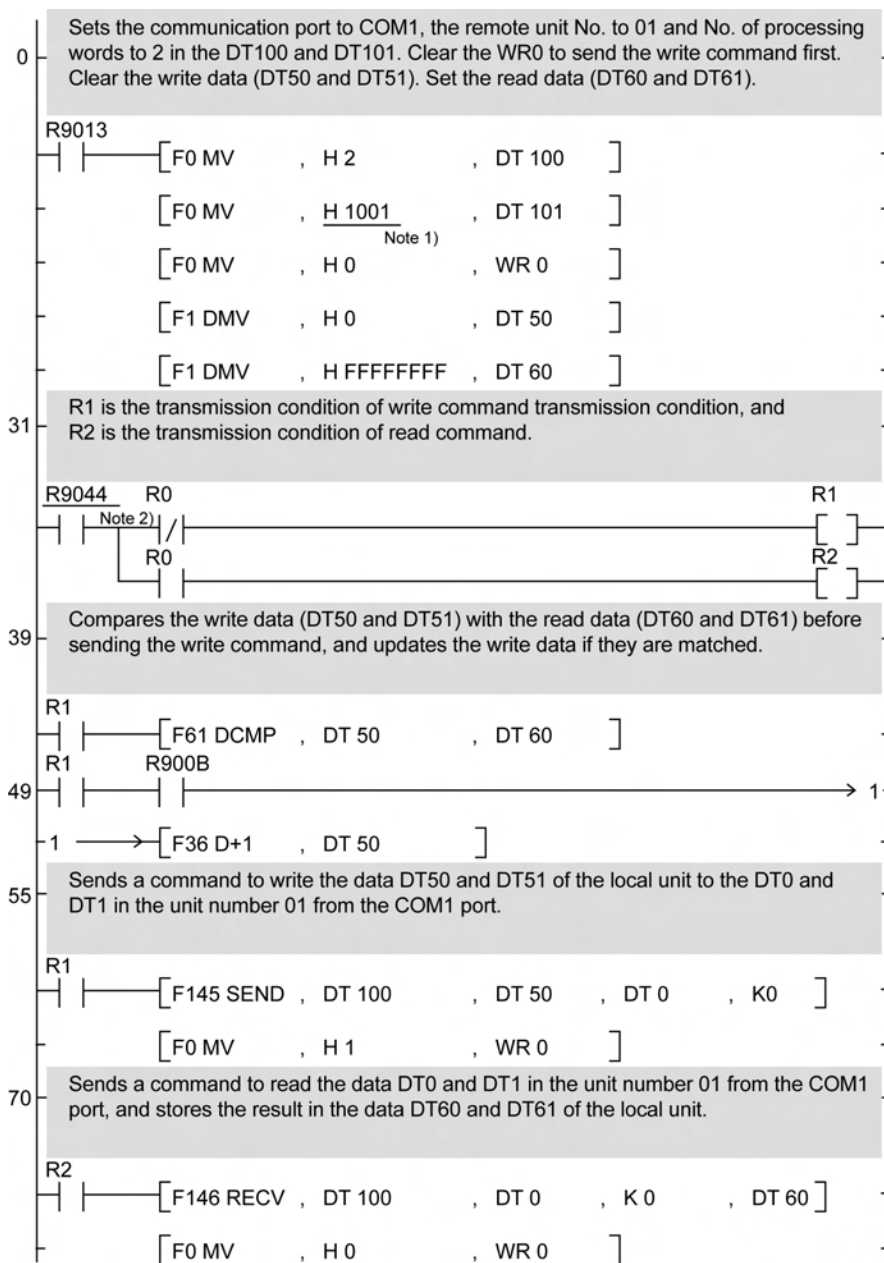
For the information on F145 (SEND) and F146 (RECV) instructions



Reference: <Programming Manual ARCT1F353>

Sample program for MODBUS master

Use the F145 (SEND) "Data send" or F146 (RECV) "Data receive" instruction to use the MODBUS master function.



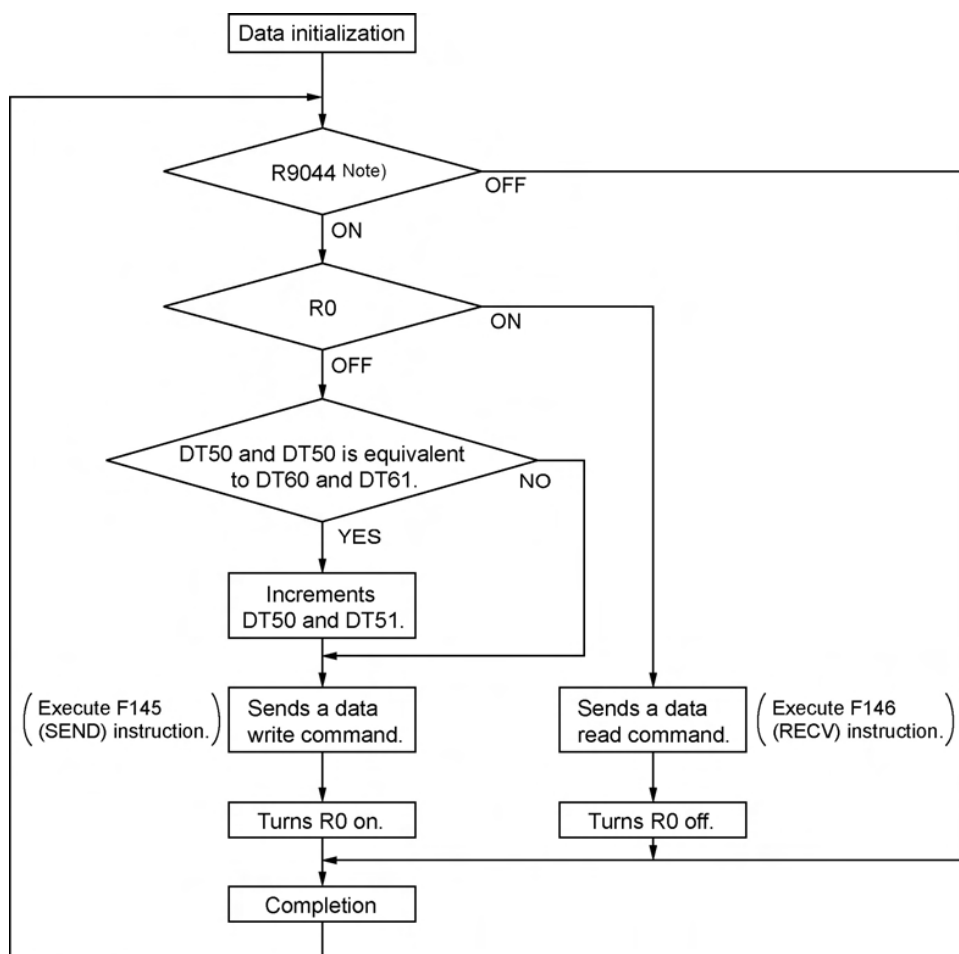
Note1) It is H2001 for COM2 port.

Note2) It is R904A for COM2 port.



Reference: For the information on the F145(SEND) and F146(RECV) instructions, <Programming Manual ARCT1F313E>

Flow chart



Note) It is R904A for COM2 port.

The above program executes the operation 1 to 3 repeatedly.

1. Updates the write data if the write data (DT50 and DT51) and the read data (DT60 and DT61) are matched.
2. Writes the DT50 and DT51 of the local unit into the data DT0 and DT1 in the unit number 1 from the COM1 port.
3. Reads the data DT0 and dT1 in the unit number 1 into the data DT60 and DT61 of the local unit from the COM1 port.

Note) The above COM1 port will be COM2 port for the COM2 port.

Chapter 8

Security Functions

8.1 Type of Security Functions

There are mainly two functions as the security function of the FPΣ.
It is possible to rewrite data during any of these functions is being used.

1: Password protect function

It is used to restrict access to the programs in the FPΣ from the programming tool by setting a password. Writing and reading ladder programs or system registers will be unperformable by setting a password and setting to the protect mode.

There are two types of passwords as below.

- 4-digit password: 4 characters of 16 characters that are “0” to “9” and “A” to “F” can be used.
- 8-digit password: A maximum of 8 English one byte characters (case-sensitive) and symbols can be used.

Note) 8-digit password is available for FPΣ 32k type only.

2: Upload protection (Available for FPΣ 32k type only)

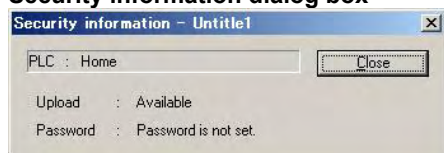
Ladder programs or system registers cannot be uploaded from the FPΣ by setting that the program is not uploaded. As transferring programs to the master memory cassette as well as the programming tool will be unperformable, it ensures higher security.

The state of the security can be checked at two displays of the programming tool FPCWIN GR.

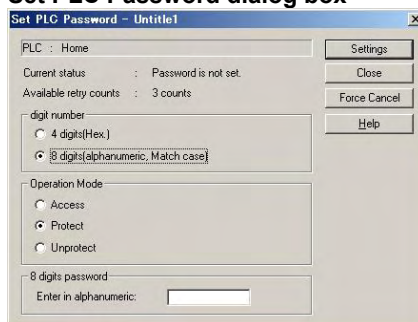
1. Select [Online Edit Mode] under the [Online] on the menu bar, or press the [CTRL] and [F2] keys at the same time, to switch to the [Online] screen.
2. Select “Security information” or “Set PLC Password” under “Tool” on the menu bar.

The following displays will be shown.

Security information dialog box



Set PLC Password dialog box



8.2 Password Protect Function

This function is used to prohibit reading and writing programs and system registers by setting a password on the FPΣ.

There are two ways to set a password as below.

1. Sets using the programming tool.
2. Sets using an instruction (SYS1 instruction).



Note: Precautions on the password setting

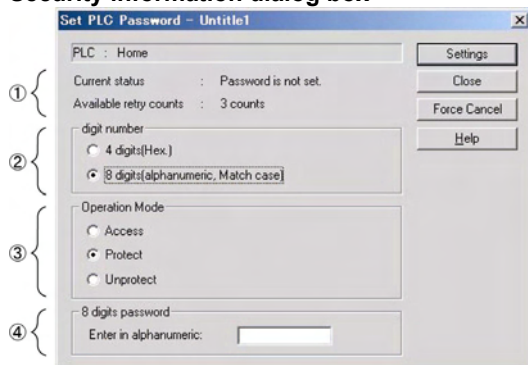
Do not forget your password. If you forget your password, you cannot read programs. (Even if you ask us for your password, we cannot crack it.)

8.2.1 Password Setting For FPΣ 32k Type Only

Setting using FPCWIN GR

1. Select [Online Edit Mode] under the [Online] on the menu bar, or press the [CTRL] and [F2] keys at the same time, to switch to the [Online] screen.
2. Select or “Set PLC Password” under “Tool” on the menu bar. The following display will be shown.

Security information dialog box



- ① Indicates the current status of the password setting.
- ② Specify the type of the password to be used.
- ③ Specify an operation mode.
Access: Accesses programs by inputting a password.
Protect: Sets a password.
Unprotect: Releases the password setting.
- ④ Input a password.

Confirmation the contents of the password setting

Confirm the settings indicated in the dialog box.

Current status

Indicates the current status of the password setting. There are following five statuses.

- | | |
|---------------------------------|--|
| 1. Password is not set | : Password is not set. |
| 2. 4 digits Protect | : Password is 4-digit password, and access is prohibited. |
| 3. 4 digits Available to access | : Password is 4-digit password, and access is allowed.
(The status that inputting the password completes and that can access programs.) |
| 4. 8 digits Protect | : Password is 8-digit password, and access is prohibited. |
| 5. 8 digits Available to access | : Password is 8-digit password, and access is allowed.
(The status that inputting the password completes and that can access programs.) |

Available retry counts

This is the number of times that you can input the password in succession. Every time incorrect password is input, the number will decrease (up to 3 times).

If you fail to input the correct password for 3 times in succession, you cannot access the program.

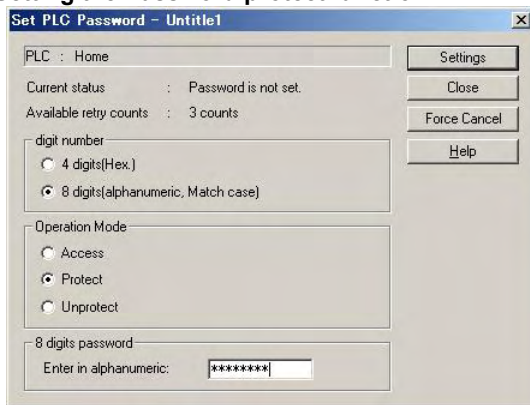
Turn the power supply of the FPΣ off and then on again to try to input the password again.



Note:

If the power supply of the PLC is turned on/off with the setting that the access is allowed, the setting will be that the PLC is protected again.

Setting the Password protect function



As the dialog box is shown, select as below.

Digit number:

Select "4 digits" or "8 digits".

Operation Mode:

Select "Protect".

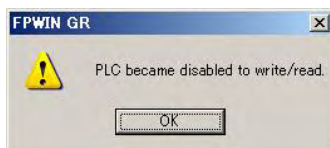
4 digits (or 8 digits) password:

Input a password to be set.

Click "Settings".



Input the password for confirmation again, and click [OK].



The setting has completed.

Setting to allow the access to the program by inputting a password



As the dialog box is shown, select as below.

Digit number:

Select "4 digits" or "8 digits".

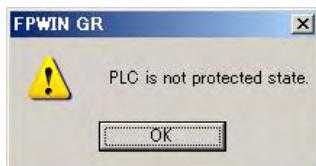
Operation Mode:

Select "Access".

4 digits (or 8 digits) password:

Input a password to be set.

Click "Settings".



The setting has completed.



Note:

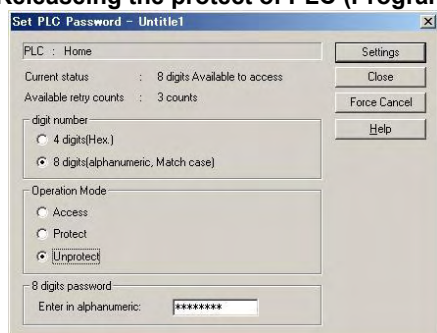
If the power supply of the PLC is turned on/off with the setting that the access is allowed, the setting will be that the PLC is protected again.

How to cancel the password setting

Following two methods are available to cancel the password setting.

	Description	Program
Unprotect	Cancels the registered password to be specified.	All programs are retained.
Force cancel	Erases all programs and security information to cancel the setting forcibly.	All programs are deleted. (The upload protection setting is also deleted.)

Releasing the protect of PLC (Programs are retained.)



As the dialog box is shown, select as below.

Digit number:

Select "4 digits" or "8 digits".

Operation Mode:

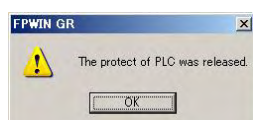
Select "Unprotect".

4 digits (or 8 digits) password:

Input a password to be set.

Click "Settings".

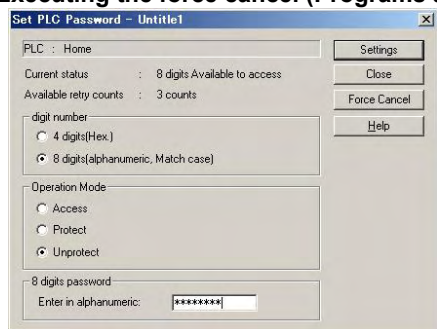
Click [OK].



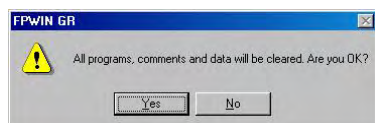
Note) The protection cannot be released if the access is not allowed.

Executing the force cancel (Programs and security information are all deleted.)

Click [Force cancel].



Click [Yes].



If the current status is "Password is not set", this procedure has completed.

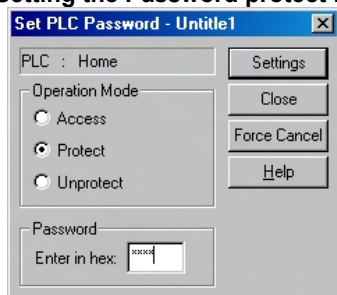
All programs and security information were deleted.

8.2.2 Password Setting For FPΣ 12k Type Only

The following functions are not available for the FPΣ 16k type.

1. 8-digit password
2. Function to display the current state of a password

Setting the Password protect function

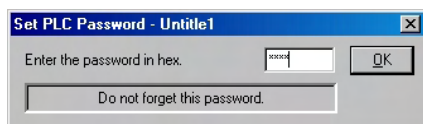


As the dialog box is shown, select as below.

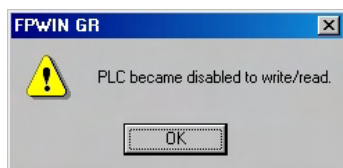
Operation Mode:
Select "Protect".

4 digits password:
Input a password to be set.

Click "Settings".

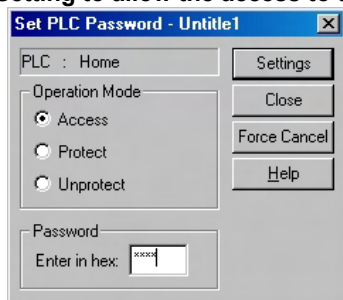


Input the password for confirmation again, and click [OK].



The setting has completed.

Setting to allow the access to the program by inputting a password

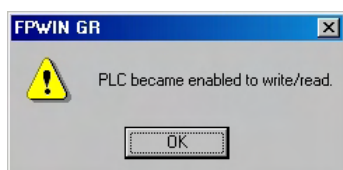


As the dialog box is shown, select as below.

Operation Mode:
Select "Access".

4 digits password:
Input a password to be set.

Click "Settings".



The setting has completed.



Note:

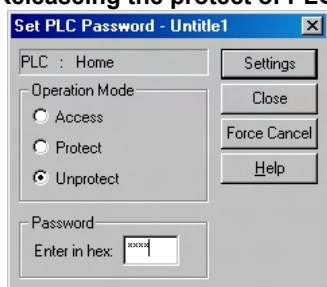
If the power supply of the PLC is turned on/off with the setting that the access is allowed, the setting will be that the PLC is protected again.

How to cancel the password setting

Following two methods are available to cancel the password setting.

	Description	Program
Unprotect	Cancels the registered password to be specified.	All programs are retained.
Force cancel	Erases all programs and security information to cancel the setting forcibly.	All programs are deleted. (The upload protection setting is also deleted.)

Releasing the protect of PLC (Programs are retained.)



As the dialog box is shown, select as below.

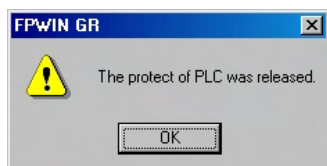
Operation Mode:

Select "Unprotect".

4 digits password:

Input a password to be set.

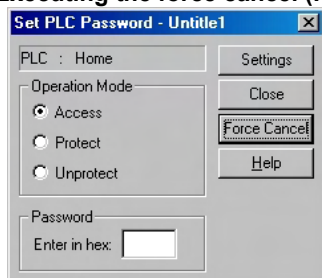
Click "Settings".



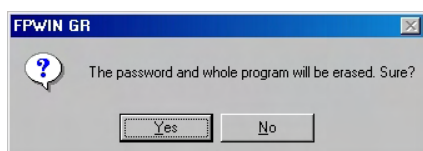
Click [OK].

Note) The protection cannot be released if the access is not allowed.

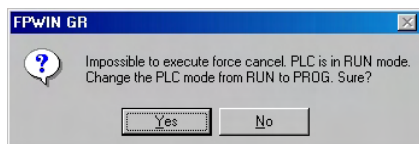
Executing the force cancel (Programs and security information are all deleted.)



Click [Force cancel].

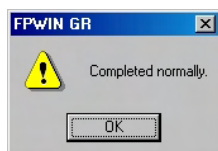


Click [Yes].



Click [Yes].

This operation may take a long time depending on the baud rate, performance of a PC or password data.



All programs and security information were deleted.

8.3 Upload Protection FPΣ 32k Type Only

This function is to prohibit reading programs and system registers by setting to disable program uploading.

If setting to prohibit program uploading, note that the ladder programs and system registers will be disabled to be uploaded after that.

However, editing the files that are controlled with a PC can be carried out online using the programming tool. Note that the programs will be broken if the programs are not absolutely matched.

When using this function, store ladder programs as files without fail.

Unperformable operations on the FPΣ set to prohibit uploading

1. Uploading ladder programs and system registers to PCs

2. Transferring programs to the master memory cassette

The setting for this function can be cancelled using the programming tool, however, all ladder programs, system registers and password information will be deleted when the setting is cancelled.



Note: When cancelling this setting forcibly:

All programs and security information will be deleted when the upload protection setting is cancelled.

We cannot restore the deleted programs even if you ask us.

We cannot read the data of the control units that are set to prohibit uploading.

Keeping your programs is your responsibility.

Interaction with the password protect function

The password setting can be specified for the FPΣ that this function is set at the same time.

Also, this function can be specified for the FPΣ that a password is set.

8.3.1 Upload Protection Setting

Following two methods are available to set the upload protection.

1. Set in the control unit using the programming tool.
2. Specify the information on the upload protection in the master memory cassette, and set in the control unit.

Setting using FPWIN GR

1. Select [Online Edit Mode] under the [Online] on the menu bar, or press the [CTRL] and [F2] keys at the same time, to switch to the [Online] screen.
2. Select or "Upload settings" under "Tool" on the menu bar. The following display will be shown.



Select "Set that PLC cannot be uploaded".

Click "Execute".

8.4 Table of Security Settings/Cancel

		Status of security			
		Security not set	Upload protection	4-digit password	8-digit password
Sets/ Cancels	Upload protection	A		A	A
	4-digit password	A	A		N/A
	8-digit password	A	A	N/A	

A: Available, N/A: Not available



Note:

The following functions are not available for the FPΣ 12k type.

8-digit password

Upload protection

Chapter 9

Other Functions

9.1 P13 (ICWT) Instruction

Data registers of 32765 words can be stored and used in the built-in ROM (F-ROM data area) control unit using the P13 (ICWT) instruction.

However, note the followings for the use:

1. Restrictions on the number of writing

Writing can be performed within 10000 times. If writing continues for more than that, the correct operation cannot be guaranteed.

2. The power supply turns off when the P13 (ICWT) instruction is being executed.

If the power supply turns off during this instruction is being executed, the hold type area may not be kept. (Also, when the power is shut off during rewriting in the RUN mode, the same event may occur.)

9.2 Sampling Trace Function 32k Type Only

9.2.1 Overview

The FPΣ control unit Ver3.10 and later versions support the sampling trace function.

Using this function enables to take samplings and record (accumulate) the state of arbitrary data of 16 bits + 3 data registered in the PLC at an arbitrary timing, and to examine the changes in the bit and data in details after stopping sampling at an arbitrary timing.

The sampling trace function is used in the time chart monitor function under the online menu of the FPWIN GR.

The instructions, functions, special relays and special registers related to the sampling trace function are as below.

F155(SMPL) sampling instruction

F156(STRG) sampling stop trigger instruction

Time charge monitor of FPWIN GR

R902C	: Sample point flag	OFF=Sampling by instruction ON=Sampling at regular time intervals
R902D	: Sampling trace end flag	When sampling trace starts=0 stops=1
R902E	: Sampling trigger flag	Turns on when sampling stop trigger is on.
R902F	: Sampling enable flag	Turns on when sampling operation starts.
DT90028	: Interval of sampling trace	k0=For sampling by instruction k1 to k3000 (10ms to 30 seconds) For sampling at regular time intervals

9.2.2 Details of Sampling Trace Function

No. of data collectable at one sampling: 16 bits +3 data

Sampling capacity (No. of samples accumulable) : 1000 samples

Types of sampling timing (When an instruction is executed, or at regular time intervals)

1: Sampling at regular time intervals From 10 ms

2: Sampling by F155(SMPL) instruction

Sampling for every scan can be executed by the instruction.

Also, more than one samplings can be executed in one scan.

Timing for the execution of the F155(SMPL) instruction can be set by the ladder sequence.



Note: It is not possible to activate the sampling at regular time intervals and the sampling by the F155(SMPL) instruction simultaneously.

How to stop sampling

Methods of the stop trigger (request): Following two methods are available.

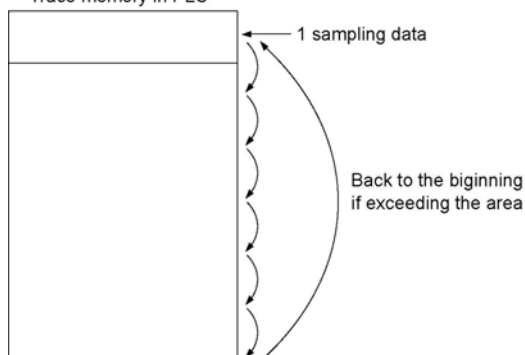
1. Deactivate request by the tool software
2. Deactivate request by the F156(STRG) instruction

If the stop trigger activates, the PLC will continue to take samplings for the specified No. of delay, and then stop the sampling operation. Once the sampling operation stops, the data will be automatically retrieved by the tool software and will be indicated in a time chart.

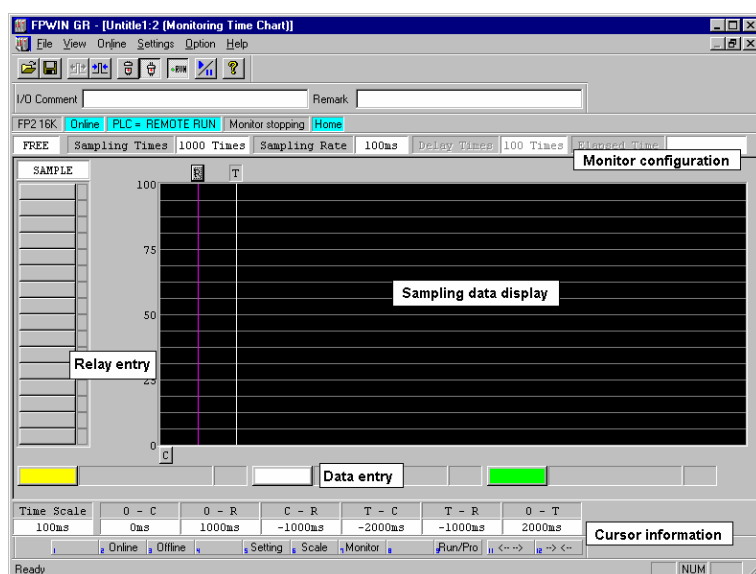
It is possible to adjust whether to see before or after the trigger point by the setting of the No. of delay.

Operation image of sampling trace

Trace memory in PLC

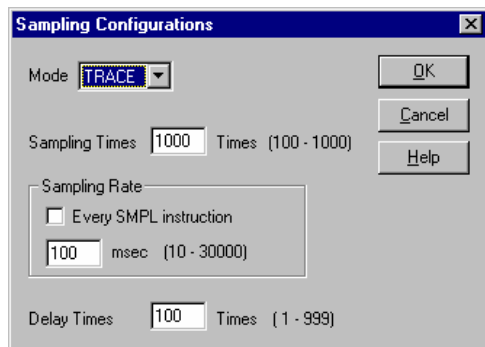


9.2.3 How to Use Sampling Trace



1. Sampling at regular time intervals

- (1) Register the bit/word device to be monitored by the time chart monitor function of FPWIN GR.
- (2) Specify the sampling configurations.
 - Set the mode of the sampling configurations to "Trace".
 - Set the sampling rate (time).

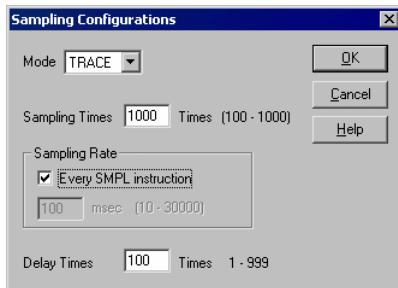


(3) Start monitoring. Start with the  button.




2. Sampling by instruction

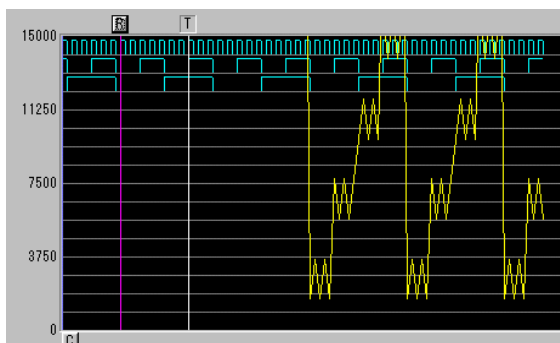
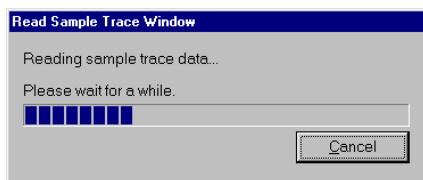
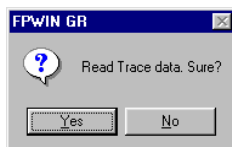
- (1) Register the bit/word device to be monitored by the time chart monitor function of FPCWIN GR.
- (2) Specify the sampling configurations.
Set the mode of the sampling configurations to "Trace".
Set the sampling rate (time) to 0.



3. Read data by trigger

- (1) Stop sampling by stopping monitoring the trace that has been started in the above procedure 1 or 2 on the time chart display of FPCWIN GR. The data will be indicated in the time chart.

Stop monitoring. (Stop with the  button, stop by the "Trigger Break" in the menu, or stop by the F156 instruction.)



Reference: <FPWIN GR Help>

Chapter 10

Self-Diagnostic and Troubleshooting

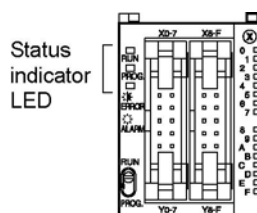
10.1 Self-Diagnostic function

10.1.1 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	Light (on)	Off	Flashes	When a self-diagnostic error occurs	Operation
	Off	Light (on)	Flashes	Shen a self-diagnostic error occurs	Stop
	—	—	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.



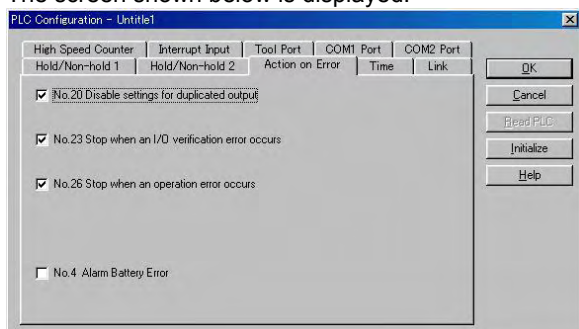
10.1.2 Operation on Error

- Normally, when an error occurs, the operation stops.
- The user may select wheter 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 toolshoftware as shown below.

“PLC System Register” setting menue on programming tool software

To specify the steps to be taken by the FPWIN GR if a PLC error occurs, select “PLC System Register setting” under “Option” on the menu bar, and click on the “Action on Error” tab.

The screen shown below is displayed.



Example1]: When allowing duplicated output

Turn off the check box for No. 20. When operation is resumed, it will not be handled as an error.

[Example2]: When continuing operation even a calculation error has occurred

Turn off the check box for No. 26. When operation is resumed, it will be continued, but will be handled as an error.

10.2 Troubleshooting

10.2.1 If ERROR/ALARM LED is Flashing

Condition: The self-diagnostic error occurs

Procedure 1

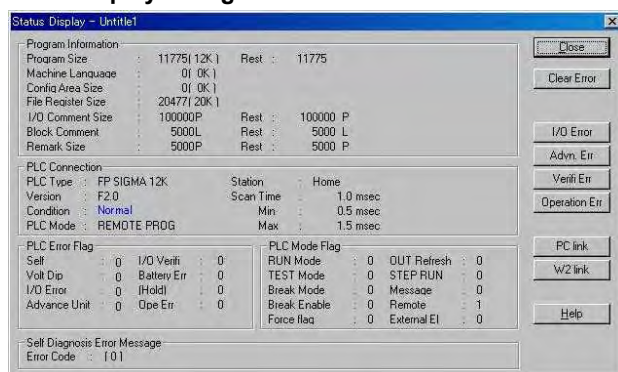
Check the error contents (error code) using the programming tool.

Using FPWIN GR

With the FPWIN GR Ver. 2, if a PLC error occurs during programming or debugging and the RUN mode is changed to the PROG. mode, the following status display dialog box is displayed automatically.

Check the contents of the self-diagnosed error.

Status display dialog box



If the error is an operation error, the error address can be confirmed in this dialog box.

After correcting the error, click on the "Clear Error" button to clear the error.



Key Point:

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

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 1**

Use the programming tool in PROG. mode to clear the error.

Using FFWIN 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.



Key Point:

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.

10.2.2 If ERROR/ALARM LED is ON

Condition: The system watchdog timer has been activated and the operation of PLC has been activated.

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 chapter 8.2.1.

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.

Check

(1) Check if instructions such as “JMP” or “LOOP” are programmed in such a way that a scan never finish.

(2) Check that interrupt instructions are executed in succession.

10.2.3 ALL LEDs are OFF

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.
- Please contact your dealer for further questions.

10.2.4 Diagnosing Output Malfunction

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 1: 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 2: 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.

Check

- (1) Check for the duplicated use of output and for the output using the high-level instruction.
- (2) Check the program flow when a control instruction such as MCR or JMP is used.

10.2.5 A Protect Error Message Appears

When a password function is used

Procedure

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

Using FPCWIN 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



10.2.6 PROG 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 if the ERROR/ALARM LED is flashing.



Reference:

If the ERROR/ALARM LED is flashing, check <10.2.2 If the ERROR/ALARM LED Lights>.

Procedure 2

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

Using FPCWIN GR

Select “Debug” on the menu bar, and select “Totally check program”. Click on the “Execute” button in the total check dialog box.

10.2.7 A Transmission Error has Occurred through RS485

Procedure 1

Check to make sure the transmission cables have been securely connected between the two (+) terminals and two (–) terminals of the units, and that the final unit has been correctly connected.

Procedure 2

Check if the transmission cables are within the specifications range. 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.



Reference:

For the specifications range of the transmission cables, refer to <7.3.3 Selection of Transmission Cables>.

Procedure 3

Check that link areas do not overlap.

10.2.8 No Communication is Available through RS232C

Condition: No communication with 1-channel type RS232C cassette

Procedure 1

Check if the CS signal is on.

When the “COM.2 R” of the communication cassette LED does not light, the CS signal is not on.

If the three-wire type is used, connect the RS signal and the CS signal of the communication cassette, and turn the CS signal on.



Reference: <7.1.2 Types of Communication Cassette>

Chapter 11

Precautions During Programming

11.1 Use of Duplicated Output

11.1.1 Duplicated Output

What is duplicated output?

- Duplicated output refers to repeatedly specifying the same output in a sequence program.
- If the same output is specified for the “OT” and “KP” instructions, it is considered to be duplicated output.
(Even if the same output is used for multiple instructions, such as the SET, RST instruction or high-level instruction (such as data transfer), it is not regarded as duplicated output.)
- If you enter RUN mode while the duplicated output condition exists, it will be normally flagged as an error. (The ERROR/ALARM LED will flash and the self-diagnostic error flag R9000 will go on.)

How to check for duplicated use

You can check for duplicated outputs in the program using the programming tool, by the following method.

- Using the tool software

Select the “Debug” → “Totally Check Program” in the menu bar, and click “Execute”. If there are any duplicated outputs, an error message and the address will be displayed.

Enabling duplicated output

- If you need to use output repeatedly due to the content of the program, duplicated output can be enabled.
- In this case, change the setting of system register 20 to “enable”.
- When this is done, an error will not occur when the program is executed.

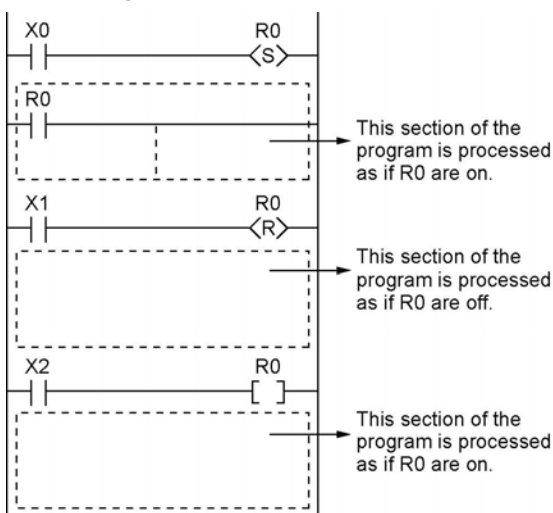
11.1.2 When Output is Repeated with an OT, KP, SET or RST Instruction

Condition of internal and output relays during operation

- When instructions are repeatedly used which output to internal and output relays such as transfer instructions and OT, KP, SET and RST instructions, the contents are rewritten at each step during operation.

<Exmample>

Processing when SET, RST and OT instructions are used (X0 to X2 are all on).

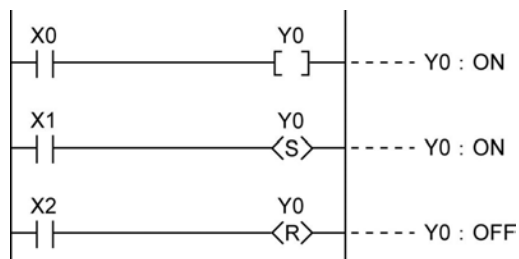


The output is determined by the final operation results

- If the same output is used by several instructions such as the OT, KP, SET, RST or data transfer functions, the output obtained at the I/O update is determined by the final results of the operation.

<Exmaple>

Output to the same output relay Y0 with OT, KP, SET and RST instructions.



When X0 to X2 are all on, Y0 is output as off at I/O update.

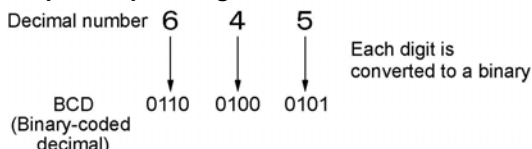
- If you need to output a result while processing is still in progress, use a partial I/O update instruction (F143).

11.2 Handling BCD Data

11.2.1 BCD Data

BCD is an acronym for binary-coded decimal, and means that each digit of a decimal number is expressed as a binary number.

<Example> Expressing a decimal number in BCD:

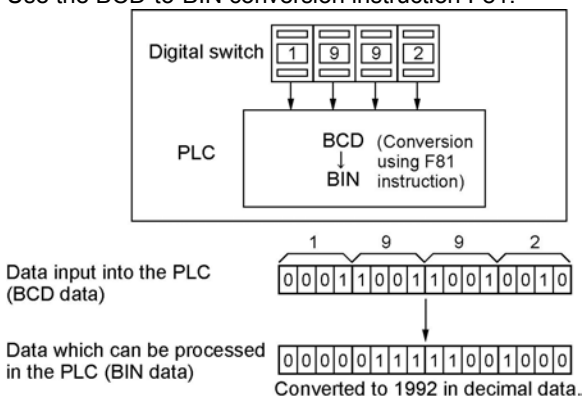


11.2.2 Handling BCD Data in the PLC

- When inputting data from a digital switch to the PLC or outputting data to a 7-segment display (with a decoder), the data must be in BCD form. In this case, use a data conversion instruction as shown in the examples at below.
- BCD arithmetic instructions (F40 to F58) also exist which allow direct operation on BCD data, however, it is normally most convenient to use BIN operation instructions (F20 to F38) as operation in the PLC takes place in binary.

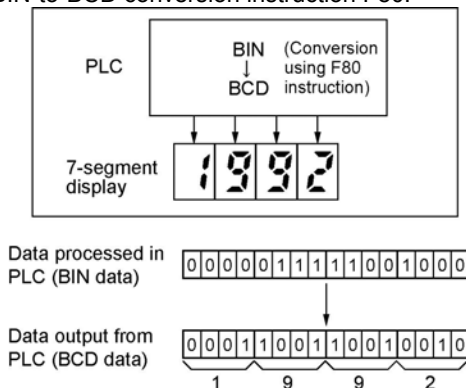
Input from a digital switch

Use the BCD-to-BIN conversion instruction F81.



Output to a 7-segment display (with decoder)

Use the BIN-to-BCD conversion instruction F80.



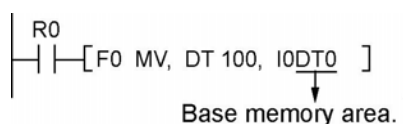
11.3 Handling Index Registers

11.3.1 Index Registers

- Like other registers, index registers have 14 points, I0 to ID, for reading and writing 16-bit data.
- Use an index register to indirectly specify a memory area number. (This is also called index modification.)

<Example>

Transferring the contents of data register DT100 to the number specified by the contents of an index register.

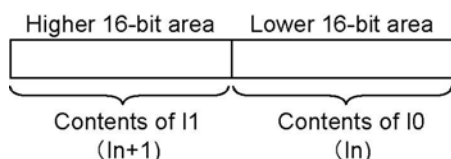


In this example, the number of the destination data register varies depending on the contents of I0 with DT0 acting as a base. For example, when I0 contains K10, the destination will be DT10, and when I0 is K20, the destination will be DT20.

- In this way, index registers allow the specification of multiple memory areas with a single instruction, and thus index registers are very convenient when handling large amounts of data.

11.3.2 Memory Areas Which can be Modified with Index Registers

- Index registers can be used to modify other types of memory areas in addition to data registers DT.
<Example> I0WX0, I0WY1, I0WR0, I0SV0, I0EV2, I0DT100
- Constants can also be modified.
<Example> I0K10, I0H1001
- An index register cannot modify another index register.
<Example> I0I0, I0I1
- When using index modification with an instruction which handles 32-bit data, specify with I0. In this case, I0 and I1 are handled together as 32-bit data.

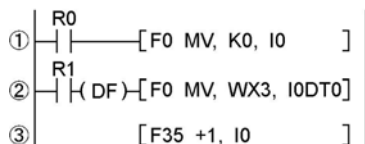


11.3.3 Example of Using an Index Register

Repeatedly reading in external data

<Example>

Writing the contents of input WX3 to a sequence of data registers beginning from DT0.

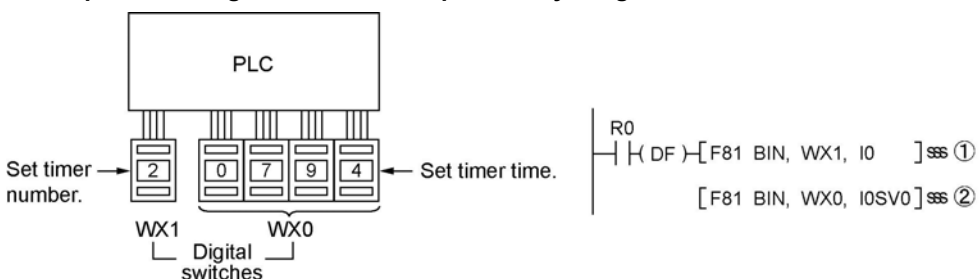


- ① When R0 turns on, 0 is written to index register I0.
- ② When the R1 turns on, the contents of input WX3 is transferred to the data register specified by I0DT0.
- ③ Add 1 to I0. In this case, the contents of I0 will change successively, and the destination data register will be as follows.

Input times of R1	Contents of I0	Destination data register
1st	0	DT0
2nd	1	DT1
3rd	2	DT2
:	:	:

Inputting and outputting data based on a number specified by an input

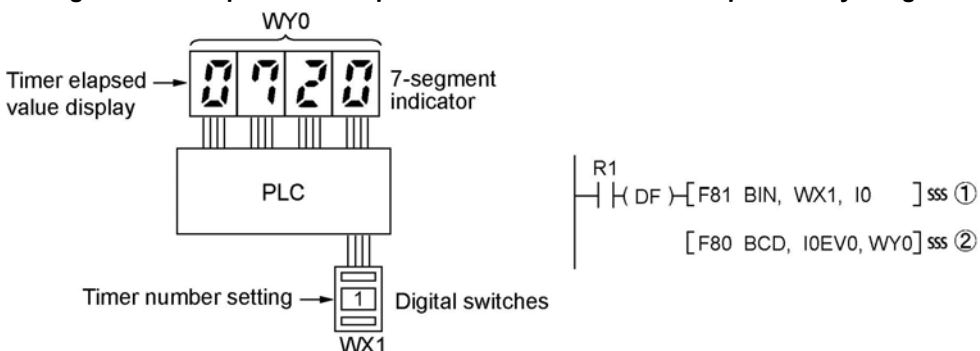
<Example 1> Setting a timer number specified by a digital switch



- ① Convert the BCD timer number data in WX1 to binary and set it in index register I0.
- ② Convert the BCD timer set value in WX0 to binary and store in the timer set value area SV specified by contents of I0.

<Example 2>

Taking external output of the elapsed value in a timer number specified by a digital switch



- ① Convert the BCD timer number data in WX1 to binary and set it in index register I0.
- ② Convert the elapsed value data EV in the timer specified by I0 to BCD, and output it to output relay WY0.

11.4 Operation Errors

11.4.1 Outline of Operation Errors

- An operation error is a condition in which operation is impossible when a high-level instruction is executed.
- When an operation error occurs, the ERROR/ALARM LED on the control unit will blink and the operation error flags (R9007 and R9008) will turn on.
- The operation error code “E45” is set at special data register DT90000.
- The error address is stored in special data registers DT90017 and DT90018.

Types of operation error

1. Address error

The memory address (number) specified by index modification is outside the area which can be used.

2. BCD data error

Operation is attempted on non-BCD data when an instruction handling BCD is executed, or BCD conversion is attempted on data which is not within the possible conversion range.

3. Parameter error

In an instruction requiring the specification of control data, the specified data is outside the possible range.

4. Over area error

The data manipulated by a block instruction exceeds the memory range.

11.4.2 Operation Mode When an Operation Error Occurs

- Normally, the operation stops when an operation error occurs.
- When you set system register 26 to “continuation”, the control unit operates even if an operation error occurs.

Using programming tool software

1. Set the mode of the CPU to PROG.
2. Select the “Option” in “PLC Configuration” option from the menu bar.
3. On the “PLC Configuration” menu, select “Action on error”. This displays system registers 20 to 26.
4. Remove the check of system register 26.
5. Press the “OK” to write the setting to the PLC.

11.4.3 Dealing with Operation Errors

<Procedure>

1. Check the location of the error.

Check the address where the error occurred, which is stored in DT90017 and DT90018, and make sure the high-level instruction for that address is correct and appropriate.

2. Clear the error.

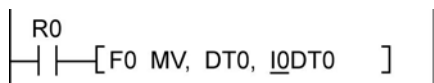
Use a programming tool to clear the error.

- Select “Online” → “Status Display” in the menu bar. Execute “Clear Error”.
- An error can be cleared by turning the power off and on in PROG. mode, however, the contents of the operation memory except the hold type data will be cleared.
- An error can also be cleared by executing a self-diagnostic error set instruction (F148).
- If the mode selector is set to “RUN”, RUN will resume as soon as the error is cleared. So if the cause of the error is not removed, the error may seem not to be cleared.

11.4.4 Points to Check in Program

1. Check if an extraordinarily large value or negative value was stored in the index register.

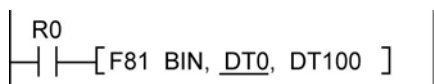
<Example> When a data register is modified using an index register



In this case, index register modifies the address of data register DT0. If data in I0 is too large, it will exceed the addressable range of the data register. The last address of the data register is DT32764, so if the contents of I0 exceeds 32764, an operation error will occur. The same is true when the contents of I0 are a negative value.

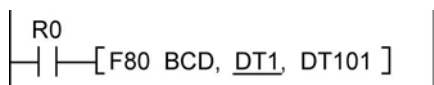
2. Is there any data which cannot be converted using BCD ↔ BIN data conversion?

<Example> When BCD-to-BIN conversion is attempted



In this case, if DT0 contains a hexadecimal number with one of the digits A through F such as 12A4, conversion will be impossible and an operation error will result.

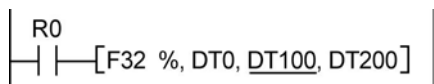
<Example> When BIN-to-BCD conversion is attempted



In this case, if DT1 contains a negative value or a value greater than K9999, an operation error will occur.

3. Check if the divisor of a division instruction is "0".

<Example>



In this case, if the content of DT100 is "0", an operation error will occur.

11.5 Instruction of Leading Edge Detection Method

11.5.1 Instructions of Leading Edge Detection Method

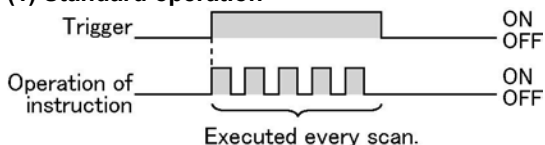
Instructions using the leading edge detection operation

1. DF (leading edge differential) instructions
2. Count input for CT (counter) instructions
3. Count input for F118 (UDC up-down counter) instructions
4. Shift input for SR (shift register) instructions
5. Shift input for F119 (LRSR left-right shift register) instructions
6. NSTP (next step) instructions
7. Differential execution type high-level instruction (P13)

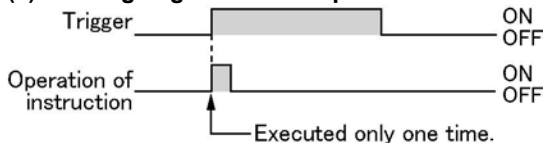
Leading edge detection method

- An instruction with a leading edge detection method operates only in the scan where its trigger (execution condition) is detected switching from off to on.

(1) Standard operation



(2) Leading edge detection operation



How to perform leading edge detection

The condition of the previous execution and the condition of the current execution are compared, and the instruction is executed only if the previous condition was off and the current condition is on. In any other case, the instruction is not executed.

Precautions when using an instruction which performs leading edge detection

- When RUN begins, for example when the system is powered on, the off → on change of the execution condition (trigger) is not detected. The instruction is not executed. Execution of the instruction will take place as explained on the next page.
- When used with one of the instructions indicated in instructions 1 to 6 below which change the order of execution of instructions, the operation of the instruction may change depending on input timing. Take care regarding this point.

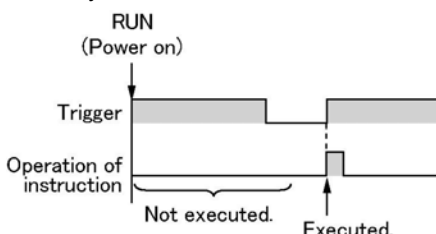
Be careful when using leading edge detection type instructions with control instructions, such as:

1. MC and MCE instructions
2. JP and LBL instructions
3. LOOP and LBL instructions
4. CNDE instruction
5. Step ladder instructions
6. Subroutine instructions

11.5.2 Operation and Precautions When RUN Starts

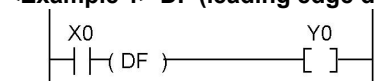
Operation of first scan after RUN begins

- The leading edge detection instruction is not executed when the mode has been switched to the RUN mode, or when the power supply is booted in the RUN mode, if the trigger (execution condition) is already on.

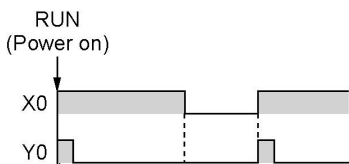
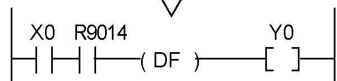


- If you need to execute an instruction when the trigger (execution condition) is on prior to switching to RUN mode, make a program as below using R9014 (initial pulse off relay). (R9014 is a special internal relay which is off during the first scan and turns on at the second scan.)

<Example 1> DF (leading edge differential) instruction

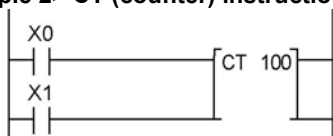


↓ Add R9014

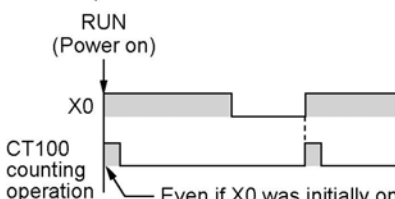
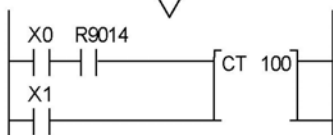


Even if X0 was initially on, the input condition for the DF instruction is off-to-on at the second scan, therefore derivative output is obtained.

<Example 2> CT (counter) instruction



↓ Add R9014

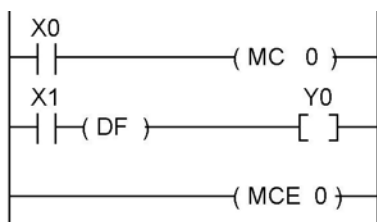


Even if X0 was initially on, the input condition for the counter is off-to-on at the second scan, therefore the count is incremented.

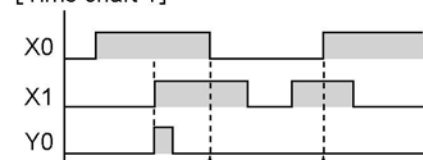
11.5.3 Precautions When Using a Control Instruction

- If a leading edge detection instruction is in a control instruction, it will be executed only under the following condition: The leading edge detection instruction was off when the execution condition of the previous control instruction was reset, and the leading edge detection instruction is on when the execution condition of the current control instruction becomes on.
- When a leading edge detection instruction is used with an instruction which changes the order of instruction execution such as MC, MCE, JP or LBL, the operation of the instruction may change as follows depending on input timing. Take care regarding this point.

<Example 1> Using the DF instruction between MC and MCE instructions



[Time chart 1]



X1 was on when
X0 became off.

The input condition (X1) for the DF instruction has not
changed since the time of the previous execution,
thus derivative output is not obtained.

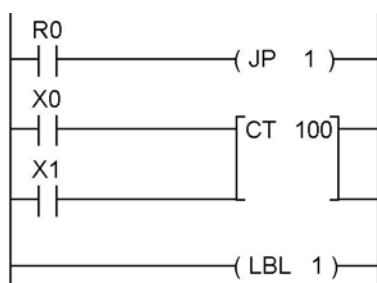
[Time chart 2]



X1 was off when
X0 became off.

The input condition (X1) for the DF instruction has
changed from off to on since the time of the previous
execution, thus derivative output is obtained.

<Example 2> Using the CT instruction between JP and LBL instructions



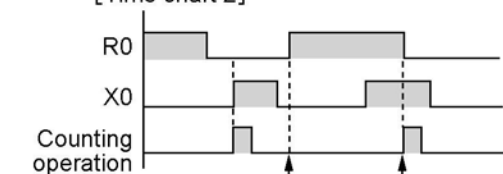
[Time chart 1]



Final timing at which the previous JP instruction was not executed.

The count is not incremented, because the final timing at which the previous JP instruction was not executed has not been change, and the execution condition X0 for the counter input has not changed.

[Time chart 2]



Final timing at which the previous JP instruction was not executed.

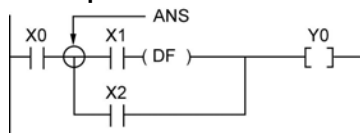
The count is not incremented, because the count input changed from off to on after the final timing at which the previous JP instruction was not executed.

11.6 Precautions for Programming

Programs which are not executed correctly

Do not write the following programs as they will not be executed correctly.

<Example 1>



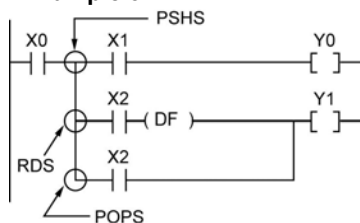
- When X1 was on prior to X0, Y0 will not be on even if X0 becomes on.

<Example 2>



- TMX will activate if X1 becomes on whether X0 is on or off.

<Example 3>

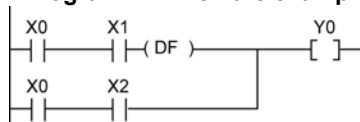


- When X2 was on prior to X0, Y1 will not be on even if X0 becomes on.

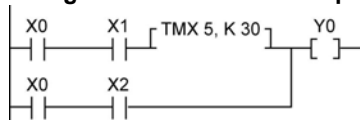
When a combination of contacts are set as the trigger (execution condition) of a differential instruction (DF) or timer instruction, do not use an AND stack (ANS) instruction, read stack (RDS) instruction, or pop stack (POPS) instruction.

Examples in which the above programs are rewritten

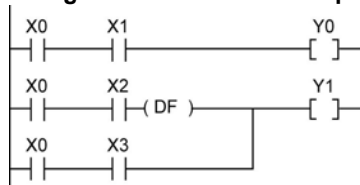
<Program in which the example 1 is rewritten>



<Program in which the example 2 is rewritten>



<Program in which the example 3 is rewritten>



11.7 Rewrite Function During RUN

11.7.1 Operation of Rewrite During RUN

How operation of rewrite during RUN

Rewriting programs can be executed even in RUN mode. When a rewrite is attempted during RUN, the tool service time is temporarily extended, program rewriting is performed, and operation is resumed without the need to change the mode. For this reason, the time of the scan during the RUN rewrite extends from several ms to several hundreds of ms.

Operation during rewrite

External output (Y) is held.

External input (X) is ignored.

The timer (T) stops the clock.

Rise and fall changes in the inputs of differential instructions (DF), counter instructions (CT), and left/right shift registers are ignored.

Interrupt functions are stopped.

Internal clock relays (special internal relays) are also stopped.

Pulse output is stopped during the rewrite.

Set values for timer/counter instructions

All set values specified with decimal constants (K) in timer and counter instructions are preset in the corresponding set value areas (SV). Values in the elapsed value area (EV) do not change.

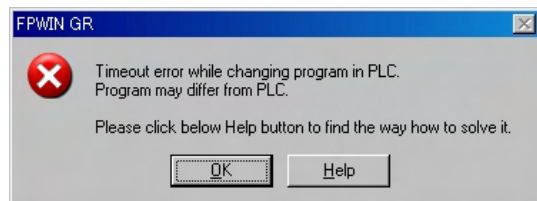
Operation of rewrite during RUN completed flag

The rewrite during RUN completed flag (R9034) is a special internal relay that goes on for only the first scan following the completion of rewriting in the RUN mode. It can be used instead of the initial pulse relay following a change in the program.

11.7.2 Cases Where Rewriting During Run is not Possible

When the timeout error message is indicated:

Even if the timeout error message is indicated, it is highly possible that the program in PLC has been already rewritten. Carry out the following operations.



1. When ladder symbol mode

As a ladder editing is left, set it to the offline edit mode. Complete the program conversion in the tool software, and then change to the online edit mode to check.

2. When boolean mode

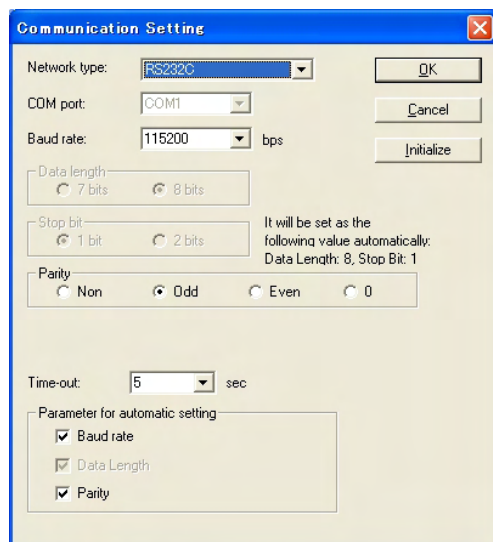
A ladder editing is cleared.

Set it to the offline edit mode and carry out the editing operation again. After the operation, change to the online edit mode to check.

When the timeout error occurs using the through mode in GT series programmable display.

Extend the timeout time of the programmable display using the GTWIN.

(The default setting is 5 seconds.)



Select "Transfer" from "File" in the menu bar. The "transfer data" screen will open. Select "Condition" to open "Communication Setting" screen. Change the value for "Timeout". Click "OK" button to complete the change of setting.

Cases where rewriting is not possible during RUN

1. When the result of rewriting is a syntax error.

<Example>

When executing the rewriting which does not form the following pair of instructions.

1. Step ladder instructions (SSTP/STPE)
2. Suroutine instructions (SUB/RET)
3. Interrupt instructions (INT/IRET)
4. JP/LBL
5. LOOP/LBL
6. MC/MCE

Also, rewriting is not possible during RUN in case of other syntax errors.

2. During the forced input/output operation

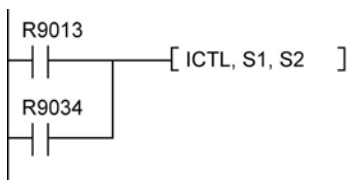
Interrupt restrictions

When using interrupt, high-speed counter, pulse output or PWM output functions, do not perform a rewrite during RUN.

If a rewrite during RUN is executed, the operation as below will be performed. Exercise caution.

1. Interrupt programs will be disabled. Enable by executing an ICTL instruction once again.

<Example> Using R9034 (rewrite during RUN completed flag)



2. The high-speed counter will continue to count.

Target value match on/off instructions (F166/F167) will continue.

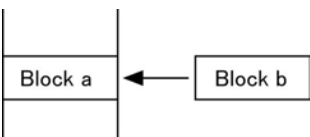
Coincidence interrupt programs will be disabled when the F166/F167 instruction is running.

3. Pulse output and PWM output will be stopped.

State	Instruction number	Name
Continue	F171 (SPDH)	Pulse output (with channel specification) (Home position return)
Stop	F172 (PLSH)	Pulse output (with channel specification) (JOG operation)
Stop	F173 (PWMH)	PWM output (with channel specification)
Continue	F174 (SP0H)	Pulse output (with channel specification) (Selectable data table control operation)
Continue	F175 (SPSH)	Pulse output (Linear interpolation)
Stop	F176 (SPCH)	Pulse output (Circular interpolation)

4. The regular sampling trace will not stop.

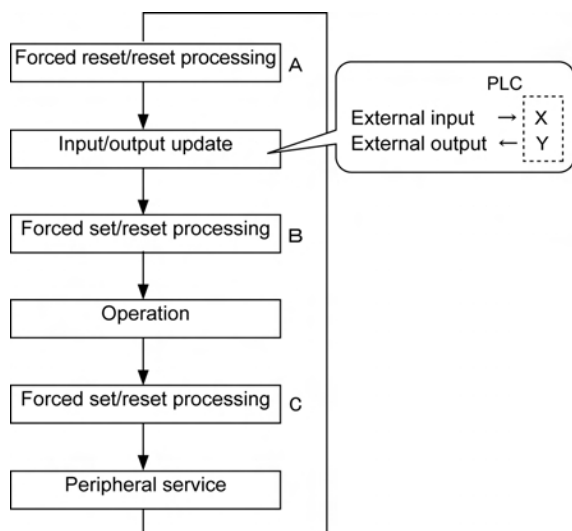
11.7.3 Procedures and Operation of Rewrite During RUN

Item		FPWIN GR Ladder symbol mode	FPWIN GR Boolean mode
Rewrite procedure		<p>Maximum jof 128 steps. Changes are performed by block. When PG conversion is executed online, the program will be rewritten.</p> 	<p>Rewriting performed by step. Caution is required as rewriting takes place simultaneously with the change.</p>
Operation of each instruction	OT/KP	If an instruction written in block a is deleted in block b, the condition before the rewrite will be held.	If an instruction written in block a is deleted in block b, the condition before the rewrite will be held. Y contact relays which are on bill be held in the on status. To turn them off in the RUN mode, use forced output.
	TM/CT	<ul style="list-style-type: none"> If an instruction written in block a is deleted in block b, the condition before the rewrite will be held. Set values specified by K constants in TM/CT instructions are preset in all of the corresponding SV's in the program. (Elapsed values EV do not change.) 	<ul style="list-style-type: none"> If an instruction written in block a is deleted in block b, the condition before the rewrite will be held. Set values specified by K constants in TM/CT instructions are preset in all of the corresponding SV's in the program. (Elapsed values EV do not change.)
	Fun High-level instructions	If an instruction written in block a is deleted in block b, the condition before the rewrite will be held.	<ul style="list-style-type: none"> If deleted, the output memory area will be held.
	MC/MCE	When writing MC/MCE instructions, be sure to write the instructions as a pair.	Writing or deleting a single instruction during RUN is not possible. Write or delete the instruction in FPWIN GR ladder symbol mode.
	CALL/SUB/RET	A subroutine is a program appearing between SUBn and RET instructions. Be sure to write it to an address which follows the ED instruction.	<p>Write in the order: RET, SUB, CALL</p> <p>Delete in the order: CALL, SUB, RET</p>
	INT/IRET	An interrupt program is a program appearing between INTn and IRET instructions. Be sure to write it to an address which follows the ED instruction.	<p>Write in the order: IRET, INT</p> <p>Delete in the order: INT, IRET</p>

Item		FPWIN GR Ladder symbol mode	FPWIN GR Boolean mode
Operation of each instructon	SSTP/STPE	A distance with the same number cannot be defined twice. An SSTP instruction cannot be written in a subprogram.	Write and deletion of a single instruction is not possible for a program with no step ladder area. Write or delete both instructions simultaneously in FPWIN GR ladder symbol mode. In the case of an SSTP instruction only, writing and deletion of a single instruction is possible for a program with a step ladder area.
	JP/LOOP/ LBL	Be sure to write the instruction for setting the loop number before LBL-LOOP instructions.	Write in the order: JP-LBL or LOOP-LBL Delete in the order: LBL-JP or LBL-LOOP

11.8 Processing During Forced Input and Output

11.8.1 Processing when forced input/output is initiated during RUN



1. Processing of external input (X)

- Regardless of the state of the input from the input device, forced on/off operation will take precedence at a contact specified for forced input/output in the above procedure B. At this time, the input LED will not blink, however, the area of input X in the operation memory will be rewritten.
- Contacts not specified will read in the on/off state according to the condition of the input from the input device.

2. Processing of external output (Y)

- Regardless of the result of operation, forced on/off will take precedence at a contact specified for forced input/output in the above procedure A. At this time, the area of output Y in the operation memory will be forcibly rewritten. External output will take place according to the input/output update timing in the above diagram.
- The on/off state of contacts not specified will be determined by the operation result.

3. Processing of Timer (T) and Counter (C)

- Regardless of the timer/counter input condition, forced on/off operation will take precedence at a contact specified for forced input/output. At this time, the contact of the timer (T) or counter (C) in the operation memory will be rewritten. Timing and counting will not take place during control.
- The on/off state of contacts not specified will be determined by the operation result.

Operation during operation

For small-sized PLCs FP0, FP1, FPΣ and FP-X

The internal relay R or output Y specified by OT or KP instruction is rewritten according to the results of operation. However, as the R or Y is set/reset again right before the peripheral service (as the above procedure C), the monitoring value with the tooling software or the output to external devices is forcibly rewritten to a specified value.

For medium-sized PLCs FP2 and FP2SH

For the internal relay R and output Y specified by OT or KP instruction, the value of the forced processing has a priority. When rewritten by a high-level instruction, the result of the instruction has a priority.

Chapter 12

Specifications

12.1 Table of Specifications

12.1.1 General Specifications

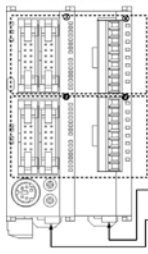
Item		Description	
Rated operating voltage		24V DC	
Operating voltage range		21.6 to 26.4V DC	
Allowed momentary power off time	C32 C28	4ms at 21.6V, 7ms at 24V, 10ms at 26.4V	
	C24	3ms at 21.6V, 5ms at 24V, 8ms at 26.4V	
Ambient temperature		0 to +55 °C	
Storage temperature		−20 to +70°C	
Ambient humidity		30 to 85%RH (at25°C non-condensing)	
Storage humidity		30 to 85%RH (at25°C non-condensing)	
Breakdown voltage	C32 C28	Between input/output terminals and power supply terminal/function earth	500VAC for 1 minute ^{Note)}
		Between input terminal and output terminal	
	C24	Between input terminals (X0 to X7)/input terminals (X8 to XF) and power supply terminal/function earth	500VAC for 1 minute ^{Note)}
		Between output terminals and power supply terminal/function earth	1500VAC for 1 minute ^{Note)}
		Between input terminals (X0 to X7) and input terminals (X8 to XF)	500VAC for 1 minute ^{Note)}
		Between input terminals (X0 to X7)/input terminals (X8 to XF) and output terminals	1500VAC for 1 minute ^{Note)}
Insulation resistance	C32	Between input/output terminals and power supply terminal/function earth	Min. 100MΩ (measured with a 500V DC megger)
	C28	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, 10 min on 3 axes	
Shock resistance		Shock of 98 m/s ² , 4 times on 3 axes	
Noise immunity		1000 Vp-p with pulse widths 50 ns and 1μs (based on in-house measurements)	
Operation condition		Free from corrosive gases and excessive dust	

Note) Cutoff current : 10 mA However, excluding varistor for protection. (Factory default setting value)

Weight

Unit type	Part No.	Weight
FPΣ control unit	FPG-C32/C28	Approx. 120g
	FPG-C24	Approx. 140g
FPΣ expansion unit	FPG-XY64D2T FPG-XY64D2P	Approx. 100g
	FPG-PP11/PP12	Approx. 75g
	FPG-PP21/PP22	Approx. 80g
	FPG-EM1	Approx. 80g
	FPG-CCLS	Approx. 90g
	FPG-SL	Approx. 85g
FP0 expansion units	FP0-E8X	Approx. 65g
	FP0-E8R/E8YR	Approx. 90g
	FP0-E8YT/E8YP	Approx. 65g
	FP0-E16R	Approx. 105g
	FP0-E16T/E16P/E 16X/E16YT/E16YP	Approx. 70g
	FP0-E32T/E32P	Approx. 85g
	FP0-A21	Approx. 80g
	FP0-A80	Approx. 90g
	FP0-IOL FP0-TC4	Approx. 85g
	FP0-TC8	Approx. 95g
	FP0-CCLS	Approx. 80g
	FP0-A04V/A04I	Approx. 75g

Unit's current consumption table

<div> <div>Example</div> <div>FPΣ control unit and FP0 Expansion Unit</div>  <div>Input circuit current consumption</div> <div>Output circuit current consumption</div> <div>Expansion unit current consumption</div> <div>Control unit current consumption</div> </div>		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 high-performance 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.	This is the current consumed by the output circuits of the various units. This value indicates the current used to drive the output circuits. This value does not include the load current value.
FPΣ control unit	FPG-C32 FPG-C28	90mA or less	–	77.2mA or less	70mA or less
	FPG-C24	160mA or less	–	77.2mA or less	None
FPΣ expansion unit	FPG-XY64D2T FPG-XY64D2P	35mA or less	–	112mA or less	15mA or less
FPΣ intelligent unit	FPG-PP11 FPG-PP12	50mA or less	20mA or less	–	–
	FPG-PP21 FPG-PP22	70mA or less	35mA or less	–	–
	FPG-EM1	35mA or less	–	–	–
	FPG-CCLS	40mA or less	40mA or less	–	–
	FPG-SL	40mA or less	–	–	–
FP0 expansion unit	FP0-E8X	10mA or less	–	34.4mA or less	–
	FP0-E8R	15mA or less	50mA or less	17.2mA or less	–
	FP0-E8YR	10mA or less	100mA or less	–	–
	FP0-E8YT/P	15mA or less	–	–	24mA or less
	FP0-E16X	20mA or less	–	68.8mA or less	–
	FP0-E16R	20mA or less	100mA or less	34.4mA or less	–
	FP0-E16T/P	25mA or less	–	34.4mA or less	24mA or less
	FP0-E16YT/P	25mA or less	–	–	48mA or less
	FP0-E32T/P	40mA or less	–	68.8mA or less	48mA or less
FP0 intelligent unit	FP0-A21	20mA or less	100mA or less	–	–
	FP0-A80	20mA or less	60mA or less	–	–
	FP0-A04V	20mA or less	100mA or less	–	–
	FP0-A04I	20mA or less	130mA or less	–	–
	FP0-TC4/C8	25mA or less	–	–	–
	FP0-IOL	30mA or less	40mA or less	–	–
	FP0-CCLS	40mA or less	40mA or less	–	–
Communication cassette	FPG-COM1 FPG-COM2	20mA or less	–	–	–
	FPG-COM3 FPG-COM4	25mA or less	–	–	–
Display GT01	AGT0030 AGT0032 AGT0130 AGT0132	80mA or less	–	–	–
C-NET adapter S2	AFP15402	50mA or less	–	–	–

12.1.2 Performance Specifications

FPΣ 12k type

Item		Descriptions			
		C32T C32TTM	C32T2 C32T2TM	C24R2 C24R2TM	C28P2 C28P2TM
No. of controllable I/O points	Control unit	32 points (DC input: 16, NPN output: 16)	32 points (DC input: 16, NPN output: 16)	24 points (DC input: 16, Relay output: 8)	28 points (DC input: 16, NPN output: 12)
	When using FP0 expansion units	Max. 128 points (up to 3 units)	Max. 128 points (up to 3 units)	Max. 120 units (up to 3 units) *When using transistor output type expansion units	Max. 124 points (up to 4 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	Max. 284 points (up to 4 units) *When using NPN 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	Max. 380 points (up to FP0 3 units and FPΣ 4 units) *When using NPN output type expansion units
Programming method/Control method		Relay symbol/Cyclic operation			
Program memory		Built-in Flash ROM (without backup battery)			
Program capacity		12000 steps			
No. of instruction	Basic	93			
	High-level	216	218	216	218
Operation speed		0.4 μs/step (by basic instruction)			
Ope- ration me- mory	Relay	External input (X) ^{Note1)}	512 points		
		External output (Y) ^{Note1)}	512 points		
		Internal relay (R)	1568 points (R0 to R97F)		
		Timer/ Counter (T/C)	1024 points ^{Note2)} (for initial setting, Timer: 1008 points (T0 to T1007), Counter: 16 points (C1008 to C1023)) Timer: can count up to (in units of 1ms, 10ms, 100ms or 1s)× 32767. Counter: Can count up to 1 to 32767.		
		Link relay(L)	1024 points		
	Mem ory area	Data register (DT)	32765 words (DT0 to DT32764)		
		Link register (LD)	128 words		
		Index register (I)	14 words (I0 to ID)		

Item		Descriptions			
		C32T C32TTM	C32T2 C32T2TM	C24R2 C24R2TM	C28P2 C28P2TM
Differential points		Unlimited points			
Master control relay points (MCR)		256 points			
No. of labels (JP and LOOP)		256 points			
No. of step ladders		1000 stages			
No. of subroutines		100 subroutines			
Pulse catch input		8 points (X0, X1, X3, X4: 5μs X2, X5 to X7: 100μs)			
No. of interrupt programs		9 programs (external input 8 points X0, X1, X3, X4: 5μs X2, X5 to X7: 100μs), periodical interrupt 1 point (0.5ms to 30s)			
Self-diagnosis function		Such as watchdog timer, program syntax check			
Calendar timer		Available (year, month, day, hour, minute, second and day of week) (However, this can only be used when a battery has been installed.) ^{Note3)}			
Flash ROM backup ^{Note4)}	Backup by F12, P13 instructions	Data register (32765 words)			
	Automatic backup when power is cut off	Counter 16 points (1008 to 1023), internal relay 128 points (R900 to R97F), data register 55 words (32710 to 32764)			
Battery backup		Memory that is set as hold area at system register (However, only when an optional battery has been installed.) ^{Note5)}			
Potentiometer (Volume) input		2 points, Resolution: 10 bits (K0 to K1000) (C32T, C32T2, C24R2, C28P2 only)			
Thermister input		2 points, Resolution: 10 bits (K0 to K1000) (C32TTM, C32T2TM, C24R2TM, C28P2TM only)			
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.			
PLC link function		Max. 16 units, Link relay: 1024 points, Link register: 128 words			
Other functions		Program edition during RUN, constant scan, forced on/off, password, floating-point operation, and PID processing			

Note1) The number of points actually available for use is determined by the hardware configuration.

Note2) The number of points can be increased by using an auxiliary timer.

Note3) Precision of calendar timer:

- At 0°C: less than 119 seconds per month
- At 25°C: less than 51 seconds per month
- At 55°C: less than 148 seconds per month

Note4) Writing is available up to 10000 times. 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.

Note5) If an area is held when the battery is not installed, the value of data may be indefinite as it is not cleared to 0 when the power is turned on. When the battery ran out of the power, the data at the hold area will be indefinite.

FPΣ 32k type

Item		Descriptions			
		C32TH C32THTM	C32T2H C32T2HTM	C24R2H C24R2HTM	C28P2H C28P2HTM
No. of controllable I/O points	Control unit	32 points (DC input: 16, NPN output: 16)	32 points (DC input: 16, NPN output: 16)	24 points (DC input: 16, Relay output: 8)	28 points (DC input: 16, NPN output: 12)
	When using FP0 expansion units	Max. 128 points (up to 3 units)	Max. 128 points (up to 3 units)	Max. 120 units (up to 3 units) *When using transistor output type expansion units	Max. 124 points (up to 3 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	Max. 284 points (up to 4 units) *When using NPN 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	Max. 380 points (up to FP0 3 units and FPΣ 4 units) *When using NPN output type expansion units
Programming method/Control method		Relay symbol/Cyclic operation			
Program memory		Built-in Flash ROM (without backup battery)			
Program capacity		32000 steps			
No. of instruction	Basic	93			
	High-level	216	218	216	218
Operation speed		0.32 μs/step (by basic instruction)			
Operation memory	Relay	External input (X)^{Note1)}	1184 points		
		External output (Y)^{Note1)}	1184 points		
		Internal relay (R)	4096 points (R0 to R255F)		
		Timer/ Counter (T/C)	1024 points ^{Note2)} (for initial setting, Timer: 1008 points (T0 to T1007), Counter: 16 points (C1008 to C1023)) Timer: can count up to (in units of 1ms, 10ms, 100ms or 1s)× 32767. Counter: Can count up to 1 to 32767.		
		Link relay(L)	2048 points		
	Memory area	Data register (DT)	32765 words (DT0 to DT32764)		
		Link register (LD)	256 words		
		Index register (I)	14 words (I0 to ID)		

Item		Descriptions			
		C32T C32TTM	C32T2 C32T2TM	C24R2 C24R2TM	C28P2 C28P2TM
Differential points		Unlimited points			
Master control relay points (MCR)		256 points			
No. of labels (JP and LOOP)		256 points			
No. of step ladders		1000 stages			
No. of subroutines		500 subroutines			
Pulse catch input		8 points (X0, X1, X3, X4: 5μs X2, X5 to X7: 100μs)			
No. of interrupt programs		9 programs (external input 8 points X0, X1, X3, X4: 5μs X2, X5 to X7: 100μs), periodical interrupt 1 point (0.5ms to 30s)			
Self-diagnosis function		Such as watchdog, program syntax check			
Calendar timer		Available (year, month, day, hour, minute, second and day of week) (However, this can only be used when a battery has been installed.) ^{Note3)}			
Flash ROM backup ^{Note4)}	Backup by F12, P13 instructions	Data register (32765 words)			
	Automatic backup when power is cut off	Counter 16 points (1008 to 1023), internal relay 128 points (R2480 to R255F), data register 55 words (32710 to 32764)			
Battery backup		Memory that is set as hold area at system register (However, only when an optional battery has been installed.) ^{Note5)}			
Potentiometer (Volume) input		2 points, Resolution: 10 bits (K0 to K1000) (C32TH, C32T2H, C24R2H, C28P2H only)			
Thermister input		2 points, Resolution: 10 bits (K0 to K1000) (C32THTM, C32T2HTM, C24R2HTM, C28P2HTM only)			
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. (328kbyte)			
PLC link function		Max. 16 units, Link relay: 1024 points, Link register: 128 words (Link area allocation can be switched between the first half and the second half.)			
Other functions		Program edition during RUN, constant scan, forced on/off, password, floating-point operation, and PID processing			

Note1)The number of points actually available for use is determined by the hardware configuration.

Note2)The number of points can be increased by using an auxiliary timer.

Note3)Precision of calendar timer:

- At 0°C: less than 119 seconds per month
- At 25°C: less than 51 seconds per month
- At 55°C: less than 148 seconds per month

Note4)Writing is available up to 10000 times. 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.

Note5)If an area is held when the battery is not installed, the value of data may be indefinite as it is not cleared to 0 when the power is turned on. When the battery ran out of the power, the data at the hold area will be indefinite.

High-speed counter, pulse output and PWM output specifications

Item		Descriptions	
High speed counter	No. of input points	When using single-phase: Max. 4 channels	When using 2-phase: Max. 2 channels
	Used ch. ^{Note2)}	ch0 to ch4	ch0, ch2
	Max. counting speed	When using single-phase: for 1 channel: Max. 50kHz (x1ch) for 2 channels: Max. 30kHz (x2ch) for 3 or 4 channels: Max. 20kHz (x3 to 4ch)	When using 2-phase: for 1 channel: Max. 20kHz (x1ch) for 2 channels: Max. 15kHz (x2ch)
	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	No. of output points	Max. 2 channels	
	Used ch ^{Note2)}	ch0, ch2	
	Output mode	CW and CCW mode, Pulse and Sign mode	
	Max. output frequency	When using 1 channel: Max. 100kHz (x1ch) When using 2 channels: Max. 60kHz (x2ch)	When using linear interpolation function: Max. 100kHz When using circular interpolation function: Max. 20kHz
	Input/output contact used ^{Note1)}	<ch0> X2: Home input Y0: CW output (Pulse output) Y1: CCW output (Sign output) Y2: Deviation counter reset output	<ch2> X5: Home input Y3: CW output (Pulse output) Y4: CCW output (Sign output) Y5: Deviation counter reset output
PWM output	No. of output points	Max. 2 channels	
	Used ch ^{Note2)}	ch0, ch2	
	Output frequency	1.5 to 12.5kHz (at resolution of 1000), 15.6 to 41.7kHz (at resolution of 100)	
	Output duty	0.0 to 99.9% (at resolution of 1000), 1 to 99% (at resolution of 100)	
	Output contact used ^{Note1)}	<ch0>Y0, <ch2>Y3	

Note1) 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 functions can be used as general inputs/outputs. Inputs X0 to X5 are pulse catch inputs, and can also be used for interrupt input.

Note2) The pulse output, PWM output and high-speed counter of the same channel cannot be used at the same time.

Communication Specifications

	Computer link ^{Note1) 9)}		General-purpose serial communication ^{Note1) 9)}		PC(PLC) link	MODBUS RTU ^{Note1)}	
	1:1 communication	1:N communication	1:1 communication	1:N communication		1:1 communication	1:N communication
Interface	RS232C	RS485	RS232C	RS485	RS232C RS485	RS232C	RS485
Target items	AFPG-801 AFPG-802 AFPG-806	AFPG-803 AFPG-806	AFPG-801 AFPG-802 AFPG-806	AFPG-803 AFPG-806	AFPG-801 AFPG-802 AFPG-803 AFPG-806	AFPG-801 AFPG-802 AFPG-806	AFPG-803 AFPG-806
Communication method	Half-duplex communication	Two-wire, half-duplex communication	Half-duplex communication	Two-wire, half-duplex communication	Token bus (Floating master)	Half-duplex communication	Two-wire, half-duplex communication

Note1) Although it has adequate tolerance to noise, it is recommendable to make the user program to execute retransmission (in order to improve reliability of the communication when a communication error occurs due to excessive noises or when a receiver equipment cannot receive data temporarily).

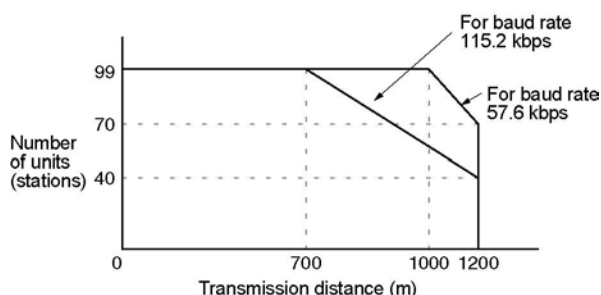
Note2) The number of units of the PC(PLC) link with RS232C is two.

Communication specifications

Item		Specifications
Interface		RS232C (non-isolated) RS485 (isolated) ^{Note1) 2)}
Communication mode		1:1 communication 1:N communication
Communication method		Half-duplex communication Two-wire half-duplex communication
Synchronous method		Start stop synchronous system
Transmission line		Multicore shielded line Shielded twisted-pair cable or VCTF
Transmission distance		15 m Max. 1200 m ^{Note1) 2)}
Baud rate ^{Note3) Note8)} (to be set by system register)		2400, 4800, 9600, 19200, 38400, 57600, 115200 bps
Transmission code	Computer link	ASCII
	General-purpose serial communication	ASCII, Binary
	MODBUS RTU	Binary
Communication format (to be set by system register) ^{Note4)}	Data length	7 bits/8 bits
	Parity	None/Even/Odd
	Stop bit	1 bit/2 bits
	Start code	STX/No STX
	End code	CR/CR+LF/None/ETX
No. of connected units ^{Note5) 6) 7)}		2 units Max. 99 units (Max. 32 units when C-NET adapter is connected.)

Note1) 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, transmission distance, and baud rate vary depending on the connected device.

Note2) The values for the transmission distance, baud rate and number of units should be within the values noted in the graph below.



When using a baud rate of 2400 bps to 38400 bps, you can set up to a maximum of 99 units (stations) and maximum transmission distance of 1200 m.

Note3) Only 9600 bps or 19200 bps can be specified when the C-NET adapter is connected with the RS485 interface.

Note4) The start code and end code can be used only in the general-purpose serial communication mode.

Note5) The converter SI-35 manufactured by Lineeye Co., Ltd is recommendable for the RS485 at the computer side. Adjust the response time for the FP-X by the SYS1 instruction if necessary.

Note6) Regarding the setting of unit numbers:

When the unit number setting switch is "0", the system register is effective.

When the unit number setting switch is other than "0", the unit number setting switch is effective, and the unit number setting of the system register is ignored.

(Max. 31 units can be specified with the unit number setting switch.) (When the setting is specified with the unit number setting switch, the COM port 1 and the COM port 2 has the same unit number.

Note7) Connect the "-" terminal and the "+" terminal with a lead wire to make the termination resistance of the AFG803 effective.

The termination resistance of the AFG806 is specified by the dip switch in the communication cassette.

There is no termination resistance at the RS232C port.

Note8) The RS485 port of the AFG806 is either 19200 bps or 115200 bps only.

Also the baud rate must be identically set by the system register and the dip switch in the communication cassette. The baud rate for the PC(PLC) link mode is fixed at 115200 bps.

The baud rate for the RS232C port of the AFG806 can be set by the system register only.

Note9) The MEWTOCOL master function, MODBUS RTU master function and general-purpose serial communication function at the TOOL port is available only for the FPΣ 32k type.

12.2 I/O No. Allocation

FPΣ control unit

Unit type		Allocation points	I/O No.
Control unit (NPN)	FPG-C32	Input: 16 points	X0 to XF
		Output: 16 points	Y0 to YF
Control unit (PNP)	FPG-C28	Input: 16 points	X0 to XF
		Output: 12 points	Y0 to YB
Control unit (Relay)	FPG-C24	Input: 16 points	X0 to XF
		Output: 8 points	Y0 to Y7

I/O No. of FPΣ expansion unit (for left side expansion)

- 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.

Unit type		Allocation points		Expansion unit 1 Slot 0	Expansion unit 2 Slot 1	Expansion unit 3 Slot 2	Expansion unit 4 Slot 3
FPΣ expansion unit	FPG-XY64D2T	Input: 32 points	—	X100 to X11F	X180 to X19F	X260 to X27F	X340 to X35F
	FPG-XY64D2P	Output: 32 points	—	Y100 to Y11F	Y180 to Y19F	Y260 to Y27F	Y340 to Y35F
FPΣ positioning unit	1-axis type: FPG-PP11 FPG-PP12	Input: 16 points	1st axis	X100 to X10F	X180 to X18F	X260 to X26F	X340 to X34F
		Output: 16 points		Y100 to Y10F	Y180 to Y18F	Y260 to Y26F	Y340 to Y34F
	2-axis type: FPG-PP21 FPG-PP22	Input: 32 points	1st axis	X100 to X10F	X180 to X18F	X260 to X26F	X340 to X34F
			2nd axis	X110 to X11F	X190 to X19F	X270 to X27F	X350 to X35F
		Output: 32 points	1st axis	Y100 to Y10F	Y180 to Y18F	Y260 to Y26F	Y340 to Y34F
			2nd axis	Y110 to Y11F	Y190 to Y19F	Y270 to Y27F	Y350 to Y35F
FPΣ expanded data memory unit	FPG-EM1	Input: 16 points	Battery error	X100 to X10F	X180 to X18F	X260 to X26F	X340 to X34F
FPΣ S-LINK unit	FPG-SL	Input	-	X100 to X17F	X180 to X25F	X260 to X33F	X340 to X41F
		Output	-	Y100 to Y17F	Y180 to Y25F	Y260 to Y33F	Y340 to Y41F

- Regarding FPΣ CC-Link slave unit, please refer to the exclusive manual.

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

- 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.

Unit type		Allocation points	Expansion unit 1	Expansion unit 2	Expansion unit 3
FP0 expansion unit	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/P FP0-E8YR	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	Input: 8 points	X20 to X27	X40 to X47	X60 to X67
	FP0-E16T/P	Output: 8 points	Y20 to Y27	Y40 to Y47	Y60 to Y67
	FP0-E16YT/P	Output: 16 points	Y20 to Y2F	Y40 to Y4F	Y60 to Y6F
FP0 analog I/O unit	FP0-A21	Input: 16 points (ch0)	WX2 (X20 to X2F)	WX4 (X40 to X4F)	WX6 (X60 to X6F)
		Input: 16 points (ch1)	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)
FP0 A/D converter unit FP0 thermocouple unit	FP0-A80 FP0-TC4 FP0-TC8	Input: 16 points (ch0, 2, 4, 6)	WX2 (X20 to X2F)	WX4 (X40 to X4F)	WX6 (X60 to X6F)
		Input: 16 points (ch1, 3, 5, 7)	WX3 (X30 to X3F)	WX5 (X50 to X5F)	WX7 (X70 to X7F)
FP0 D/A converter unit	FP0-A04V FP0-A04I	Input: 16 points	WX2 (X20 to X2F)	WX4 (X40 to X4F)	WX6 (X60 to X6F)
		Input: 16 points (ch0, 2, 4, 6)	WY2 (Y20 to Y2F)	WY4 (Y40 to Y4F)	WY6 (Y60 to Y6F)
		Input: 16 points (ch1, 3, 5, 7)	WY3 (Y30 to Y3F)	WY5 (Y50 to Y5F)	WY7 (Y70 to Y7F)
FP0 I/O link unit	FP0-IOL	Input: 32 points	X20 to X3F	X40 to X5F	X60 to X7F
		Output: 32 points	Y20 to Y3F	Y40 to Y5F	Y60 to Y7F

- The data of each channel for FP0 A/D converter unit (FP0-A80), FP0 thermocouple unit (FP0-TC4/FP0-TC8), FP0 D/A converter unit (FP0-A04V/FP0-A04I) is switched and read/write using a program that includes the flag for switching converted data.
- Regarding FP0 CC-Link slave unit, please refer to the exclusive manual.

12.3 Relays, Memory Areas and Constants

FPΣ 32k type

Item		Number of points and range of memory area available for use		Function
		C32T C32TTM	C32T2 C23T2TM C24R2 C24R2TM C28P2 C28P2TM	
Relay	External input ^{Note1)} (X)	512 points (X0 to X31F)	1184 points (X0 to X73F)	Turns on or off based on external input.
	External output ^{Note1)} (Y)	512 points (Y0 to Y31F)	1184 points (Y0 to Y73F)	Externally outputs on or off state
	Internal relay ^{Note2)} (R)	1568 points (R0 to R97F)		Relay which turns on or off only within program.
	Link relay ^{Note2)} (L)	1024 points (L0 to R97F)		This relay is a shared relay used for PLC link.
	Timer ^{Note2)} (T)	1024 points (T0 to T1007/C1008 to C1023) ^{Note3)}		This goes on when the timer reaches the specified time. It corresponds to the timer number.
	Counter ^{Note2)} (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 ^{Note1)} (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 ^{Note1)} (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 ^{Note2)} (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 ^{Note2)} (DT)	32765 words (DT0 to DT32764)		Data memory used in program. Data is handled in 16-bit units (one word).
	Link register ^{Note2)} (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 ^{Note2)} (SV)	1024 words (SV0 to SV1023)		Data memory for storing a target value of a timer and setting value of a counter. Stores by timer/counter number
	Timer/Counter elapsed value area ^{Note2)} (EV)	1024 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.
Control instruction point	Master control relay points (MCR)	256		
	Number of labels (JP and LOOP)	256		
	Number of step ladders	1000 stages		
	Number of subroutines	100 subroutines		
	Number of interrupt programs	9 programs (8 external input points "X0 to X7", 1 periodical interrupt point "0.5 ms to 30s")		

Item		Number of points and range of memory area available for use		Function
		C32T C32TTM	C32T2 C23T2TM C24R2 C24R2TM C28P2 C28P2TM	
Constant	Decimal constants (Integer type) (K)	K-32, 768 to K32, 767 (for 16-bit operation)		
		K-2, 147, 483, 648 to K2, 147, 483, 647 (for 32-bit operation)		
	Hexadecimal constants (H)	H0 to HFFFF (for 16-bit operation)		
		H0 to HFFFFFFFF (for 32-bit operation)		
	Floating point type (F)	F-1.175494 x 10 ⁻³⁸ to F-3.402823 x 10 ³⁸		
F-1.175494 x 10 ⁻³⁸ to F-3.402823 x 10 ³⁸				

Note1) 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.

Note2) 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). Writing is available up to 10000 times. Then 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. If an area is held when the battery is not installed, the value of data may be indefinite as it is not cleared to 0 when the power is turned on. When the battery ran out of the power, the data at the hold area will be indefinite.

Note3) 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.

FPΣ 32k type

Item		Number of points and range of memory area available for use	Function
		C32TH/C32THTM C32T2H/C32T2HTM C24R2H/C24R2HTM C28P2H/C28P2HTM	
Relay	External input ^{Note1)} (X)	1184 points (X0 to X73F)	Turns on or off based on external input.
	External output ^{Note1)} (Y)	1184 points (Y0 to Y73F)	Externally outputs on or off state
	Internal relay ^{Note2)} (R)	4096 points (R0 to R255F)	Relay which turns on or off only within program.
	Link relay ^{Note2)} (L)	2048 points (L0 to R127F)	This relay is a shared relay used for PLC link.
	Timer ^{Note2)} (T)	1024 points (T0 to T1007/C1008 to C1023) ^{Note3)}	This goes on when the timer reaches the specified time. It corresponds to the timer number.
	Counter ^{Note2)} (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 ^{Note1)} (WX)	74 words (WX0 to WX73)	Code for specifying 16 external input points as one word (16 bits) of data.
	External output ^{Note1)} (WY)	74 words (WY0 to WY73)	Code for specifying 16 external output points as one word (16 bits) of data.
	Internal relay ^{Note2)} (WR)	256 words (WR0 to WR255)	Code for specifying 16 internal relay points as one word (16 bits) of data.
	Link relay (WL)	128 words (WL0 to WL127)	Code for specifying 16 link relay points as one word (16 bits) of data.
	Data register ^{Note2)} (DT)	32765 words (DT0 to DT32764)	Data memory used in program. Data is handled in 16-bit units (one word).
	Link register ^{Note2)} (LD)	256 words (LD0 to LD255)	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 ^{Note2)} (SV)	1024 words (SV0 to SV1023)	Data memory for storing a target value of a timer and setting value of a counter. Stores by timer/counter number
	Timer/Counter elapsed value area ^{Note2)} (EV)	1024 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.
Control Instruction point	Master control relay points (MCR)	256	
	Number of labels (JP and LOOP)	256	
	Number of step ladders	1000 stages	
	Number of subroutines	100 subroutines	
	Number of interrupt programs	9 programs (8 external input points "X0 to X7", 1 periodical interrupt point "0.5 ms to 30s")	
Constant	Decimal constants (Integer type) (K)	K-32, 768 to K32, 767 (for 16-bit operation) K-2, 147, 483, 648 to K2, 147, 483, 647 (for 32-bit operation)	
	Hexadecimal constants (H)	H0 to HFFFF (for 16-bit operation) H0 to HFFFFFFFF (for 32-bit operation)	
	Floating point type (F)	F-1.175494 x 10 ⁻³⁸ to F-3.402823 x 10 ³⁸	
		F-1.175494 x 10 ⁻³⁸ to F-3.402823 x 10 ³⁸	

Note1) 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.

Note2) If no battery is used, only the fixed area is backed up. (counters 16 points: C1008 to C1023, internal relays 128 points: R2480 to R255F, data registers 55 words: DT32710 to DT32764). Writing is available up to 10000 times. Then 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. If an area is held when the battery is not installed, the value of data may be indefinite as it is not cleared to 0 when the power is turned on. When the battery ran out of the power, the data at the hold area will be indefinite.

Note3) 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.

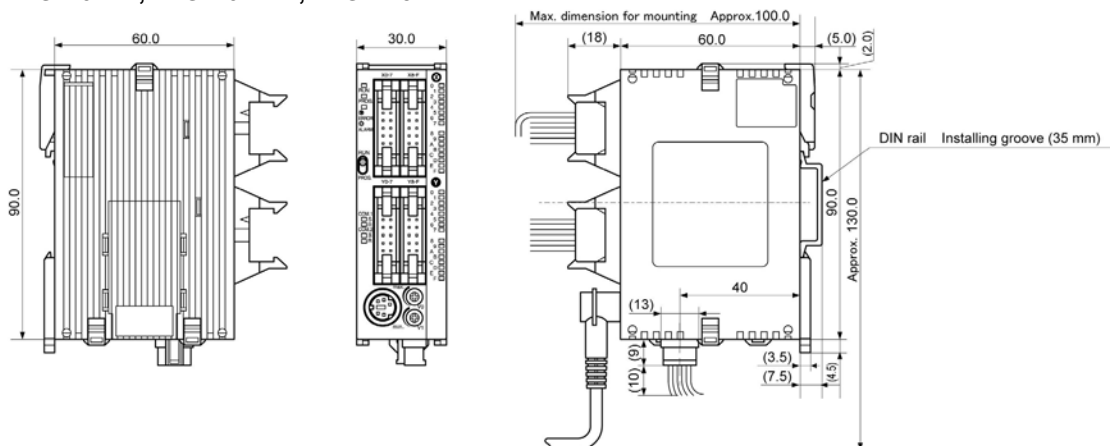
Chapter 13

Dimensions

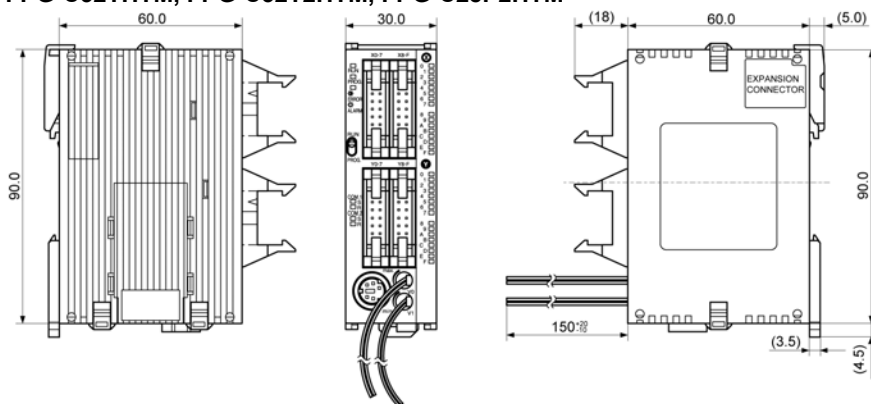
13.1 Dimensions

13.1.1 Control Unit (Transistor Output Type)

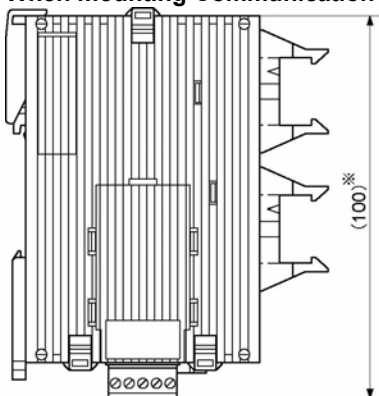
FPG-C32T, FPG-C32T2, FPG-C28P2
FPG-C32TH, FPG-C32T2H, FPG-C28P2H



FPG-C32TTM, FPG-C32T2TM, FPG-C28P2TM
FPG-C32THTM, FPG-C32T2HTM, FPG-C28P2HTM



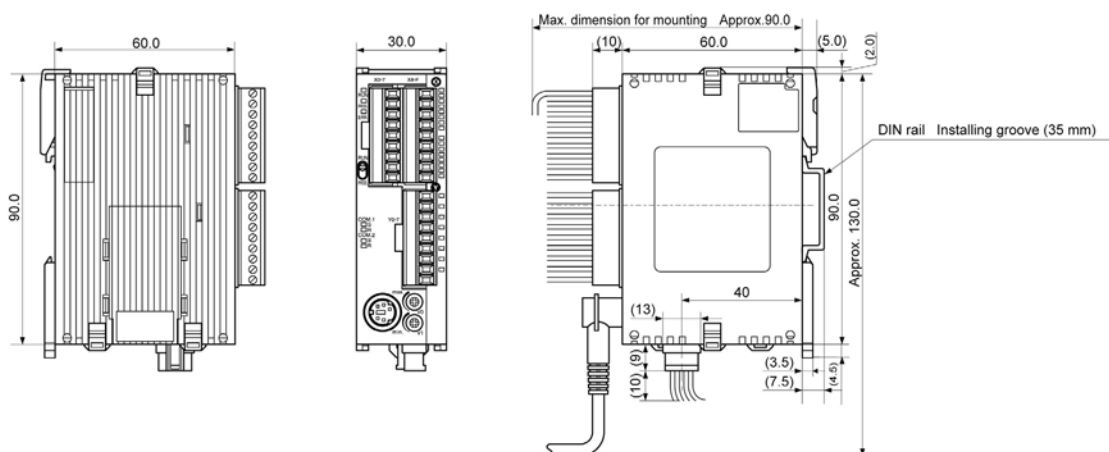
When mounting Communication cassette



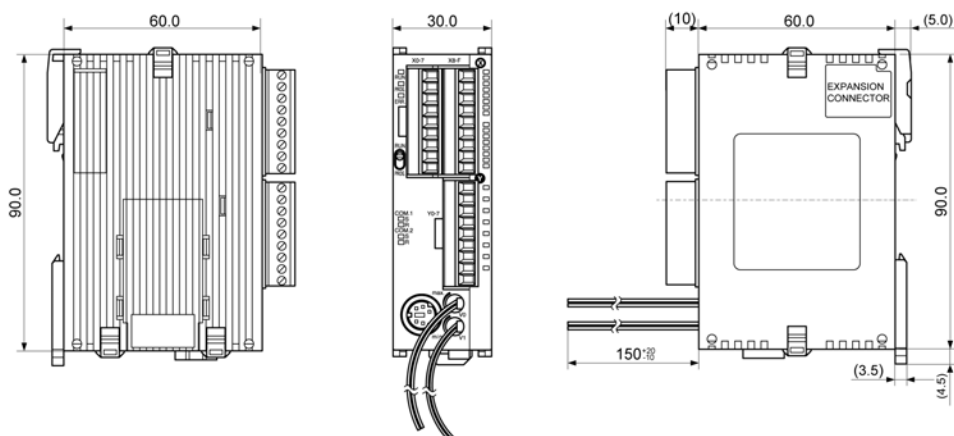
* The dimension with the communication cassette mounted is 105mm.

13.1.2 Control Unit (Relay Output Type)

FPG-C24R2, FPG-C24R2H



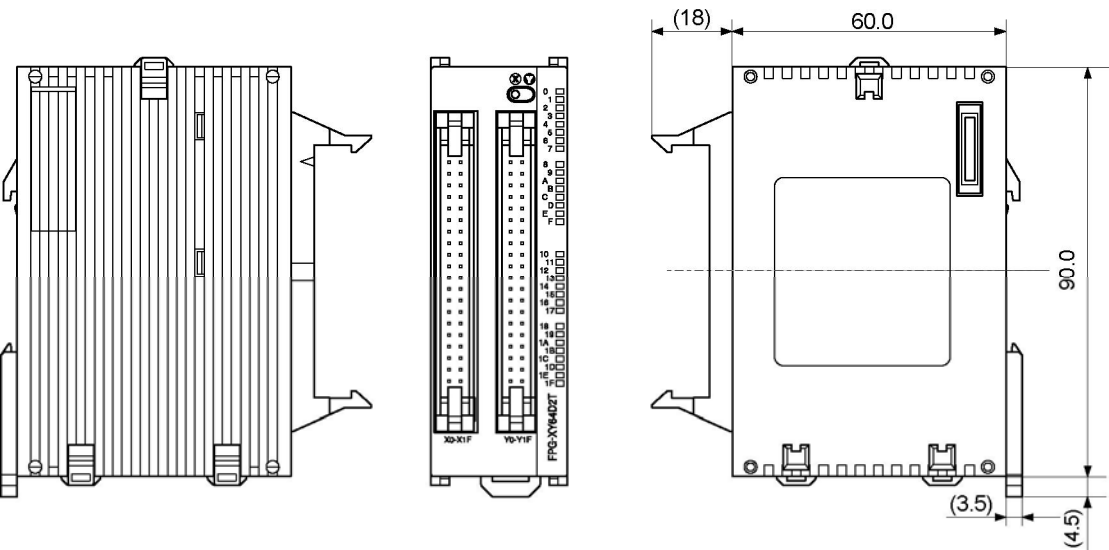
FPG-C24R2TM, FPG-C24R2HTM



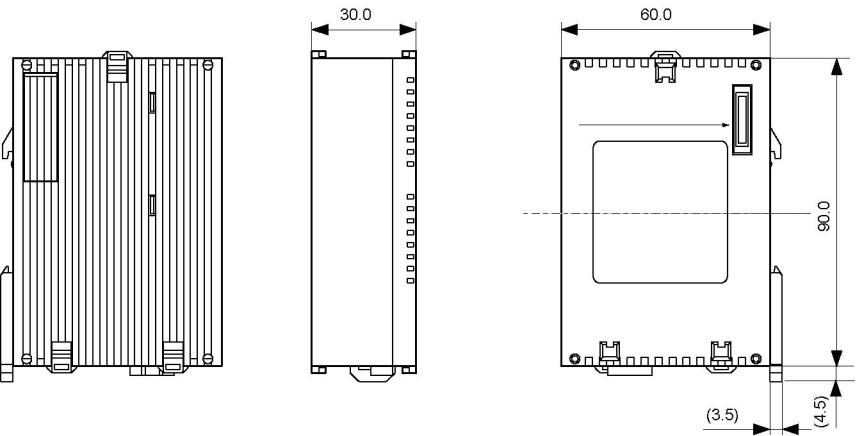
* The dimension with the communication cassette mounted is the same as the transistor output type.

13.1.3 Expansion Unit

FPG-XY64D2T, FPG-XY64D2P

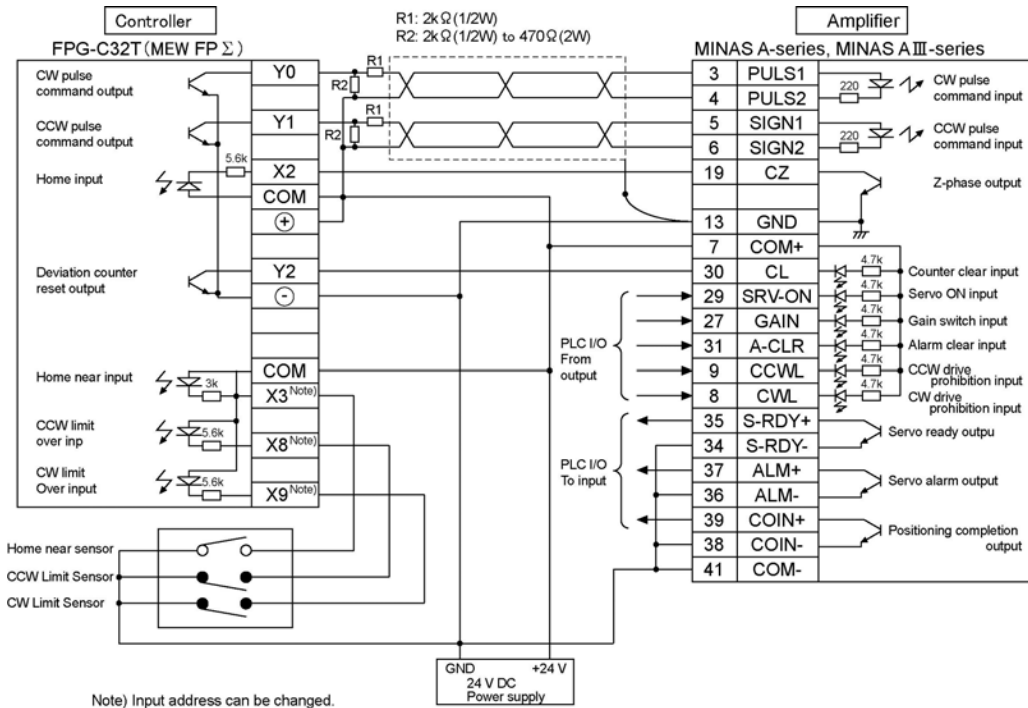


FPG-EM1

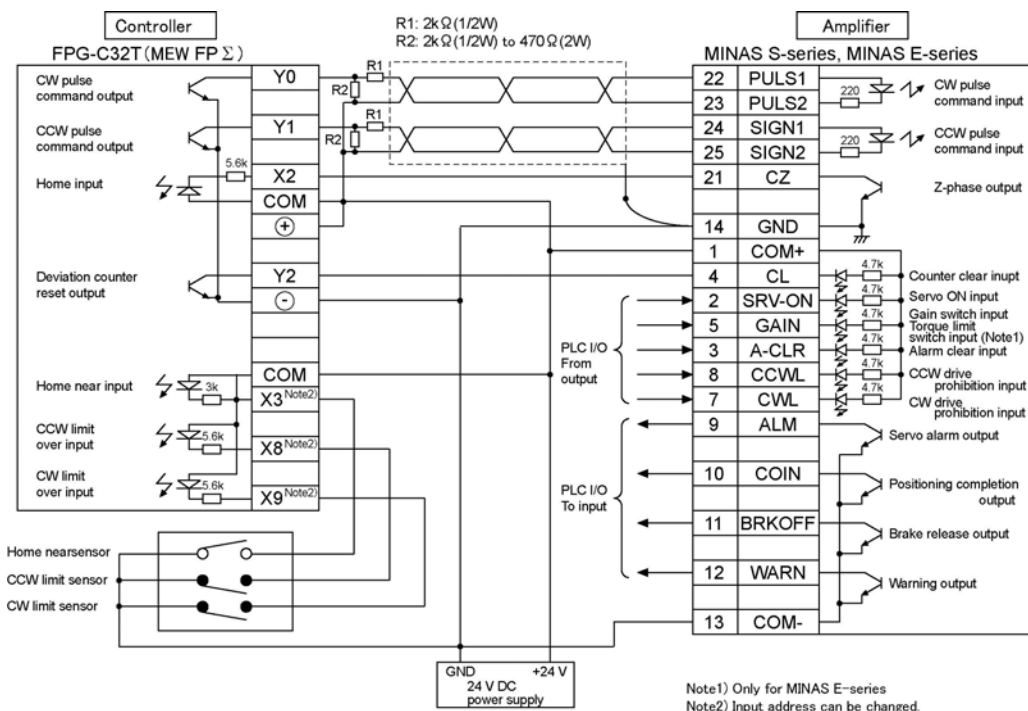


13.2 Connection Diagram with Motor Driver

13.2.1 Matsushita Electric Industrial Co., Ltd. MINAS A-series, AIII-series



13.2.2 Matsushita Electric Industrial Co., Ltd. MINAS Sseries, E-series



13.2.3 Power Supply Specification

FP0 Power Supply Unit (AFP0634)

Item		Description
Input	Rated operationg voltage	100-240 V AC
	Operating voltage range	85-264 V AC
	Rated frequency	50/60 Hz
	Operating frequency	47-63 Hz
	The number of phase	Single phase
	Inrush current	30 A(0-p) or less (Cold start)
	Leakage current	0.75 mA or less
	Holding time	10 ms or more
Output	Reted output	24 V ($\pm 5\%$) DC
	Rated current	0.7A
	Operating output current	0-0.7A
	Output ripple	500 mV
Protection feature	Over current regulation	0.735 A or more
	Over voltage regulation	Possible
Life time		20000h (at 55 °C)

Chapter 14

Appendix

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14.1 System Registers / Special Internal Relays / Special Data Registers

Precation for 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

The registers to be used depend on each PLC.

(1) Allocation of user memory (System registers 0, 1 and 2)

These registers set the size of the program area and file register area, allowing the user memory area to be configured for the environment used. The size of the memory area will vary depending on the type.

(2) Allocation of timers and counters (System register 5)

The number of timers and counters is set by specifying the starting counter number.

(3) Hold/non-hold type setting (System registers 6 to 18)

When these registers are set to "hold type", the values in the relays and data memory will be retained even if the system is switched to PROG. mode or the power is turned off. If set to "non-hold type", the values will be cleared to "0".

(4) Operation mode setting on error (System registers 4, 20 to 28)

Set the operation mode when errors such as battery error, duplicated use of output, I/O verification error and operation error occur.

(5) Time settings (System registers 30 to 34)

Set time-out error detection time and the constant scan time.

(6) Remote I/O operation settings (System registers 35 and 36)

These registers are used to select whether or not to wait for a slave station connection when the remote I/O is started, and the remote I/O update timing.

(7) MEWNET-W0/MEWNET-W/P PLC link settings (System registers 40 to 47, 50 to 55, and 57)

These settings are for using link relays and link registers for MEWNET-W0/MEWNET-W/P PC(PLC) link communication.

Note) The default value setting is "no PC(PLC) link communication".

(8) MEWNET-H PC(PLC) link settings (System register 49)

Set the data size to be processed during one scan in the MEWNET-H PC(PLC) link communication.

(9) Input settings (System registers 400 to 406)

When using the high-speed counter function, pulse catch function or interrupt function, set the operation mode and the input number to be used for the function.

(10) Input time constant settings (FP1/FP-M System registers 404 to 407)

Changing the input signal width to be loaded enables to prevent the malfunctions caused by chattering or noises.

(11) Number of temperature input averaging process settings (System register 409)

The number of averaging times can be set in order to even out the variation in the input thermocouple values. For normal use it, set the number of times to at least twenty. For default value "0", the number of average processing times is 20.

(12) Tool and COM. ports communication settings (System registers 410 to 421)

Set these registers when the Tool port, and COM1 and COM2 ports are to be used for computer link, general-purpose serial communication, PC(PLC) link, and modem communication. Note that the default setting is computer link mode.

Checking and changing the set value of system register

If you are going to use a value which is already set (the value which appears when read), there is no need write it again.

Using programming tool software

Produce:

1. Set the control unit in the PROG mode.
2. Option -> PLC Configuration
3. When the function for which setting 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, choose OK

Precautions for system register setting

-System register settings are effective from the time they are set.

However, input settings, tool port, COM port, and modem connection 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.

14.1.1 Table of System Registers for FPΣ

	No.	Name	Default value	Descriptions	
Hold/ Non-hold 1	5	Starting number setting for counter	1008	0 to 1024	<ul style="list-style-type: none">• These settings are effective if the optional backup battery is installed.• If no backup battery is used, do not change the default settings. Otherwise proper functioning of hold/non-hold values cannot be guaranteed.
	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	12k: 90 32k: 0 to 256	12k: 0 to 98 32k: 0 to 256	
	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	
	4	Previous value is held for a leading edge detection instruction (DF instrucion) with MC ^{Note)}	Hold	Hold/ Non-hold	
Hold/ Non-hold 2	10	Hold type area starting word number for PC(PLC) link relays (for PC(PLC) link 0)	64	0 to 64	
	11	Hold type area starting word number for PC(PLC) link relays (for PC(PLC) link 1)	128 (32k only)	64 to 128	
	12	Hold type area starting number for PC(PLC) link registers (for PC(PLC) link 0)	128	0 to 128	
	13	Hold type area starting number for PC(PLC) link registers (for PC(PLC) link 1)	256 (32k only)	128 to 256	
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	Dis-abled: Ena-bled:	When a battery error occurs, a self-diagnostic error is not issued and the ERROR/ALARM LED does not flash. When a battery error occurs, a self-diagnostic error is issued and the ERROR/ALARM LED flashes.

Note) The 12k type is available with Ver. 1.4 to 1.9, 2.4 or later.

	No.	Name	Default value	Descriptions
Time setting	31	Wait time setting for multi-frame communication	6500.0 ms	10 to 81900 ms
	32	Communication timeout setting for SEND/RECV, RMRD/RMWT commands	10000.0 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
PC (PLC) link 0 setting	40	Range of link relays used for PC(PLC) link	0	0 to 64 words
	41	Range of link data registers used for PC(PLC) link	0	0 to 128 words
	42	Starting word 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
	46	PC(PLC) link switch flag	Normal (32k only)	Normal/reverse
	47	Maximum unit number setting for MEWNET-W0 PC(PLC) link	16	1 to 16
PC (PLC) link 1 setting (32k only)	50	Range of link relays used for PC(PLC) link	0	0 to 64 words
	51	Range of link data registers used for PC(PLC) link	0	0 to 128 words
	52	Starting word number for link relay transmission	64	64 to 127
	53	Link relay transmission size	0	0 to 64 words
	54	Starting number for link data register transmission	128	128 to 255
	55	Link data register transmission size	0	0 to 127 words
	57	Maximum unit number setting for MEWNET-W0 PC(PLC) link	16	1 to 16

	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. Two-phase input (X0, X1) Two-phase input (X0, X1), Reset input (X2) Incremental input (X0) Incremental input (X0), Reset input (X2) Decremental input (X0) Decremental input (X0), Reset input (X2) incremental/decremental input (X0, X1) incremental/decremental input (X0, X1), Reset input (X2) Incremental/decremental control input (X0, X1) Incremental/decremental control input (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. Incremental input (X1) Incremental input (X1), Reset input (X2) Decremental input (X1) Decremental input (X1), Reset input (X2)
	401	High-speed counter operation mode settings (X3 to X5)	CH2: Do not set input X3 as high-speed counter	CH2	Do not set input X3 as high-speed counter. Two-phase input (X3, X4) Two-phase input (X3, X4), Reset input (X5) Incremental input (X3) Incremental input (X3), Reset input (X5) Decremental input (X5) Decremental input (X5), Reset input (X5) Incremental/decremental input (X3, X4) Incremental/decremental input (X3, X4), Reset input (X5) Incremental/decremental control (X3, X4) Incremental/decremental control (X3, X4), Reset input (X5)
			HC3: Does not set input X4 as high-speed counter	CH3	Does not set input X4 as high-speed counter. Incremental input (X4) Incremental input (X4), Reset input (X5) Decremental input (X4) Decremental input (X4), Reset input (X5)

	No.	Name	Default value	Descriptions
Inter- rupt- input	402	Pulse catch input settings	Not set	<div>X0 X1 X2 X3 X4 X5 X6 X7</div> <div><input type="checkbox"/><input type="checkbox"/><input type="checkbox"/><input type="checkbox"/><input type="checkbox"/><input type="checkbox"/><input type="checkbox"/><input type="checkbox"/></div> Specify the input contacts used as pulse catch input.
	403	Interrupt input settings	Not set	<div>X0 X1 X2 X3 X4 X5 X6 X7</div> <div><input type="checkbox"/><input type="checkbox"/><input type="checkbox"/><input type="checkbox"/><input type="checkbox"/><input type="checkbox"/><input type="checkbox"/><input type="checkbox"/></div> Specify the input contacts used as interrupt input. <div>X0 X1 X2 X3 X4 X5 X6 X7</div> <div><input type="checkbox"/><input type="checkbox"/><input type="checkbox"/><input type="checkbox"/><input type="checkbox"/><input type="checkbox"/><input type="checkbox"/><input type="checkbox"/></div> Specify the effective interrupt edge. (When set: ON→OFF is valid)

Note1) If the operation mode is set to Two-phase, incremental/decremental, or incremental/decremental control, the setting for CH1 is invalid in part 2 of system register 400 and the setting for CH3 is invalid in part2 of system register 401.

Note2) If reset input settings overlap, the CH1 setting takes precedence in system register 400 and the CH3 setting takes precedence in system register 401.

Note3) The settings for pulse catch and interrupt input can only be specified in system registers 402 and 403.

Note4) 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 addition input mode, even if input X0 is specified as an interrupt input or as pulse catch input, those settings are invalid, and X0 functions as counter input for the high-speed counter.

	No.	Name	Default value	Descriptions
Tool port setting	410	Unit No. setting	1	1 to 99
	412	Communication mode setting	Computer link	Computer link General-purpose communications
		Selection of modem connection	Disabled	Enabled/Disabled
	413	Communication format setting	Data length bit: 8 bits Parity check: "with odd" Stop bit: 1 bit	Enter the settings for the various items. - Data length bit: 7 bits/8 bits - Parity check: none/with odd/with even - Stop bit: 1 bit/2 bits - The following setting is valid only when the communication mode specified by system register 412 has been set to "General-purpose serial communication". - Terminator CR/CR+LF/None - 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
	420	Starting address for received buffer of general (serial data) communication mode	0	0 to 32764
COM 1 port setting	421	Buffer capacity setting for data received of general (serial data) communication mode	0	0 to 2048
	410	Unit No. setting	1	1 to 99
	412	Communication mode setting	Computer link	Computer link General-purpose serial communication PC(PLC) link MODBUS RTU
		Selection of modem connection	Disabled	Enabled/Disabled
	413	Communication format setting	Data length bit: 8 bits Parity check: Odd Stop bit: 1 bit	Enter the settings for the various items. - Data length bit: 7 bits/8 bits - Parity check: none/with odd/with even - Stop bit: 1 bit/2 bits - The following setting is valid only when the communication mode specified by system register 412 has been set to "General-purpose serial communication". - Terminator CR/CR+LF/None - 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 in a PLC link is fixed at the following settings:

Data length is 8 bits, odd parity, stop bit is 1.

The communication speed (baud rate) is fixed at 115200 bps.

The transmission speed of the RS485 port (COM1) of AFP806 must be identically set by the system register and the dip switch in the communication cassette.

	No.	Name	Default value	Descriptions
COM 2 port set- ting	411	Unit No. setting	1	1 to 99
	412	Communication mode setting	Computer link	Computer link General-purpose serial communication MODBUS RTU
		Selection of modem connection	Disabled	Enabled/Disabled
	414	Communication format setting	Data length bit: 8 bits Parity check: "with odd" Stop bit: 1 bit	Enter the settings for the various items. - Data length bit: 7 bits/8 bits - Parity check: none/odd/even - Stop bit: 1 bit/2 bits - The following setting is valid only when the communication mode specified by system register 412 has been set to "General-purpose serial communication". - Terminator: CR/CR+LF/None - 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	2048	0 to 32764
	417	Buffer capacity setting for data received of general (serial data) communication mode	2048	0 to 2048

Note) The communication format in a 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 115200 bps.

The transmission speed of the RS485 port (COM1) of AFP806 must be identically set by the system register and the dip switch in the communication cassette.

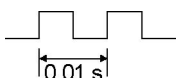
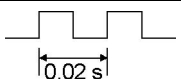
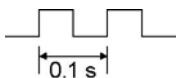
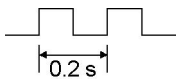
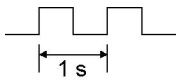
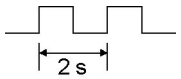
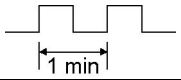
14.1.2 Table of Special Internal Relays for FP Σ

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.

WR900

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 when a backup battery error occurs.
R9006	Backup battery error flag (hold)	Turns on 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 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.

WR901

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	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	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 only the first scan of a process after the boot at the step ladder control.
R9016	Not used	-
R9017	Not used	-
R9018	0.01 s clock pulse relay	Repeats on/off operations in 0.01 sec. 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	-

WR902

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 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	Sample point flag ^{Note)}	Sampling by the instruction=0 Sampling at constant time intervals=1
R902D	Sample trace end flag ^{Note)}	When the sampling operation stops=1, When the sampling operation starts=0
R902E	Sampling stop trigger flag ^{Note)}	When the sampling stop trigger activates=1 When the sampling stop trigger stops=0
R902F	Sampling enable flag ^{Note)}	When sampling starts=1 When sampling stops=0

Note) Available for the 32k type only.

WR903

Relay No.	Name		Description
R9030	Not used		-
R9031	Not used		-
R9032	COM1 port communication mode flag		<ul style="list-style-type: none"> - Turns on when the general-purpose communication function is being used - 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		Goes on for only the first scan following completion of a rewrite during the RUN operation.
R9035	Not used		-
R9036	Not used		-
R9037	COM1 port communication error flag		<ul style="list-style-type: none"> - Goes on is a transmission error occurs during data communication. - Goes off when a request is made to send data, using the F159 (MTRN) instruction.
R9038	COM1 port reception done flag during general purpose communication		- Turns on when the terminator is received during general - purpose serial communication.
R9039	COM1 port transmission done flag during general-purpose serial communication		<ul style="list-style-type: none"> - Goes on when transmission has been completed in general-purpose serial communication. - Goes off when transmission is requested in general-purpose serial communication.
R903A	High-speed counter control flag	ch0	Turn on while the high-speed counter instructions F166(HC15), F167(HC1R) and the pulse output instructions F171(SPDH) to F176(PWMH) are executed.
R903B	High-speed counter control flag	ch1	Turn on while the high-speed counter instructions F166(HC15), F167(HC1R) and the pulse output instructions F171(SPDH) to F176(PWMH) are executed.
R903C	High-speed counter control flag	ch2	Turn on while the high-speed counter instructions F166(HC15), F167(HC1R) and the pulse output instructions F171(SPDH) to F176(PWMH) are executed.
R903D	High-speed counter control flag	ch3	Turn on while the high-speed counter instructions F166(HC15), F167(HC1R) and the pulse output instructions F171(SPDH) to F176(PWMH) are executed.
R903E	TOOL port reception done flag during general purpose communication		- Turns on when the terminator is received during general - purpose serial communication.
R903F	TOOL port transmission done flag during general-purpose serial communication		<ul style="list-style-type: none"> - Goes on when transmission has been completed in general-purpose serial communication. - Goes off when transmission is requested in general-purpose serial communication.

Note) R9030 to R9030F can be changed during 1 scan.

WR904

Relay No.	Name	Description
R9040	TOOL port operation mode flag	- Turns on when the general-purpose communication function is being used. - Goes off when the computer link function is being used.
R9041	COM1 port PLC link flag	Turn on while the PLC link function is used.
R9042	COM2 port communication mode flag	- Goes on when the general-purpose serial communication is used. - Goes off when the MEWTOCOL is used.
R9043	Not used	-
R9044	COM1 port SEND/RECV instruction execution flag	Monitors whether the F145 (SEND) or F146 (RECV) instructions can be executed or not. Off: None of the above mentioned instructions can be executed. (During executing the instruction) On: One of the above mentioned instructions can be executed.
R9045	COM1 port SEND/RECV instruction execution end flag	Monitors if an abnormality has been detected during the execution of the F145 (SEND) or F146 (RECV) instructions as follows: Off: No abnormality detected. On: An abnormality detected. (communication error) The error code is stored in DT90039. End code: DT90124
R9046	Not used	-
R9047	COM2 port communication error flag	- Goes on if a transmission error occurs during data communication. - Goes off when a request is made to send data, using the F159 (MTRN) instruction.
R9048	COM2 port port reception done flag during general-purpose communicating	- Turn on when the terminator is received during general-purpose serial communication.
R9049	COM2 port transmission done flag during general-purpose communication	- Goes on when transmission has been completed in general-purpose serial communication. - Goes off when transmission is requested in general-purpose communication.
R904A	COM2 port SEND/RECV instruction execution flag	Monitors whether the F145 (SEND) or F146 (RECV) instructions can be executed or not. Off: None of the above mentioned instructions can be executed. (During executing the instruction) On: One of the above mentioned instructions can be executed.
R904B	COM2 port SEND/RECV instruction execution end flag	Monitors if an abnormality has been detected during the execution of the F145 (SEND) or F146 (RECV) instructions as follows: Off: No abnormality detected. On: An abnormality detected. (communication error) The error code is stored in DT90039. End code: DT90125
R904C to R904D	Not used	-
R904E	Circular interpolation control flag	Goes on when the F176 (SPCH) circular interpolation instruction is executed.
R904F	Circular interpolation data overwrite confirmation flag	It is used to overwrite next data when the circular interpolation instruction is used in the continuation mode.

Note) R9040 to R904F can be changed during 1 scan.

WR905

Relay No.	Name	Description
R9050	MEWNET-W0 PLC link transmission error flag	When using MEWNET-W0 - Turns on when a transmission error occurs at PLC link. - Turns on when there is an error in the PLC link area settings.
R9051 to R905F	Not used	

WR906

Relay No.	Name	Description
R9060	MEWNET-W0 PC(PLC) link 0 transmission assurance relay	Unit No.1 Turns on when Unit No. 1 is communicating properly in PC(PLC) link 0 mode. Turns off when operation is stopped, when an error occurs, or when not in the PC(PLC) link 0 mode.
R9061		Unit No.2 Turns on when Unit No. 2 is communicating properly in PC(PLC) link 0 mode. Turns off when operation is stopped, when an error occurs, or when not in the PC(PLC) link 0 mode.
R9062		Unit No.3 Turns on when Unit No. 3 is communicating properly in PC(PLC) link 0 mode. Turns off when operation is stopped, when an error occurs, or when not in the PC(PLC) link 0 mode.
R9063		Unit No.4 Turns on when Unit No. 4 is communicating properly in PC(PLC) link 0 mode. Turns off when operation is stopped, when an error occurs, or when not in the PC(PLC) link 0 mode.
R9064		Unit No.5 Turns on when Unit No. 5 is communicating properly in PC(PLC) link 0 mode. Turns off when operation is stopped, when an error occurs, or when not in the PC(PLC) link 0 mode.
R9065		Unit No.6 Turns on when Unit No. 6 is communicating properly in PC(PLC) link 0 mode. Turns off when operation is stopped, when an error occurs, or when not in the PC(PLC) link 0 mode.
R9066		Unit No.7 Turns on when Unit No. 7 is communicating properly in PC(PLC) link 0 mode. Turns off when operation is stopped, when an error occurs, or when not in the PC(PLC) link 0 mode.
R9067		Unit No.8 Turns on when Unit No. 8 is communicating properly in PC(PLC) link 0 mode. Turns off when operation is stopped, when an error occurs, or when not in the PC(PLC) link 0 mode.
R9068		Unit No.9 Turns on when Unit No. 9 is communicating properly in PC(PLC) link 0 mode. Turns off when operation is stopped, when an error occurs, or when not in the PC(PLC) link 0 mode.
R9069		Unit No.10 Turns on when Unit No. 10 is communicating properly in PC(PLC) link 0 mode. Turns off when operation is stopped, when an error occurs, or when not in the PC(PLC) link 0 mode.
R906A		Unit No.11 Turns on when Unit No. 11 is communicating properly in PC(PLC) link 0 mode. Turns off when operation is stopped, when an error occurs, or when not in the PC(PLC) link 0 mode.
R906B		Unit No.12 Turns on when Unit No. 12 is communicating properly in PC(PLC) link 0 mode. Turns off when operation is stopped, when an error occurs, or when not in the PC(PLC) link 0 mode.
R906C		Unit No.13 Turns on when Unit No. 13 is communicating properly in PC(PLC) link 0 mode. Turns off when operation is stopped, when an error occurs, or when not in the PC(PLC) link 0 mode.
R906D		Unit No.14 Turns on when Unit No. 14 is communicating properly in PC(PLC) link 0 mode. Turns off when operation is stopped, when an error occurs, or when not in the PC(PLC) link 0 mode.
R906E		Unit No.15 Turns on when Unit No. 15 is communicating properly in PC(PLC) link 0 mode. Turns off when operation is stopped, when an error occurs, or when not in the PC(PLC) link 0 mode.
R906F		Unit No.16 Turns on when Unit No. 16 is communicating properly in PC(PLC) link 0 mode. Turns off when operation is stopped, when an error occurs, or when not in the PC(PLC) link 0 mode.

WR907

Relay No.	Name	Description
R9070	MEWNET-W0 PC(PLC) link 0 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.

WR908

Relay No.	Name	Description
R9080	MEWNET-W0 PC(PLC) link 1 transmission assurance relay (32k only)	Turns on when Unit No. 1 is communicating properly in PC(PLC) link 1 mode. Turns off when operation is stopped, when an error occurs, or when not in the PC(PLC) link 1 mode.
R9081		Turns on when Unit No. 2 is communicating properly in PC(PLC) link 1 mode. Turns off when operation is stopped, when an error occurs, or when not in the PC(PLC) link 1 mode.
R9082		Turns on when Unit No. 3 is communicating properly in PC(PLC) link 1 mode. Turns off when operation is stopped, when an error occurs, or when not in the PC(PLC) link 1 mode.
R9083		Turns on when Unit No. 4 is communicating properly in PC(PLC) link 1 mode. Turns off when operation is stopped, when an error occurs, or when not in the PC(PLC) link 1 mode.
R9084		Turns on when Unit No. 5 is communicating properly in PC(PLC) link 1 mode. Turns off when operation is stopped, when an error occurs, or when not in the PC(PLC) link 1 mode.
R9085		Turns on when Unit No. 6 is communicating properly in PC(PLC) link 1 mode. Turns off when operation is stopped, when an error occurs, or when not in the PC(PLC) link 1 mode.
R9086		Turns on when Unit No. 7 is communicating properly in PC(PLC) link 1 mode. Turns off when operation is stopped, when an error occurs, or when not in the PC(PLC) link 1 mode.
R9087		Turns on when Unit No. 8 is communicating properly in PC(PLC) link 1 mode. Turns off when operation is stopped, when an error occurs, or when not in the PC(PLC) link 1 mode.
R9088		Turns on when Unit No. 9 is communicating properly in PC(PLC) link mode. Turns off when operation is stopped, when an error occurs, or when not in the PC(PLC) link mode.
R9089		Turns on when Unit No. 10 is communicating properly in PC(PLC) link 1 mode. Turns off when operation is stopped, when an error occurs, or when not in the PC(PLC) link 1 mode.
R908A		Turns on when Unit No. 11 is communicating properly in PC(PLC) link 1 mode. Turns off when operation is stopped, when an error occurs, or when not in the PC(PLC) link 1 mode.
R908B		Turns on when Unit No. 12 is communicating properly in PC(PLC) link 1 mode. Turns off when operation is stopped, when an error occurs, or when not in the PC(PLC) link 1 mode.
R908C		Turns on when Unit No. 13 is communicating properly in PC(PLC) link 1 mode. Turns off when operation is stopped, when an error occurs, or when not in the PC(PLC) link 1 mode.
R908D		Turns on when Unit No. 14 is communicating properly in PC(PLC) link 1 mode. Turns off when operation is stopped, when an error occurs, or when not in the PC(PLC) link 1 mode.
R908E		Turns on when Unit No. 15 is communicating properly in PC(PLC) link 1 mode. Turns off when operation is stopped, when an error occurs, or when not in the PC(PLC) link 1 mode.
R908F		Turns on when Unit No. 16 is communicating properly in PC(PLC) link 1 mode. Turns off when operation is stopped, when an error occurs, or when not in the PC(PLC) link 1 mode.

WR909

Relay No.	Name	Description
R9090	MEWNET-W0 PC(PLC) link 1 operation mode relay (32k only)	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.
R9091		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.
R9092		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.
R9093		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.
R9094		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.
R9095		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.
R9096		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.
R9097		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.
R9098		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.
R9099		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.
R909A		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.
R909B		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.
R909C		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.
R909D		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.
R909E		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.
R909F		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.

14.1.3 Table of Special Data Registers for FPΣ

The special data registers are one word (16-bit) memory areas which store specific information.

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

Register No.	Name	Descriptions	Read-ing	Writ-ing
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	<p>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.</p> <p>15 11 7 3 2 1 0 (Bit No.)</p> <p>3 2 1 0 (Unit No.)</p> <p>on "1": error, off "0": normal</p>	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	<p>When an error condition is detected in an intelligent unit, the bit corresponding to the unit No. will turn on . Monitor using binary display.</p> <p>15 11 7 3 2 1 0 (Bit No.)</p> <p>3 2 1 0 (Unit No.)</p> <p>on "1": error, off "0": normal</p>	A	N/A
DT90007	Not used		N/A	N/A
DT90008	Not used		N/A	N/A
DT90009	Communication error flag for COM2	Stores the error contents when using COM2 port.	A	N/A
DT90010	Position of I/O verify error unit for FP0 right side expansion	<p>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 turn on. Monitor using binary display.</p> <p>15 11 7 3 2 1 0 (Bit No.)</p> <p>2 1 0 (Unit No.)</p> <p>on "1": error, off "0": normal</p>	A	N/A

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

Register No.	Name	Descriptions	Read-ing	Writing
DT90011	Position of I/O verify error unit for FPΣ left side expansion	<p>When the state of installation of an FPΣ expansion I/O unit has changed since the power was turned on, the bit corresponding to the unit No. will turn on. Monitor using binary display.</p> <div style="text-align: center;"> <div style="display: flex; justify-content: space-around; margin-bottom: 5px;"> 151173210 (Bit No.) </div> <div style="border: 1px solid black; width: 100px; height: 15px; margin: 0 auto;"></div> <div style="display: flex; justify-content: space-around; margin-top: 5px;"> 3210 (Unit No.) </div> </div> <p>on "1": error, off "0": normal</p>	A	N/A
DT90012	Not used		N/A	N/A
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	<p>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.</p>	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 an operation error occurred is stored. Each time an error occurs, the new address overwrites the previous address. At the beginning of a scan, the address is 0. Monitor the address using decimal display.	A	N/A
DT90019	2.5 ms ring counter Note1)	<p>The data stored here is increased by one every 2.5 ms. (H0 to HFFFF)</p> <p>Difference between the values of the two points (absolute value) x 2.5 ms = Elapsed time between the two points.</p>	A	N/A
DT90020	10 μs ring counter Note1) Note2)	<p>The data stored here is increased by one every 10.24 μs. (H0 to HFFFF)</p> <p>Difference between the values of the two points (absolute value) x 10.24 μs = Elapsed time between the two points.</p> <p>Note) The exact value is 10.24 μs.</p>	A	N/A
DT90021	Not used		N/A	N/A

Note1) It is renewed once at the beginning of each one scan.

Note2) As DT90020 is renewed even if F0(MV), DT90020 and D instruction is being executed, it can be used to measure the block time.

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

Register No.	Name	Descriptions	Read-ing	Writ-ing															
DT90022	Scan time (current value) <small>Note)</small>	The current scan time is stored here. Scan time is calculated using the formula: Scan time (ms) = stored data (decimal) x 0.1 ms Example: K50 indicates 5 ms.	A	N/A															
DT90023	Scan time (minimum value) <small>Note)</small>	The minimum scan time is stored here. Scan time is calculated using the formula: Scan time (ms) = stored data (decimal) x 0.1 ms Example: K50 indicates 5 ms.	A	N/A															
DT90024	Scan time (maximum value) <small>Note)</small>	The maximum scan time is stored here. The scan time is calculated using the formula: Scan time (ms) = stored data (decimal) x 0.1 ms Example: K125 indicates 12.5 ms.	A	N/A															
DT90025	Mask condition monitoring register for interrupts (INT0 to 7)	The mask conditions of interrupts using the instruction can be stored here. Monitor using binary display. <div style="text-align: center;"> <table style="margin: auto;"> <tr> <td>15</td><td>11</td><td>7</td><td>3</td><td>0 (Bit No.)</td></tr> <tr> <td colspan="5" style="border: 1px solid black; height: 15px; position: relative;"> <div style="position: absolute; left: 0; right: 0; top: 0; bottom: 0; border: 1px solid black;"></div> </td></tr> <tr> <td colspan="2" style="text-align: center;">7</td><td colspan="2" style="text-align: center;">3</td><td>0 (INT No.)</td></tr> </table> <p>0: interrupt disabled 1: interrupt enabled</p> </div>	15	11	7	3	0 (Bit No.)	<div style="position: absolute; left: 0; right: 0; top: 0; bottom: 0; border: 1px solid black;"></div>					7		3		0 (INT No.)	A	N/A
15	11	7	3	0 (Bit No.)															
<div style="position: absolute; left: 0; right: 0; top: 0; bottom: 0; border: 1px solid black;"></div>																			
7		3		0 (INT No.)															
DT90026	Not used		N/A	N/A															
DT90027	Periodical interrupt interval (INT24)	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		N/A	N/A															
DT90030	Message 0	The contents of the specified message (Data length) 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															

Note) Scan time display is only possible in RUN mode, and shows the operation cycle time. (In PROG. mode, the scan time for the operation is not displayed.) The maximum and minimum values are cleared each time the mode is switched from RUN to PROG.

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

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

Register No.	Name		Descriptions	Reading	Writing
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 tiemrs 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
DT90044	High-speed counter elapsed value	For CH0	The elapsed value (32-bit data) of the high-speed counter is stored here. The value can be read or written by executing F1 (DMV) instruction.	A	A
DT90045					
DT90046	High-speed counter target value	For CH0	The targe 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
DT90047					
DT90048	High-speed counter elapsed value area	For CH1	The elapsed value (32-bit data) of the high-speed counter is stored here. The value can be read and written by executing F1 (DMV) instruction.	A	A
DT90049					
DT90050	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
DT90051					

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

Register No.	Name	Descriptions	Read-ing	Writ-ing												
DT90052	High-speed counter and pulse output control flag	<p>A value can be written with F0 (MV) instruction to reset the high-speed counter, disable counting, continue or clear high-speed counter instruction.</p> <p>Control code setting</p> <div><div><div>151243210</div><div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div></div><div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div></div></div><p>Channel setting [HSC] 0 to 3: CH0 to CH3 [PLS] 0, 2: CH0, CH2</p><p>[PLS] Home near input 0: Invalid/1: Valid</p><p>[HSC] High-speed counter instruction 0: Continue/1: Clear [PLS] Pulse output 0: Continue/1: Stop</p><p>[HSC] Hardware reset 0: Enable/1: Disable</p><p>[HSC] [PLS] Count 0: Enable/1: Disable</p><p>[HSC] [PLS] Software reset 0: No/1: Yes</p><p>Note) Refer to the “Count for reset input” in “Count 6.3.2 “Input Mode and Count”</p></div>	N/A	A												
DT90053	Clock/calendar monitor (hour/minute)	<p>Hour and minute data of the clock/calendar are stored here. This data is read-only data. It cannot be overwritten.</p> <div><div>Higher byteLower byte</div><div><div></div><div></div></div><p>Hour data H00 to H23 Minute data H00 to H59</p></div> <td>A</td> <td>N/A</td>	A	N/A												
DT90054	Clock/calendar setting (minute/second)	<p>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 by writing a value using a programming tool software or a program that uses the F0 (MV) instruction.(see example for DT90058)</p> <div><div>Higher byteLower byte</div><div><div></div><div></div></div><table><tr><td>DT90054</td><td>Minute data (H00 to H59)</td><td>Second data (H00 to H59)</td></tr><tr><td>DT90055</td><td>Day data (H01 to H31)</td><td>Hour data (H00 to H23)</td></tr><tr><td>DT90056</td><td>Year data (H00 to H99)</td><td>Month data (H01 to H12)</td></tr><tr><td>DT90057</td><td>—</td><td>Day-of-the-week (H00 to H06)</td></tr></table><p>As a day of the week is not automatically set on FPWIN GR, fix what day is set to 00, and set each value for 00 to 06.</p></div>	DT90054	Minute data (H00 to H59)	Second data (H00 to H59)	DT90055	Day data (H01 to H31)	Hour data (H00 to H23)	DT90056	Year data (H00 to H99)	Month data (H01 to H12)	DT90057	—	Day-of-the-week (H00 to H06)	A	A
DT90054	Minute data (H00 to H59)		Second data (H00 to H59)													
DT90055	Day data (H01 to H31)		Hour data (H00 to H23)													
DT90056	Year data (H00 to H99)	Month data (H01 to H12)														
DT90057	—	Day-of-the-week (H00 to H06)														
DT90055	Clock/calendar setting (day/hour)															
DT90056	Clock/calendar setting (year/month)															
DT90057	Clock/calendar setting (day-of-the-week)															

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

Register No.	Name	Descriptions	Read-ing	Writ-ing
DT90058	Clock/calendar time setting	<p>The clock calendar is adjusted as follows. When setting the clock/calendar by program By setting 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.)</p> <p><Example> Set the time to 12:00:00 on the 5th day when the X0 turns on.</p> <pre> graph LR X0((X0)) --> DF1[DF] DF1 --> F0_0[F0 MV, H 0, DT90054] F0_0 --- Note1[Inputs 0 minutes and 0 seconds] X0 --> DF2[DF] DF2 --> F0_512[F0 MV, H 512, DT90055] F0_512 --- Note2[Inputs 12th hour 5th day] X0 --> DF3[DF] DF3 --> F0_H8000[F0 MV, H8000, DT90058] F0_H8000 --- Note3[Sets the time] </pre> <p>Note) If the values of DT90054 to DT90057 are changed with the programming tool software, the time will be set when the new values are written. Therefore, it is unnecessary to write to DT90058.</p>	A	A
DT90059	Serial communication error code	Error code is sotred here when a communication error occurs.	N/A	N/A

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

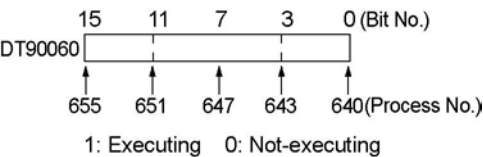
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Register No.	Name	Descriptions	Read- ing	Writ- ing
DT90060	Step ladder process (0 to 15)	<p>Indicates the startup condition of the step ladder process. When the process starts up, the bit corresponding to the process number turns on.</p> <p>Monitor using binary display.</p> <p><Example></p> <div><div>1511730 (Bit No.)</div><div>DT90060<div></div></div><div>730 (Process No.)</div><div>1: Executing 0: Not-executing</div></div> <p>A programming tool software can be used to write data.</p>	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)			
DT90077	Step ladder process (272 to 287)			
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)			

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

Register No.	Name	Descriptions	Reading	Writing
DT90082	Step ladder process (352 to 367)	<p>Indicates the startup condition of the step ladder process. When the process starts up, the bit corresponding to the process number turns on .</p> <p>Monitor using binary display.</p> <p><Example></p> <div style="text-align: center;"> <div style="display: flex; justify-content: space-around; margin-bottom: 5px;"> 1511730 (Bit No.) </div> <div style="display: flex; align-items: center;"> DT90060 <div style="border: 1px solid black; width: 150px; height: 15px; position: relative;"> <div style="position: absolute; top: -10px; left: 0; right: 0; text-align: center;"> 15 11 7 3 0 (Process No.) </div> </div> </div> <p>1: Executing 0: Not-executing</p> <p>A programming tool software can be used to write data.</p> </div>	A	A
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)			

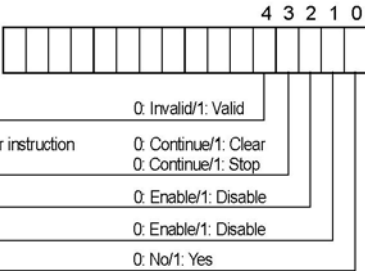
(A: Available, N/A: Not available)

Register No.	Name	Descriptions	Read- ing	Writ- ing
DT90098	Step ladder process (608 to 623)	<p>Indicates the startup condition of the step ladder process. When the process starts up, the bit corresponding to the process number turns on "1".</p> <p>Monitor using binary display</p> <p><Example></p>  <p>1: Executing 0: Not-executing</p> <p>A programming tool software can be used to write data.</p>	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 is not used.)			

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

Register No.	Name	Descriptions	Read- ing	Writ- ing
DT90123	Not used	-	N/A	N/A
DT90124	COM1 SEND/RECV instruction end code	For details, refer to Programming Manual (F145 and F146).	N/A	N/A
DT90125	COM2 SEND/RECV instruction end code	For details, refer to Programming Manual (F145 and F146).	N/A	N/A
DT90126	Forced Input/Output unit No.	Used by the system	N/A	N/A
DT90127 to DT90139	Not used	-	N/A	N/A
DT90140	MEWNET-W0 PC(PLC) link 0 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 x 2.5ms		
DT90142		The minimum interval between two receiving operations: value in the register x 2.5ms		
DT90143		The maximum interval between two receiving operations: value in the register x 2.5ms		
DT90144		The number of times the sending operation is performed.		
DT90145		The current interval between two sending operations: value in the register x 2.5ms		
DT90146		The minimum interval between two sending operations: value in the register x 2.5ms		
DT90147		The maximum interval between two sending operations: value in the register x 2.5ms		
DT90148	MEWNET-W0 PC(PLC) link 1 status (32k type only)	The number of times the receiving operation is performed.	A	N/A
DT90149		The current interval between two receiving operations: value in the register x 2.5ms		
DT90150		The minimum interval between two receiving operations: value in the register x 2.5ms		
DT90151		The maximum interval between two receiving operations: value in the register x 2.5ms		
DT90152		The number of times the sending operation is performed.		
DT90153		The current interval between two sending operations: value in the register x 2.5ms		
DT90154		The minimum interval between two sending operations: value in the register x 2.5ms		
DT90155		The maximum interval between two sending operations: value in the register x 2.5ms		

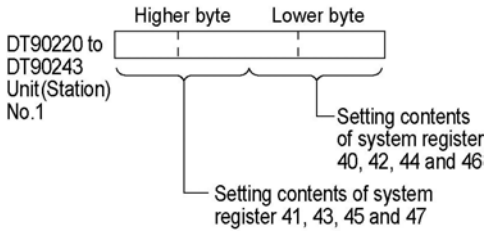
(A: Available, N/A: Not available)

Register No.	Name	Descriptions	Reading	Writing
DT90156	MEWNET-W0 PC(PLC) link 0 status	Area used for measurement of receiving interval.	A	N/A
DT90157		Area used for measurement of sending interval.		
DT90158	MEWNET-W0 PC(PLC) link 1 Status (32k type only)	Area used for measurement of receiving interval.	A	N/A
DT90159		Area used for measurement of sending interval.		
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
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 underfined 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	<p>This monitors the data specified in DT90052.</p>  <p>Home near input 0: Invalid/1: Valid</p> <p>High-speed counter instruction 0: Continue/1: Clear</p> <p>Pulse output 0: Continue/1: Stop</p> <p>Hardware reset 0: Enable/1: Disable</p> <p>Count 0: Enable/1: Disable</p> <p>Software reset 0: No/1: Yes</p>	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			

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

Register No.	Name		Descriptions	Reading	Writing
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 the 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					
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 the F1 (DMV) instruction.	A	N/A
DT90207					
DT90208 to DT90218	Not used			N/A	N/A








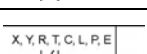

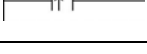
(A: Available, N/A: Not available)

Register No.	Name		Descriptions	Read- ing	Writ- ing
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 regis- ter 40 and 41	<p>The contents of the system register settings pertaining to the PLC inter-link function for the various unit numbers are stored as shown below.</p> <p><Example> When DT90219 is 0</p> 	A	N/A
DT90221		System regis- ter 42 and 43			
DT90222		System regis- ter 44 and 45			
DT90223		System regis- ter 46 and 47			
DT90224	PLC link Unit (station) No. 2 or 10	System regis- ter 40 and 41			
DT90225		System regis- ter 42 and 43			
DT90226		System regis- ter 44 and 45			
DT90227		System regis- ter 46 and 47			
DT90228	PLC link Unit (station) No. 3 or 11	System regis- ter 40 and 41			
DT90229		System regis- ter 42 and 43			
DT90230		System regis- ter 44 and 45			
DT90231		System regis- ter 46 and 47			
DT90232	PLC link Unit (station) No. 4 or 12	System regis- ter 40 and 41			
DT90233		System regis- ter 42 and 43			
DT90234		System regis- ter 44 and 45			
DT90235		System regis- ter 46 and 47			
DT90236	PLC link Unit (station) No. 5 or 13	System regis- ter 40 and 41			
DT90237		System regis- ter 42 and 43			
DT90238		System regis- ter 44 and 45			
DT90239		System regis- ter 46 and 47			

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

Register No.	Name		Descriptions	Reading	Writing
DT90240	PLC link Unit (station) No. 6 or 14	System register 40 and 41	<p>The contents of the system register settings pertaining to the PLC inter-link function for the various unit numbers are stored as shown below.</p> <p><Example> when DT90219 is 0.</p>	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			
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	Not used			N/A	N/A
DT90253	Not used				
DT90254	Not used				
D590255	Not used				
DT90256	Unit No. (Station No.) switch monitor for COM port		Used by the system	N/A	N/A

14.2 Table of Basic Instructions

Name	Boolean	Symbol	Description	Steps Note1)
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 (2)
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)
Leading edge start	ST↑		Begins a logic operation only for one scan when the leading edge of the trigger is detected.	2
Trailing edge start	ST↓		Begins a logic operation only for one scan when the trailing edge of the trigger is detected.	2


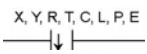





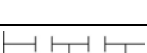
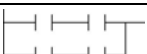
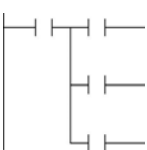
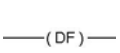
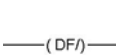
Note1) In the FP2/FP2SH/FP10SH, when using X1280, Y1280, R1120 (special internal relay included), L1280, T256, C256 or anything beyond for the ST, ST/, OT, AN, AN/, OR and OR/ instructions, the number of steps is shown in parentheses. Also, in the FP2/FP2SH/FP10SH, when a relay number has an index modifier, the number of steps is shown in parentheses.

Name	Availability												
	FP0	FPΣ	FP-X	FP-φ	FP1			FP-M		FP3	FP2	FP2SH	FP10SH
					C14 C16	C24 C40	C56 C72	C16	C20 C32				
Sequence basic instructions													
Start	A	A	A	A	A	A	A	A	A	A	A	A	A
Start Not	A	A	A	A	A	A	A	A	A	A	A	A	A
Out	A	A	A	A	A	A	A	A	A	A	A	A	A
Not	A	A	A	A	A	A	A	A	A	A	A	A	A
AND	A	A	A	A	A	A	A	A	A	A	A	A	A
AND Not	A	A	A	A	A	A	A	A	A	A	A	A	A
OR	A	A	A	A	A	A	A	A	A	A	A	A	A
OR Not	A	A	A	A	A	A	A	A	A	A	A	A	A
Leading edge start	N/A	Partly N/A Note2)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A
Trailing edge start	N/A	Partly N/A Note2)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A

• A: Available, N/A: Not available

Note1) The type of the devices that can be specified depends on the models.

Note2) This instruction is available for FP-X Ver. 2.0 or later and FPsigma Ver.3.10 or later.

Name	Boolean	Symbol	Description	Steps Note1)
Leading edge AND	AN↑		Connects a Form A (normally open) contact serially only for one scan when the leading edge of the trigger is detected.	2
Trailing edge AND	AN↓		Connects a Form A (normally open) contact serially only for one scan when the trailing edge of the trigger is detected.	2
Leading edge OR	OR↑		Connects a Form A (normally open) contact in parallel only for one scan when the leading edge of the trigger is detected.	2
Trailing edge OR	OR↓		Connects a Form A (normally open) contact in parallel only for one scan when the trailing edge of the trigger is detected.	2
Leading edge out	OT↑		Outputs the operated result to the specified output only for one scan when leading edge of the trigger is detected. (for pulse relay)	2
Trailing edge out	OT↓		Outputs the operated result to the specified output only for one scan when trailing edge of the trigger is detected. (for pulse relay)	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

Note1) In the FP2/FP2SH/FP10SH, when using X1280, Y1280, R1120 (special internal relay included), L1280, T256, C256 or anything beyond for the ST, ST/, OT, AN, AN/, OR and OR/ instructions, the number of steps is shown in parentheses. Also, in the FP2/FP2SH/FP10SH, when a relay number has an index modifier, the number of steps is shown in parentheses.


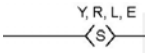
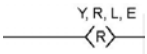
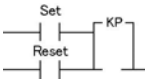
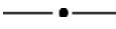
Name	Availability												
	FP0	FP2	FP-X	FP-φ	FP1			FP-M		FP3	FP2	FP2SH	FP10SH
					C14 C16	C24 C40	C56 C72	C16	C20 C32				
Leading edge AND	N/A	Partly N/A <small>Note2)</small>	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A
Trailing edge AND	N/A	Partly N/A <small>Note2)</small>	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A
Leading edge OR	N/A	Partly N/A <small>Note2)</small>	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A
Trailing edge OR	N/A	Partly N/A <small>Note2)</small>	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A
Leading edge out	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A
Trailing edge out	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A
Alternative out	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A
AND stack	A	A	A	A	A	A	A	A	A	A	A	A	A
OR stack	A	A	A	A	A	A	A	A	A	A	A	A	A
Push stack <small>Note3)</small>	A	A	A	A	A	A	A	A	A	A	A	A	A
Read stack	A	A	A	A	A	A	A	A	A	A	A	A	A
Pop stack <small>Note3)</small>	A	A	A	A	A	A	A	A	A	A	A	A	A
Leading edge differential	A	A	A	A	A	A	A	A	A	A	A	A	A
Trailing edge differential	A	A	A	A	A	A	A	A	A	A	A	A	A

• A: Available, N/A: Not available

Note1) The type of the devices that can be specified depends on the models.

Note2) This instruction is available for FP-X Ver. 2.0 or later.





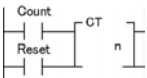

Note3) The allowable number of using the PSHS and RDS instruction depends on the models.

Name	Boolean	Symbol	Description	Steps Note1)
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 (2)
No operation	NOP		No operation.	1

Note1) In the FP2/FP2SH/FP10SH, when using Y1280, R1120 (special internal relay included), L1280 or anything beyond for the KP instruction, the number of steps is shown in parentheses. Also, in the FP2/FP2SH/FP10SH, when a relay number has an index modifier, the number of steps is shown in parentheses.

Name	Availability												
	FP0	FP2	FP-X	FP-φ	FP1			FP-M		FP3	FP2	FP2SH	FP10SH
					C14 C16	C24 C40	C56 C72	C16	C20 C32				
Leading edge differential (initial execution type)	N/A	A	A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A
Set	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset	A	A	A	A	A	A	A	A	A	A	A	A	A
Keep	A	A	A	A	A	A	A	A	A	A	A	A	A
No operation	A	A	A	A	A	A	A	A	A	A	A	A	A

- A: Available, N/A: Not available

Name	Boolean	Symbol	Description	Steps Note1)
Basic function instructions				
On-delay timer	TML		After set value "n" x 0.001 seconds, timer contact "a" is set to on.	3 (4)
	TMR		After set value "n" x 0.01 seconds, timer contact "a" is set to on.	3 (4)
	TMX		After set value "n" x 0.1 seconds, timer contact "a" is set to on.	3 (4)
	TMY		After set value "n" x 1 second, timer contact "a" is set to on.	4 (5)
Auxiliary timer (16-bit)	F137 (STMR)		After set value "S" x 0.01 seconds, the specified output and R900D are set to on.	5
Auxiliary timer (32-bit)	F183 (DSTM)		After set value "S" x 0.01 seconds, the specified output and R900D are set to on.	7
Time constant processing	F182		Executes the filter processing for the specified input.	9
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


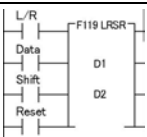
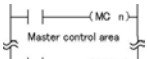
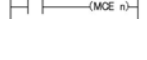
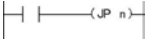
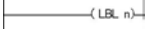
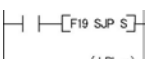

Note1) In the FP2/FP2SH/FP10SH, when timer 256 or higher, or counter 255 or lower, is used, the number of steps is the number in parentheses. Also, in the FP2/FP2SH/FP10SH, when a timer number or counter number has an index modifier, the number of steps is the number in parentheses.

Name	Availability												
	FP0	FPΣ	FP-X	FP-φ	FP1			FP-M		FP3	FP2	FPΣH	FP10SH
					C14 C16	C24 C40	C56 C72	C16	C20 C32				
Basic function instructions													
On-delay timer TML	A	A	Partly N/A <small>Note1)</small>	A	N/A	N/A	N/A	N/A	N/A	N/A	A	Partly N/A <small>Note1)</small>	Partly N/A <small>Note1)</small>
On-delay timer TMR	A	A	Partly N/A <small>Note1)</small>	A	A	A	A	A	A	A	A	Partly N/A <small>Note1)</small>	Partly N/A <small>Note1)</small>
On-delay timer TMX	A	A	Partly N/A <small>Note1)</small>	A	A	A	A	A	A	A	A	Partly N/A <small>Note1)</small>	Partly N/A <small>Note1)</small>
On-delay timer TMY	A	A	Partly N/A <small>Note1)</small>	A	A	A	A	A	A	A	A	Partly N/A <small>Note1)</small>	Partly N/A <small>Note1)</small>
Auxiliary timer (16-bit)	A	A	A	A	N/A	N/A	A	N/A	A	A	A	A	A
Auxiliary timer (32-bit)	A	A	A	A	N/A	N/A	N/A	N/A	A	N/A	A	A	A
Time constant processing	N/A	N/A	Partly N/A <small>Note2)</small>	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Counter	A	A	Partly N/A <small>Note1)</small>	A	A	A	A	A	A	A	A	Partly N/A <small>Note1)</small>	Partly N/A <small>Note1)</small>
UP/DOWN counter	A	A	A	A	A	A	A	A	A	A	A	A	A

• A: Available, N/A: Not available

Note1) With FP2SH, FP10SH, FP-X Ver2.0 or later, an arbitrary device can be specified for the setting value of the counter instruction.

Note2) This instruction is available only for FP-X Ver. 2.0 or later.


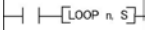
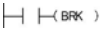


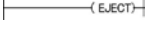
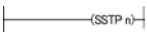

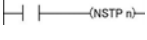
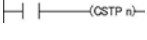
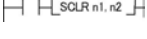
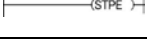
Name	Boolean	Symbol	Description	Steps
Shift register	SR		Shifts one bit of 16-bit [word internal relay (WR)] data to the left.	1 (2) Note1)
Left/right shift register	F119 (LRSR)		Shifts one bit of 16-bit data range specified by "D1" and "D2" to the left or to the right.	5
Control instructions				
Master 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 (3) Note2)
Label	LBL			1
Auxiliary jump	F19 (SJP)		The program jumps to the label instruction specified by "S" and continues from there.	3
Label	LBL			1

*1) In the FP2/FP2SH/FP10SH, when internal relay WR240 or higher is used, the number of steps is the number in parentheses. Also, in the FP2/FP2SH/FP10SH, when the specified internal relay number (word address) has an index modifier, the number of steps is the number in parentheses.

*2) In the FP2/FP2SH/FP10SH, when the number "n" in a jump instruction has an index modifier, the number of steps is the number in parentheses.

Name	Availability												
	FP0	FP2	FP-X	FP-φ	FP1			FP-M		FP3	FP2	FP2SH	FP10SH
					C14 C16	C24 C40	C56 C72	C16	C20 C32				
Shift register	A	A	A	A	A	A	A	A	A	A	A	A	A
Left/right shift register	A	A	A	A	A	A	A	A	A	A	A	A	A
Control instructions													
Master control relay	A	A	A	A	A	A	A	A	A	A	A	A	A
Master control relay end	A	A	A	A	A	A	A	A	A	A	A	A	A
Jump Label	A	A	A	A	A	A	A	A	A	A	A	A	A
Auxiliary jump Label	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A	A

- A: Available, N/A: Not available

Name	Boolean	Symbol	Description	Steps
Loop	LOOP		The program jumps to the label instruction and continues from there (the number of jumps is set in "S").	4 (5) Note1)
Label	LBL			1
Break	BRK		Stops program execution when the predetermined trigger turns on in the TEST/RUN mode only.	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
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 started. (Scan execution type)	3
	NSTP		Start the specified process "n" and clear the process currently started. (Pulse execution type)	3
Clear step	CSTP		Resets the specified process "n".	3
Clear multiple steps	SCLR		Resets multiple processes specified by "n1" and "n2".	5
Step end	STPE		End of step ladder area	1

Note1) In the FP2/FP2SH/FP10SH, when the number "n" in a loop instruction has an index modifier, the number of steps is the number in parentheses.

Name	Availability												
	FP0	FP2	FP-X	FP-φ	FP1			FP-M		FP3	FP2	FP2SH	FP10SH
					C14 C16	C24 C40	C56 C72	C16	C20 C32				
Loop	A	A	A	A	A	A	A	A	A	A	A	A	A
Label													
Break	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A	A
End	A	A	A	A	A	A	A	A	A	A	A	A	A
Conditional end	A	A	A	A	A	A	A	A	A	A	A	A	A
Eject	N/A	A	A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A
Step ladder instructions													
Start step	A	A	A	A	A	A	A	A	A	A	A	A	A
Next step NSTL	A	A	A	A	A	A	A	A	A	A	A	A	A
Next step NSTP	A	A	A	A	A	A	A	A	A	A	A	A	A
Clear step	A	A	A	A	A	A	A	A	A	A	A	A	A
Clear multiple steps	N/A	A	A	A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A
Step end	A	A	A	A	A	A	A	A	A	A	A	A	A

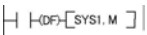

- A: Available, N/A: Not available

Name	Boolean	Symbol	Description	Steps
Subroutine instructions				
Subroutine call	CALL		Executes the specified subroutine. When returning to the main program, outputs in the subroutine program are maintained.	2 (3) Note1)
Output off type subroutine call	FCALL		Executes the specified subroutine. When returning to the main program, all outputs in the subroutine program are set to off.	4 (5) Note1)
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

Note1) In the FP2/FP2SH/FP10SH, when the number "n" of a subroutine program has an index modifier, the number of steps is the number in parentheses.

Name	Availability												
	FP0	FP2	FP-X	FP-φ	FP1			FP-M		FP3	FP2	FP2SH	FP10SH
					C14 C16	C24 C40	C56 C72	C16	C20 C32				
Subroutine instructions													
Subroutine call	A	A	A	A	A	A	A	A	A	A	A	A	A
Output off type subrou- tine call	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	A
Subroutine entry	A	A	A	A	A	A	A	A	A	A	A	A	A
Subroutine return	A	A	A	A	A	A	A	A	A	A	A	A	A
Interrupt instructions													
Interrupt	A	A	A	A	N/A	A	A	A	A	A	A	A	A
Interrupt return	A	A	A	A	N/A	A	A	A	A	A	A	A	A
Interrupt control	A	A	A	A	N/A	A	A	N/A	A	A	A	A	A

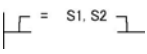

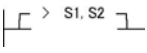
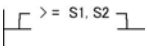

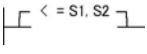
- A: Available, N/A: Not available

Name	Boolean	Symbol	Description	Steps
Special setting instructions				
Communica- tion condi- tions 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.	
MEWTOCOL -COM response control			Change the communication conditions of the COM. port or tool port for MEWTOCOL-COM based on the contents specified by the character constant.	
High-speed counter operation mode changing			Change the operation mode of the high-speed counter, 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	Availability												
	FP0	FPΣ	FP-X	FP-e	FP1			FP-M		FP3	FP2	FP2SH	FP10SH
					C14 C16	C24 C40	C56 C72	C16	C20 C32				
Special setting instructions													
Communication conditions setting	N/A	A	A <small>Note1)</small>	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Password setting	N/A	A <small>Note2)</small>	A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Interrupt setting	N/A	A	A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
PLC link time setting	N/A	A	A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
MEWTOCOL-COM response control	N/A	A	A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
High-speed counter operation mode changing	N/A	A	A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
System registers “No. 40 to No. 47” changing	N/A	A	A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

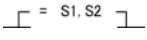
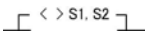
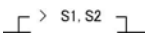
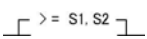
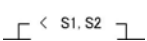
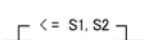
Note1) With FP-X Ver2.0 or later and FPsigma Ver3.10 or later, the baud rate can be selected from 300, 600 or 1200 bps.

Note2) With FPsigma 32k type, the 8-digit password can be selected.

Name	Boolean	Symbol	Description	Steps
Data compare instructions				
16-bit data compare (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" or "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" or "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" or "S1=S2".	5

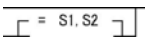
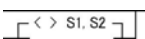
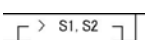
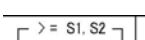
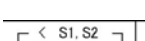
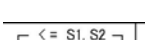
Name	Availability												
	FP0	FPΣ	FP-X	FP-e	FP1			FP-M		FP3	FP2	FP2SH	FP10SH
					C14 C16	C24 C40	C56 C72	C16	C20 C32				
Data compare instructions													
16-bit data compare (Start) ST=	A	A	A	A	N/A	A	A	N/A	A	A	A	A	A
16-bit data compare (Start) ST<>	A	A	A	A	N/A	A	A	N/A	A	A	A	A	A
16-bit data compare (Start) ST>	A	A	A	A	N/A	A	A	N/A	A	A	A	A	A
16-bit data compare (Start) ST>=	A	A	A	A	N/A	A	A	N/A	A	A	A	A	A
16-bit data compare (Start) ST<	A	A	A	A	N/A	A	A	N/A	A	A	A	A	A
16-bit data compare (Start) ST<=	A	A	A	A	N/A	A	A	N/A	A	A	A	A	A

- A: Available, N/A: Not available

Name	Boolean	Symbol	Description	Steps
16-bit data compare (AND)	AN=		Connects a Form A (normally open) contact serially by comparing two 16-bit data in the comparative condition "S1=S2".	5
	AN<>		Connects a Form A (normally open) contact serially by comparing two 16-bit data in the comparative condition "S1<S2" or "S1>S2".	5
	AN>		Connects a Form A (normally open) contact serially by comparing two 16-bit data in the comparative condition "S1>S2".	5
	AN>=		Connects a Form A (normally open) contact serially by comparing two 16-bit data in the comparative condition "S1>S2" or "S1=S2".	5
	AN<		Connects a Form A (normally open) contact serially by comparing two 16-bit data in the comparative condition "S1<S2".	5
	AN<=		Connects a Form A (normally open) contact serially by comparing two 16-bit data in the comparative condition "S1<S2" or "S1=S2".	5

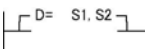
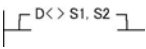

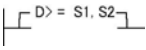

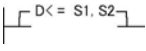
Name	Availability												
	FP0	FP2	FP-X	FP-φ	FP1			FP-M		FP3	FP2	FP2SH	FP10SH
					C14 C16	C24 C40	C56 C72	C16	C20 C32				
16-bit data compare (AND) AN=	A	A	A	A	N/A	A	A	N/A	A	A	A	A	A
16-bit data compare (AND) AN<>	A	A	A	A	N/A	A	A	N/A	A	A	A	A	A
16-bit data compare (AND) AN>	A	A	A	A	N/A	A	A	N/A	A	A	A	A	A
16-bit data compare (AND) AN>=	A	A	A	A	N/A	A	A	N/A	A	A	A	A	A
16-bit data compare (AND) AN<	A	A	A	A	N/A	A	A	N/A	A	A	A	A	A
16-bit data compare (AND) AN<=	A	A	A	A	N/A	A	A	N/A	A	A	A	A	A

• A: Available, N/A: Not available

Name	Boolean	Symbol	Description	Steps
16-bit data compare (OR)	OR=		Connects a Form A (normally open) contact in parallel by comparing two 16-bit data in the comparative condition "S1=S2".	5
	OR<>		Connects a Form A (normally open) contact in parallel by comparing two 16-bit data in the comparative condition "S1<S2" or "S1>S2".	5
	OR>		Connects a Form A (normally open) contact in parallel by comparing two 16-bit data in the comparative condition "S1>S2".	5
	OR>=		Connects a Form A (normally open) contact in parallel by comparing two 16-bit data in the comparative condition "S1>S2" or "S1=S2".	5
	OR<		Connects a Form A (normally open) contact in parallel by comparing two 16-bit data in the comparative condition "S1<S2".	5
	OR<=		Connects a Form A (normally open) contact in parallel by comparing two 16-bit data in the comparative condition "S1<S2" or "S1=S2".	5

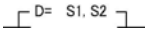
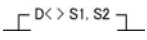
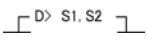
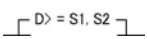

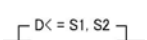
Name	Availability												
	FP0	FP2	FP-X	FP-φ	FP1			FP-M		FP3	FP2	FP2SH	FP10SH
					C14 C16	C24 C40	C56 C72	C16	C20 C32				
16-bit data compare (OR) OR=	A	A	A	A	N/A	A	A	N/A	A	A	A	A	A
16-bit data compare (OR) OR<>	A	A	A	A	N/A	A	A	N/A	A	A	A	A	A
16-bit data compare (OR) OR>	A	A	A	A	N/A	A	A	N/A	A	A	A	A	A
16-bit data compare (OR) OR>=	A	A	A	A	N/A	A	A	N/A	A	A	A	A	A
16-bit data compare (OR) OR<	A	A	A	A	N/A	A	A	N/A	A	A	A	A	A
16-bit data compare (OR) OR<=	A	A	A	A	N/A	A	A	N/A	A	A	A	A	A

• A: Available, N/A: Not available

Name	Boolean	Symbol	Description	Steps
32-bit data compare (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)" or "(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)" or "(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)" or "(S1+1, S1)=(S2+1, S2)".	9

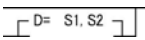
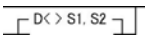
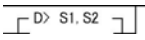
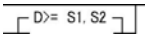
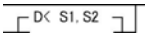
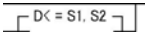
Name	Availability												
	FP0	FP2	FP-X	FP-φ	FP1			FP-M		FP3	FP2	FP2SH	FP10SH
					C14 C16	C24 C40	C56 C72	C16	C20 C32				
32-bit data compare (Start) STD=	A	A	A	A	N/A	A	A	N/A	A	A	A	A	A
32-bit data compare (Start) STD<>	A	A	A	A	N/A	A	A	N/A	A	A	A	A	A
32-bit data compare (Start) STD>	A	A	A	A	N/A	A	A	N/A	A	A	A	A	A
32-bit data compare (Start) STD>=	A	A	A	A	N/A	A	A	N/A	A	A	A	A	A
32-bit data compare (Start) STD<	A	A	A	A	N/A	A	A	N/A	A	A	A	A	A
32-bit data compare (Start) STD<=	A	A	A	A	N/A	A	A	N/A	A	A	A	A	A

- A: Available, N/A: Not available

Name	Boolean	Symbol	Description	Steps
32-bit data compare (AND)	AND=		Connects a Form A (normally open) contact serially by comparing two 32-bit data in the comparative condition “(S1+1, S1)=(S2+1, S2)”.	9
	AND<>		Connects a Form A (normally open) contact serially by comparing two 32-bit data in the comparative condition “(S1+1, S1)<(S2+1, S2)” or “(S1+1, S1)>(S2+1, S2)”.	9
	AND>		Connects a Form A (normally open) contact serially by comparing two 32-bit data in the comparative condition “(S1+1, S1)>(S2+1, S2)”.	9
	AND>=		Connects a Form A (normally open) contact serially by comparing two 32-bit data in the comparative condition “(S1+1, S1)>(S2+1, S2)” or “(S1+1, S1)=(S2+1, S2)”.	9
	AND<		Connects a Form A (normally open) contact serially by comparing two 32-bit data in the comparative condition “(S1+1, S1)<(S2+1, S2)”.	9
	AND<=		Connects a Form A (normally open) contact serially by comparing two 32-bit data in the comparative condition “(S1+1, S1)<(S2+1, S2)” or “(S1+1, S1)=(S2+1, S2)”.	9

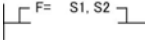
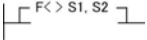
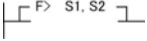
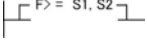
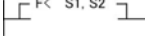
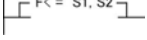
Name	Availability												
	FP0	FP2	FP-X	FP-φ	FP1			FP-M		FP3	FP2	FP2SH	FP10SH
					C14 C16	C24 C40	C56 C72	C16	C20 C32				
32-bit data compare (AND) AND=	A	A	A	A	N/A	A	A	N/A	A	A	A	A	A
32-bit data compare (AND) AND<>	A	A	A	A	N/A	A	A	N/A	A	A	A	A	A
32-bit data compare (AND) AND>	A	A	A	A	N/A	A	A	N/A	A	A	A	A	A
32-bit data compare (AND) AND>=	A	A	A	A	N/A	A	A	N/A	A	A	A	A	A
32-bit data compare (AND) AND<	A	A	A	A	N/A	A	A	N/A	A	A	A	A	A
32-bit data compare (AND) AND<=	A	A	A	A	N/A	A	A	N/A	A	A	A	A	A

• A: Available, N/A: Not available

Name	Boolean	Symbol	Description	Steps
32-bit data compare (OR)	ORD=		Connects a Form A (normally open) contact in parallel by comparing two 32-bit data in the comparative condition “(S1+1, S1)=(S2+1, S2)”.	9
	ORD<>		Connects a Form A (normally open) contact in parallel by comparing two 32-bit data in the comparative condition “(S1+1, S1)<(S2+1, S2)” or “(S1+1, S1)>(S2+1, S2)”.	9
	ORD>		Connects a Form A (normally open) contact in parallel by comparing two 32-bit data in the comparative condition “(S1+1, S1)>(S2+1, S2)”.	9
	ORD>=		Connects a Form A (normally open) contact in parallel by comparing two 32-bit data in the comparative condition “(S1+1, S1)>(S2+1, S2)” or “(S1+1, S1)=(S2+1, S2)”.	9
	ORD<		Connects a Form A (normally open) contact in parallel by comparing two 32-bit data in the comparative condition “(S1+1, S1)<(S2+1, S2)”.	9
	ORD<=		Connects a Form A (normally open) contact in parallel by comparing two 32-bit data in the comparative condition “(S1+1, S1)<(S2+1, S2)” or “(S1+1, S1)=(S2+1, S2)”.	9

Name	Availability												
	FP0	FP2	FP-X	FP-φ	FP1			FP-M		FP3	FP2	FP2SH	FP10SH
					C14 C16	C24 C40	C56 C72	C16	C20 C32				
32-bit data compare (OR) ORD=	A	A	A	A	N/A	A	A	N/A	A	A	A	A	A
32-bit data compare (OR) ORD<>	A	A	A	A	N/A	A	A	N/A	A	A	A	A	A
32-bit data compare (OR) ORD>	A	A	A	A	N/A	A	A	N/A	A	A	A	A	A
32-bit data compare (OR) ORD>=	A	A	A	A	N/A	A	A	N/A	A	A	A	A	A
32-bit data compare (OR) ORD<	A	A	A	A	N/A	A	A	N/A	A	A	A	A	A
32-bit data compare (OR) ORD<=	A	A	A	A	N/A	A	A	N/A	A	A	A	A	A


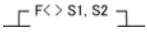
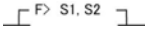
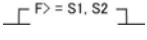
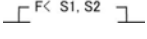
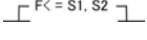
• A: Available, N/A: Not available

Name	Boolean	Symbol	Description	Steps
Floating point type real number data compare (Start)	STF=		Begins a logic operation by comparing two 32-bit data in the comparative condition "(S1+1, S1)=(S2+1, S2)".	9
	STF<>		Begins a logic operation by comparing two 32-bit data in the comparative condition "(S1+1, S1)<(S2+1, S2)" or "(S1+1, S1)>(S2+1, S2)".	9
	STF>		Begins a logic operation by comparing two 32-bit data in the comparative condition "(S1+1, S1)>(S2+1, S2)".	9
	STF>=		Begins a logic operation by comparing two 32-bit data in the comparative condition "(S1+1, S1)>(S2+1, S2)" or "(S1+1, S1)=(S2+1, S2)".	9
	STF<		Begins a logic operation by comparing two 32-bit data in the comparative condition "(S1+1, S1)<(S2+1, S2)".	9
	STF<=		Begins a logic operation by comparing two 32-bit data in the comparative condition "(S1+1, S1)<(S2+1, S2)" or "(S1+1, S1)=(S2+1, S2)".	9

Name	Availability												
	FP0	FPΣ	FP-X	FP-φ	FP1			FP-M		FP3	FP2	FP2SH	FP10SH
					C14 C16	C24 C40	C56 C72	C16	C20 C32				
Floating point type real number data compare (Start) STF=	N/A	Partly N/A Note1)	Partly N/A Note1)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Partly N/A Note1)	Partly N/A Note1)	Partly N/A Note1)
Floating point type real number data compare (Start) STF<>	N/A	Partly N/A Note1)	Partly N/A Note1)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Partly N/A Note1)	Partly N/A Note1)	Partly N/A Note1)
Floating point type real number data compare (Start) STF>	N/A	Partly N/A Note1)	Partly N/A Note1)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Partly N/A Note1)	Partly N/A Note1)	Partly N/A Note1)
Floating point type real number data compare (Start) STF>=	N/A	Partly N/A Note1)	Partly N/A Note1)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Partly N/A Note1)	Partly N/A Note1)	Partly N/A Note1)
Floating point type real number data compare (Start) STF<	N/A	Partly N/A Note1)	Partly N/A Note1)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Partly N/A Note1)	Partly N/A Note1)	Partly N/A Note1)
Floating point type real number data compare (Start) STF<=	N/A	Partly N/A Note1)	Partly N/A Note1)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Partly N/A Note1)	Partly N/A Note1)	Partly N/A Note1)

• A: Available, N/A: Not available


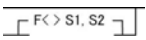
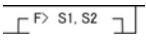
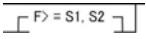
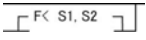
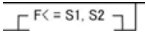
Note1) This instruction is available for FP-X V1.10 or later, FPΣ 32k and FP2/FP2SH V2.0 or later.

Name	Boolean	Symbol	Description	Steps
Floating point type real number data compare (AND)	ANF=		Connects a Form A (normally open) contact serially by comparing two 32-bit data in the comparative condition “(S1+1, S1)=(S2+1, S2)”.	9
	ANF<>		Connects a Form A (normally open) contact serially by comparing two 32-bit data in the comparative condition “(S1+1, S1)<(S2+1, S2)” or “(S1+1, S1)>(S2+1, S2)”.	9
	ANF>		Connects a Form A (normally open) contact serially by comparing two 32-bit data in the comparative condition “(S1+1, S1)>(S2+1, S2)”.	9
	ANF>=		Connects a Form A (normally open) contact serially by comparing two 32-bit data in the comparative condition “(S1+1, S1)>(S2+1, S2)” or “(S1+1, S1)=(S2+1, S2)”.	9
	ANF<		Connects a Form A (normally open) contact serially by comparing two 32-bit data in the comparative condition “(S1+1, S1)<(S2+1, S2)”.	9
	ANF<=		Connects a Form A (normally open) contact serially by comparing two 32-bit data in the comparative condition “(S1+1, S1)<(S2+1, S2)” or “(S1+1, S1)=(S2+1, S2)”.	9

Name	Availability												
	FP0	FPΣ	FP-X	FP-φ	FP1			FP-M		FP3	FP2	FP2SH	FP10SH
					C14 C16	C24 C40	C56 C72	C16	C20 C32				
Floating point type real number data compare (AND) ANF=	N/A	Partly N/A Note1)	Partly N/A Note1)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Partly N/A Note1)	Partly N/A Note1)	Partly N/A Note1)
Floating point type real number data compare (AND) ANF<>	N/A	Partly N/A Note1)	Partly N/A Note1)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Partly N/A Note1)	Partly N/A Note1)	Partly N/A Note1)
Floating point type real number data compare (AND) ANF>	N/A	Partly N/A Note1)	Partly N/A Note1)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Partly N/A Note1)	Partly N/A Note1)	Partly N/A Note1)
Floating point type real number data compare (AND) ANF>=	N/A	Partly N/A Note1)	Partly N/A Note1)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Partly N/A Note1)	Partly N/A Note1)	Partly N/A Note1)
Floating point type real number data compare (AND) ANF<	N/A	Partly N/A Note1)	Partly N/A Note1)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Partly N/A Note1)	Partly N/A Note1)	Partly N/A Note1)
Floating point type real number data compare (AND) ANF<=	N/A	Partly N/A Note1)	Partly N/A Note1)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Partly N/A Note1)	Partly N/A Note1)	Partly N/A Note1)

• A: Available, N/A: Not available

Note1) This instruction is available for FP-X V1.10 or later, FPΣ 32k and FP2/FP2SH V2.0 or later.

Name	Boolean	Symbol	Description	Steps
Floating point type real number data compare (OR)	ORF=		Connects a Form A (normally open) contact in parallel by comparing two 32-bit data in the comparative condition "(S1+1, S1)=(S2+1, S2)".	9
	ORF<>		Connects a Form A (normally open) contact in parallel by comparing two 32-bit data in the comparative condition "(S1+1, S1)<(S2+1, S2)" or "(S1+1, S1)>(S2+1, S2)".	9
	ORF>		Connects a Form A (normally open) contact in parallel by comparing two 32-bit data in the comparative condition "(S1+1, S1)>(S2+1, S2)".	9
	ORF>=		Connects a Form A (normally open) contact in parallel by comparing two 32-bit data in the comparative condition "(S1+1, S1)>(S2+1, S2)" or "(S1+1, S1)=(S2+1, S2)".	9
	ORF<		Connects a Form A (normally open) contact in parallel by comparing two 32-bit data in the comparative condition "(S1+1, S1)<(S2+1, S2)".	9
	ORF<=		Connects a Form A (normally open) contact in parallel by comparing two 32-bit data in the comparative condition "(S1+1, S1)<(S2+1, S2)" or "(S1+1, S1)=(S2+1, S2)".	9

Name	Availability												
	FP0	FPΣ	FP-X	FP-φ	FP1			FP-M		FP3	FP2	FP2SH	FP10SH
					C14 C16	C24 C40	C56 C72	C16	C20 C32				
Floating point type real number data compare (OR) ORF=	N/A	Partly N/A Note1)	Partly N/A Note1)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Partly N/A Note1)	Partly N/A Note1)	Partly N/A Note1)
Floating point type real number data compare (OR) ORF<>	N/A	Partly N/A Note1)	Partly N/A Note1)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Partly N/A Note1)	Partly N/A Note1)	Partly N/A Note1)
Floating point type real number data compare (OR) ORF>	N/A	Partly N/A Note1)	Partly N/A Note1)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Partly N/A Note1)	Partly N/A Note1)	Partly N/A Note1)
Floating point type real number data compare (OR) ORF>=	N/A	Partly N/A Note1)	Partly N/A Note1)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Partly N/A Note1)	Partly N/A Note1)	Partly N/A Note1)
Floating point type real number data compare (OR) ORF<	N/A	Partly N/A Note1)	Partly N/A Note1)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Partly N/A Note1)	Partly N/A Note1)	Partly N/A Note1)
Floating point type real number data compare (OR) ORF<=	N/A	Partly N/A Note1)	Partly N/A Note1)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Partly N/A Note1)	Partly N/A Note1)	Partly N/A Note1)

• A: Available, N/A: Not available

Note1) This instruction is available for FP-X V1.10 or later, FPΣ 32k and FP2/FP2SH V2.0 or later.

14.3 Table of High-level Instructions

The high-level instructions are expressed by the prefixes “F” or “P” with numbers. For most of the high-level instructions, “F” and “P” types are available. The differences between the two types are explained as follows:

- Instructions with the prefix “F” are executed in every scan while its trigger is in the on.
- Instructions with the prefix “P” are executed only when the leading edge of its trigger is detected.

Number	Name	Boolean	Operand	Description	Steps
Data transfer instructions					
F0 P0	16-bit data move	MV PMV	S, D	(S)→(D)	5
F1 P1	32-bit data move	DMV PDMV	S, D	(S+1, S)→(D+1, D)	7
F2 P2	16-bit data invert and move	MV PMV/	S, D	(S)→(D)	5
F3 P3	32-bit data invert and move	DMV/ PDMV/	S, D	($\overline{S+1}$, S)→(D+1, D)	7
F4 P4	Reading of head word No. of the specified slot	GETS PGETS	S, D	The head word No. of the specified slot is read.	5
F5 P5	Bit data move	BTM PBTM	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 P6	Hexadecimal digit (4-bit) data move	DGT PDGT	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 P7	Two 16-bit data move	MV2 PMV2	S1, S2, D	(S1)→(D), (S2)→(D+1)	7
F8 P8	Two 32-bit data move	DMV2 PDMV2	S1, S2, D	(S1+1, S1)→(D+1, D), (S2+1, S2)→(D+3, D+2)	11
F10 P10	Block move	BKMOV PBKMOV	S1, S2, D	The data between “S1” and “S2” is transferred to the area starting at “D”.	7

Name	Availability												
	FP0 <small>Note1)</small>	FPΣ <small>Note1)</small>	FP-X <small>Note1)</small>	FP-e	FP1 <small>Note1)</small>			FP-M <small>Note1)</small>		FP3	FP2	FP2SH	FP10SH
					C14 C16	C24 C40	C56 C72	C16	C20 C32				
Data transfer instructions													
F0 P0	A	A	A	A	A	A	A	A	A	A	A	A	A
F1 P1	A	A	A	A	A	A	A	A	A	A	A	A	A
F2 P2	A	A	A	A	A	A	A	A	A	A	A	A	A
F3 P3	A	A	A	A	A	A	A	A	A	A	A	A	A
F4 P4	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Partly N/A <small>Note2)</small>	Partly N/A <small>Note2)</small>	N/A
F5 P5	A	A	A	A	A	A	A	A	A	A	A	A	A
F6 P6	A	A	A	A	A	A	A	A	A	A	A	A	A
F7 P7	N/A	A	A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A
F8 P8	N/A	A	A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A
F10 P10	A	A	A	A	A	A	A	A	A	A	A	A	A

• A: Available, N/A: Not available

Note1) For the FP0/FP Σ /FP-X/FP1/FP-M, the P type high-level instructions are not available.

Note2) This instruction is available for FP2/FP2SH Ver. 1.5 or later.

Num-ber	Name	Boolean	Operand	Description	Steps
F11 P11	Block copy	COPY PCOPY	S, D1, D2	The data of "S" is transferred to the all area between "D1" and "D2".	7
F12 P12	Data read from IC card/ROM	ICRD PICRD	S1, S2, D	The data stored in the expansion memory of the IC card or ROM specified by "S1" and "S2" are transferred to the area startign at "D".	11
F12		ICRD			
F13 P13	Data write to IC card/ROM	ICWT PICWT	S1, S2, D	The data specified by "S1" and "S2" are transferred to the IC card expansion memory area or ROM starting at "D".	11
P13		PICWT			
F14 P14	Program read from IC memory card	PGRD PPGRD	S	The program specified using "S" is transferred into the CPU from IC memory card and executes it.	3
F15 P15	16-bit data exchange	XCH PXCH	D1, D2	(D1)→(D2), (D2)→(D1)	5
F16 P16	32-bit data exchange	DXCH PDXCH	D1, D2	(D1+1, D1)→(D2+1, D2) (D2+1, D2)→(D1+1, D1)	5
F17 P17	Higher/lower byte in 16-bit data exchange	SWAP PSWAP	D	The higher byte and lower byte of "D" are exchanged.	3
F18 P18	16-bit data block exchange	BXCH PBXCH	D1, D2, D3	Exchange the data between "D1" and "D2" with the data specified by "D3".	7
Control instruction					
F19	Auxiliary jump	SJP	S	The program jumps to the label instruction specified by "S" and continues from there.	3
Binary arithmetic instructions					
F20 P20	16-bit data addition	+ P+	S, D	(D)+(S)→(D)	5
F21 P21	32-bit data addition	D+ PD+	S, D	(D+1, D)+(S+1, S)→(D+1, D)	7
F22 P22	16-bit data addition	+ P+	S1, S2, D	(S1)+(S2)→(D)	7

Name	Availability												
	FP0 <small>Note1)</small>	FPΣ <small>Note1)</small>	FP-X <small>Note1)</small>	FP-e	FP1 <small>Note1)</small>			FP-M <small>Note1)</small>		FP3	FP2	FP2SH	FP10SH
					C14 C16	C24 C40	C56 C72	C16	C20 C32				
F11 P11	A	A	A	A	A	A	A	A	A	A	A	A	A
F12 P12	-	-	-	-	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	A
F12	A	A	A	A									
F13 P13	-	-	-	-	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	A
P13	A	A	A	A									
F14 P14	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	A
F15 P15	A	A	A	A	A	A	A	A	A	A	A	A	A
F16 P16	A	A	A	A	A	A	A	A	A	A	A	A	A
F17 P17	A	A	A	A	A	A	A	A	A	A	A	A	A
F18 P18	N/A	A	A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A
Control instruction													
F19	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A	A
Binary arithmetic instructions													
F20 P20	A	A	A	A	A	A	A	A	A	A	A	A	A
F21 P21	A	A	A	A	A	A	A	A	A	A	A	A	A
F22 P22	A	A	A	A	A	A	A	A	A	A	A	A	A

• A: Available, N/A: Not available

Note1) For the FP0/FPΣ/FP-X/FP-e/FP1/FP-M, the P type high-level instructions except for P13 (PICWT) instruction are not available.

Num-ber	Name	Boolean	Operand	Description	Steps
F23 P23	32-bit data addition	D+ PD+	S1, S2, D	$(S1+1, S1)+(S2+1, S2) \rightarrow (D+1, D)$	11
F25 P25	16-bit data subtraction	- P-	S, D	$(D)-(S) \rightarrow (D)$	5
F26 P26	32-bit data subtraction	D- PD-	S, D	$(D+1, D)-(S+1, S) \rightarrow (D+1, D)$	7
F27 P27	16-bit data subtraction	- P-	S1, S2, D	$(S1)-(S2) \rightarrow (D)$	7
F28 P28	32-bit data subtraction	D- PD-	S1, S2, D	$(S1+1, S1)-(S2+1, S2) \rightarrow (D+1, D)$	11
F30 P30	16-bit data multiplication	* P*	S1, S2, D	$(S1)X(S2) \rightarrow (D+1, D)$	7
F31 P31	32-bit data multiplication	D* PD*	S1, S2, D	$(S1+1, S1)X(S2+1, S2) \rightarrow (D+3, D+2, D+1, D)$	11
F32 P32	16-bit data division	% P%	S1, S2, D	$(S1) \div (S2) \rightarrow \text{quotient (D)}$ remainder (DT9015 for FP0/FP-e/FP1/FP-M/FP3 or DT90015 for FP0 T32/FP Σ /FP2/FP2SH/FP10SH)	7
F33 P33	32-bit data division	D% PD%	S1, S2, D	$(S1+1, S1) \div (S2+1, S2) \rightarrow \text{quotient (D+1, D)}$ remainder (DT9016, DT9015 for FP0/FP-e/FP1/FP-M/FP3 or DT90016, DT90015 for FP0 T32/FP Σ /FP2/FP2SH/FP10SH)	11
F34 P34	16-bit data multiplication (result in 16 bits)	*W P*W	S1, S2, D	$(S1)X(S2) \rightarrow (D)$	7
F35 P35	16-bit data increment	+1 P+1	D	$(D)+1 \rightarrow (D)$	3
F36 P36	32-bit data increment	D+1 PD+1	D	$(D+1, D)+1 \rightarrow (D+1, D)$	3

Name	Availability												
	FP0 <small>Note1)</small>	FPΣ <small>Note1)</small>	FP-X <small>Note1)</small>	FP-φ	FP1 <small>Note1)</small>			FP-M <small>Note1)</small>		FP3	FP2	FP2SH	FP10SH
					C14 C16	C24 C40	C56 C72	C16	C20 C32				
F23 P23	A	A	A	A	A	A	A	A	A	A	A	A	A
F25 P25	A	A	A	A	A	A	A	A	A	A	A	A	A
F26 P26	A	A	A	A	A	A	A	A	A	A	A	A	A
F27 P27	A	A	A	A	A	A	A	A	A	A	A	A	A
F28 P28	A	A	A	A	A	A	A	A	A	A	A	A	A
F30 P30	A	A	A	A	A	A	A	A	A	A	A	A	A
F31 P31	A	A	A	A	N/A	A	A	N/A	A	A	A	A	A
F32 P32	A	A	A	A	A	A	A	A	A	A	A	A	A
F33 P33	A	A	A	A	N/A	A	A	N/A	A	A	A	A	A
F34 P34	N/A	A	A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A
F35 P35	A	A	A	A	A	A	A	A	A	A	A	A	A
F36 P36	A	A	A	A	A	A	A	A	A	A	A	A	A

• A: Available, N/A: Not available

Note1) For the FP0/FPΣ/FP-X/FP1/FP-M, the P type high-level instructions are not available.

Number	Name	Boolean	Operand	Description	Steps
F37 P37	16-bit data decrement	-1 P-1	D	$(D)-1 \rightarrow (D)$	3
F38 P38	32-bit data decrement	D-1 PD-1	D	$(D+1, D)-1 \rightarrow (D+1, D)$	3
F39 P39	32-bit data multiplication (result in 32 bits)	D*D PD*D	S1, S2, D	$(S1+1, S1) \times (S2+1, S2) \rightarrow (D+1, D)$	11
BCD arithmetic instructions					
F40 P40	4-digit BCD data addition	B+ PB+	S, D	$(D)+(S) \rightarrow (D)$	5
F41 P41	8-digit BCD data addition	DB+ PDB+	S, D	$(D+1, D)+(S+1, S) \rightarrow (D+1, D)$	7
F42 P42	4-digit BCD data addition	B+ PB+	S1, S2, D	$(S1)+(S2) \rightarrow (D)$	7
F43 P43	8-digit BCD data addition	DB+ PDB+	S1, S2, D	$(S1+1, S1)+(S2+1, S2) \rightarrow (D+1, D)$	11
F45 P45	4-digit BCD data subtraction	B- PB-	S, D	$(D)-(S) \rightarrow (D)$	5
F46 P46	8-digit BCD data subtraction	DB- PDB-	S, D	$(D+1, D)-(S+1, S) \rightarrow (D+1, D)$	7
F47 P47	4-digit BCD data subtraction	B- PB-	S1, S2, D	$(S1)-(S2) \rightarrow (D)$	7

Name	Availability												
	FP0 <small>Note1)</small>	FPΣ <small>Note1)</small>	FP-X <small>Note1)</small>	FP-φ	FP1 <small>Note1)</small>			FP-M <small>Note1)</small>		FP3	FP2	FP2SH	FP10SH
					C14 C16	C24 C40	C56 C72	C16	C20 C32				
F37 P37	A	A	A	A	A	A	A	A	A	A	A	A	A
F38 P38	A	A	A	A	A	A	A	A	A	A	A	A	A
F39 P39	N/A	A	A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A
BCD arithmetic instructions													
F40 P40	A	A	A	A	A	A	A	N/A	A	A	A	A	A
F41 P41	A	A	A	A	A	A	A	N/A	A	A	A	A	A
F42 P42	A	A	A	A	A	A	A	N/A	A	A	A	A	A
F43 P43	A	A	A	A	A	A	A	N/A	A	A	A	A	A
F45 P45	A	A	A	A	A	A	A	N/A	A	A	A	A	A
F46 P46	A	A	A	A	A	A	A	N/A	A	A	A	A	A
F47 P47	A	A	A	A	A	A	A	N/A	A	A	A	A	A

• A: Available, N/A: Not available

Note1) For the FP0/FPΣ/FP-X/FP1/FP-M, the P type high-level instructions are not available.

Number	Name	Boolean	Operand	Description	Steps
F48 P48	8-digit BCD data subtraction	DB- PDB-	S1, S2, D	$(S1+1, S1)-(S2+1, S2) \rightarrow (D+1, D)$	11
F50 P50	4-digit BCD data multiplication	B* PB*	S1, S2, D	$(S1) \times (S2) \rightarrow (D+1, D)$	7
F51 P51	8-digit BCD data multiplication	DB* PDB*	S1, S2, D	$(S1+1, S1) \times (S2+1, S2) \rightarrow (D+3, D+2, D+1, D)$	11
F52 P52	4-digit BCD data division	B% PB%	S1, S2, D	$(S1) \div (S2) \rightarrow \text{quotient (D)}$ remainder (DT9015 for FP0/FP-e/FP1/FP-M/FP3 or DT90015 for FP0 T32/FP Σ /FP2/FP2SH/FP10SH)	7
F53 P53	8-digit BCD data division	DB% PDB%	S1, S2, D	$(S1+1, S1) \div (S2+1, S2) \rightarrow \text{quotient (D+1, D)}$ remainder (DT9016, DT9015 for FP0/FP-e/FP1/ FP-M/FP3 or DT90016, DT90015 for FP0 T32/ FP Σ /FP2/FP2SH/FP10SH)	11
F55 P55	4-digit BCD data increment	B+1 PB+1	D	$(D)+1 \rightarrow (D)$	3
F56 P56	8-digit BCD data increment	DB+1 PDB+1	D	$(D+1, D)+1 \rightarrow (D+1, D)$	3
F57 P57	4-digit BCD data decrement	B-1 PB-1	D	$(D)-1 \rightarrow (D)$	3
F58 P58	8-digit BCD data decrement	DB-1 PDB-1	D	$(D+1, D)-1 \rightarrow (D+1, D)$	3

Name	Availability												
	FP0 <small>Note1)</small>	FPΣ <small>Note1)</small>	FP-X <small>Note1)</small>	FP-φ	FP1 <small>Note1)</small>			FP-M <small>Note1)</small>		FP3	FP2	FP2SH	FP10SH
					C14 C16	C24 C40	C56 C72	C16	C20 C32				
F48 P48	A	A	A	A	A	A	A	N/A	A	A	A	A	A
F50 P50	A	A	A	A	A	A	A	N/A	A	A	A	A	A
F51 P51	A	A	A	A	N/A	A	A	N/A	A	A	A	A	A
F52 P52	A	A	A	A	A	A	A	N/A	A	A	A	A	A
F53 P53	A	A	A	A	N/A	A	A	N/A	A	A	A	A	A
F55 P55	A	A	A	A	A	A	A	N/A	A	A	A	A	A
F56 P56	A	A	A	A	A	A	A	N/A	A	A	A	A	A
F57 P57	A	A	A	A	A	A	A	N/A	A	A	A	A	A
F58 P58	A	A	A	A	A	A	A	N/A	A	A	A	A	A

• A: Available, N/A: Not available

Note1) For the FP0/FPΣ/FP-X/FP1/FP-M, the P type high-level instructions are not available.

Number	Name	Boolean	Operand	Description	Steps
Data compare instructions					
F60 P60	16-bit data compare	CMP PCMP	S1, S2	(S1)>(S2)→R900A: on (S1)=(S2)→R900B: on (S1)<(S2)→R900C: on	5
F61 P61	32-bit data compare	DCMP PDCMP	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 P62	16-bit data band compare	WIN PWIN	S1, S2, S3	(S1)>(S3)→R900A: on (S2)< or=(S1)< or=(S3)→R900B: on (S1)<(S2)→R900C: on	7
F63 P63	32-bit data band compare	DWIN PDWIN	S1, S2, S3	(S1+1, S1)>(S3+1, S3)→R900A: on (S2+1, S2)< or=(S1+1, S1)< or=(S3+1, S3)→R900B: on (S1+1, S1)<(S2+1, S2)→R900C: on	13
F64 P64	Block data compare	BCMP PBCMP	S1, S2, S3	Compares the two blocks beginning with "S2" and "S3" to see if they are equal.	7
Logic operation instructions					
F65 P65	16-bit data AND	WAN PWAN	S1, S2, D	(S1) AND (S2)→(D)	7
F66 P66	16-bit data OR	WOR PWOR	S1, S2, D	(S1) OR (S2)→(D)	7
F67 P67	16-bit data exclusive OR	XOR PXOR	S1, S2, D	$\{(S1) \text{ AND } \overline{(S2)}\} \text{ OR } \{\overline{(S1)} \text{ AND } (S2)\} \rightarrow (D)$	7
F68 P68	16-bit data exclusive NOR	XNR PXNR	S1, S2, D	$\{(S1) \text{ AND } (S2)\} \text{ OR } \{\overline{(S1)} \text{ AND } \overline{(S2)}\} \rightarrow (D)$	7
F69 P69	16-bit data unite	WUNI PWUNI	S1, S2, S3, D	$[(S1) \text{ AND } (S3)] \text{ OR } [(S2) \text{ AND } (S3)] \rightarrow (D)$ When (S3) is H0, (S2)→(D) When (S3) is HFFFF, (S1)→(D)	9

Name	Availability												
	FP0 <small>Note1)</small>	FPΣ <small>Note1)</small>	FP-X <small>Note1)</small>	FP-φ	FP1 <small>Note1)</small>			FP-M <small>Note1)</small>		FP3	FP2	FP2SH	FP10SH
					C14 C16	C24 C40	C56 C72	C16	C20 C32				
Data compare instructions													
F60 P60	A	A	A	A	A	A	A	A	A	A	A	A	A
F61 P61	A	A	A	A	A	A	A	A	A	A	A	A	A
F62 P62	A	A	A	A	A	A	A	A	A	A	A	A	A
F63 P63	A	A	A	A	A	A	A	A	A	A	A	A	A
F64 P64	A	A	A	A	N/A	A	A	N/A	A	A	A	A	A
Logic operation instructions													
F65 P65	A	A	A	A	A	A	A	A	A	A	A	A	A
F66 P66	A	A	A	A	A	A	A	A	A	A	A	A	A
F67 P67	A	A	A	A	A	A	A	A	A	A	A	A	A
F68 P68	A	A	A	A	A	A	A	A	A	A	A	A	A
F69 P69	N/A	A	A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A

• A: Available, N/A: Not available

Note1) For the FP0/FPΣ/FP-X/FP1/FP-M, the P type high-level instructions are not available.

Num-ber	Name	Boolean	Operand	Description	Steps
Data conversion instructions					
F70 P70	Block check code calculation	BCC PBCC	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 P71	Hexadecimal data → ASCII code	HEXA PHEXA	S1, S2, D	Converts the hexadecimal data specified by "S1" and "S2" to ASCII code and stores it in "D". Example: HABCD → H <u>42</u> <u>41</u> <u>44</u> <u>43</u> B A D C	7
F72 P72	ASCII code → Hexadeci- mal data	AHEX PAHEX	S1, S2, D	Converts the ASCII code specified by "S1" and "S2" to hexadecimal data and stores it in "D". Example: H <u>44</u> <u>43</u> <u>42</u> <u>41</u> → HCDAB D C B A	7
F73 P73	4-digit BCD data → ASCII code	BCDA PBCDA	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 <u>32</u> <u>31</u> <u>34</u> <u>33</u> 2 1 4 3	7
F74 P74	ASCII code → 4-digit BCD data	ABCD PABCD	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 <u>34</u> <u>33</u> <u>32</u> <u>31</u> → H3412 4 3 2 1	9
F75 P75	16-bit binary data → ASCII code	BINA PBINA	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 <u>30</u> <u>30</u> <u>31</u> <u>2D</u> <u>20</u> <u>20</u> 0 0 1 -	7
F76 P76	ASCII code → 16-bit binary data	ABIN PABIN	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 <u>30</u> <u>30</u> <u>31</u> <u>2D</u> <u>20</u> <u>20</u> → K-100 0 0 1 -	7
F77 P77	32-bit binary data → ASCII code	DBIA PDBIA	S1, S2, D	Converts the 32 bits of binary data (S1+1, S1) to ASCII code and stores it in D (area of "S2" bytes).	11

Name	Availability												
	FP0 <small>Note1)</small>	FPΣ <small>Note1)</small>	FP-X <small>Note1)</small>	FP-e	FP1 <small>Note1)</small>			FP-M <small>Note1)</small>		FP3	FP2	FP2SH	FP10SH
					C14 C16	C24 C40	C56 C72	C16	C20 C32				
Data conversion instructions													
F70 P70	A	A	A	A	N/A	A	A	N/A	A	A	A	A	A
F71 P71	A	A	A	A	N/A	A	A	N/A	A	A	A	A	A
F72 P72	A	A	A	A	N/A	A	A	N/A	A	A	A	A	A
F73 P73	A	A	A	A	N/A	A	A	N/A	A	A	A	A	A
F74 P74	A	A	A	A	N/A	A	A	N/A	A	A	A	A	A
F75 P75	A	A	A	A	N/A	A	A	N/A	A	A	A	A	A
F76 P76	A	A	A	A	N/A	A	A	N/A	A	A	A	A	A
F77 P77	A	A	A	A	N/A	A	A	N/A	A	A	A	A	A

• A: Available, N/A: Not available

Note1) For the FP0/FPΣ/FP-X/FP1/FP-M, the P type high-level instructions are not available.

Number	Name	Boolean	Operand	Description	Steps
F78 P78	ASCII code → 32-bit binary data	DABI PDABI	S1, S2, D	Converts the ASCII code specified by “S1” and “S2” to 32 bits of binary data and stores it in (D+1, D).	11
F80 P80	16-bit binary data → 4-digit BCD data	BCD PBCD	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 P81	4-digit BCD data → 16-bit binary data	BIN PBIN	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 P82	32-bit binary data → 8-digit BCD data	DBCD PDBCD	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 P83	8-digit BCD data → 32-bit binary data	DBIN PDBIN	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 P84	16-bit data invert (com- plement of 1)	INV PINV	D	Inverts each bit of data of “D”.	3
F85 P85	16-bit data complement of 2	NEG PNEG	D	Inverts each bit of data of “D” and adds 1 (inverts the sign).	3
F86 P86	32-bit data complement of 2	DNEG PDNEG	D	Inverts each bit of data of (D+1, D) and adds 1 (inverts the sign).	3
F87 P87	16-bit data absolute	ABS PABS	D	Gives the absolute value of the data of “D”.	3

Name	Availability												
	FP0 <small>Note1)</small>	FPΣ <small>Note1)</small>	FP-X <small>Note1)</small>	FP-φ	FP1 <small>Note1)</small>			FP-M <small>Note1)</small>		FP3	FP2	FP2SH	FP10SH
					C14 C16	C24 C40	C56 C72	C16	C20 C32				
F78 P78	A	A	A	A	N/A	A	A	N/A	A	A	A	A	A
F80 P80	A	A	A	A	A	A	A	A	A	A	A	A	A
F81 P81	A	A	A	A	A	A	A	A	A	A	A	A	A
F82 P82	A	A	A	A	A	A	A	A	A	A	A	A	A
F83 P83	A	A	A	A	A	A	A	A	A	A	A	A	A
F84 P84	A	A	A	A	A	A	A	A	A	A	A	A	A
F85 P85	A	A	A	A	A	A	A	A	A	A	A	A	A
F86 P86	A	A	A	A	A	A	A	A	A	A	A	A	A
F87 P87	A	A	A	A	A	A	A	A	A	A	A	A	A

• A: Available, N/A: Not available

Note1) For the FP0/FPΣ/FP-X/FP1/FP-M, the P type high-level instructions are not available.

Number	Name	Boolean	Operand	Description	Steps
F88 P88	32-bit data absolute	DABS PDABS	D	Gives the absolute value of the data of (D+1, D).	3
F89 P89	16-bit data sign extension	EXT PEXT	D	Extends the 16 bits of data in "D" to 32 bits in (D+1, D).	3
F90 P90	Decode	DECO PDECO	S, n, D	Decodes part of the data of "S" and stores it in "D". The part is specified by "n".	7
F91 P91	7-segment decode	SEGT PSEGT	S, D	Converts the data of "S" for use in a 7-segment display and stores it in (D+1, D).	5
F92 P92	Encode	ENCO PENCO	S, n, D	Encodes part of the data of "S" and stores it in "D". The part is specified by "n".	7
F93 P93	16-bit data combine	UNIT PUNIT	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 P94	16-bit data distribute	DIST PDIST	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 P95	Character→ASCII code	ASC PASC	S, D	Twelve characters of the character constants of "S" are converted to ASCII code and stored in "D" to "D+5".	15
F96 P96	16-bit table data search	SRC PSRC	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 DT9037 and DT9038 for FP0/FP-e/FP1/FP-M/FP3 and DT90037 and DT90038 for FP0 T32/FPΣ/FP2/FP2SH/FP10SH.	7
F97 P97	32-bit table data search	DSRC PDSRC	S1, S2, S3	The data of (S1+1, S1) is searched for in the 32-bit data designated by "S3", beginning from "S2", and the result is stored in DT90037 and DT90038.	11
Data shift instructions					
F98 P98	Data table shift-out and compress	CMPR PCMPR	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

Name	Availability												
	FP0 <small>Note1)</small>	FPΣ <small>Note1)</small>	FP-X <small>Note1)</small>	FP-φ	FP1 <small>Note1)</small>			FP-M <small>Note1)</small>		FP3	FP2	FP2SH	FP10SH
					C14 C16	C24 C40	C56 C72	C16	C20 C32				
F88 P88	A	A	A	A	A	A	A	A	A	A	A	A	A
F89 P89	A	A	A	A	A	A	A	A	A	A	A	A	A
F90 P90	A	A	A	A	A	A	A	A	A	A	A	A	A
F91 P91	A	A	A	A	A	A	A	A	A	A	A	A	A
F92 P92	A	A	A	A	A	A	A	A	A	A	A	A	A
F93 P93	A	A	A	A	A	A	A	A	A	A	A	A	A
F94 P94	A	A	A	A	A	A	A	A	A	A	A	A	A
F95 P95	A	A	A	A	N/A	A	A	N/A	A	A	A	A	A
F96 P96	A	A	A	A	A	A	A	A	A	A	A	A	A
F97 P97	N/A	A	A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A
Data shift instructions													
F98 P98	N/A	A	A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A	A

• A: Available, N/A: Not available

Note1) For the FP0/FPΣ/FP-X/FP1/FP-M, the P type high-level instructions are not available.

Num-ber	Name	Boolean	Operand	Description	Steps
F99 P99	Data table shift-in and compress	CMPW PCMPW	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 P100	Right shift of multiple bits (n bits) in a 16-bit data	SHR PSHR	D, n	Shifts the "n" bits of "D" to the right.	5
F101 P101	Left shift of multiple bits (n bits) in a 16-bit data	SHL PSHL	D, n	Shifts the "n" bits of "D" to the left.	5
F102 P102	Right shift of n bits in a 32-bit data	DSHR PDSHR	D, n	Shifts the "n" bits of the 32-bit data area specified by (D+1, D) to the right.	5
F103 P103	Left shift of n bits in a 32-bit data	DSHL PDSHL	D, n	Shifts the "n" bits of the 32-bit data area specified by (D+1, D) to the left.	5
F105 P105	Right shift of one hexadecimal digit (4-bit)	BSR PBSR	D	Shifts the one digit of data of "D" to the right.	3
F106 P106	Left shift of one hexadecimal digit (4-bit)	BSL PBSL	D	Shifts the one digit of data of "D" to the left.	3
F108 P108	Right shift of multiple bits (n bits)	BITR PBITR	D1, D2, n	Shifts the "n" bits of data range by "D1" and "D2" to the right.	7
F109 P109	Left shift of multiple bits (n bits)	BITL PBITL	D1, D2, n	Shifts the "n" bits of data range by "D1" and "D2" to the left.	7
F110 P110	Right shift of one word (16-bit)	WSHR PWSHR	D1, D2	Shifts the one word of the areas by "D1" and "D2" to the right.	5
F111 P111	Left shift of one word (16-bit)	WSHL PWSHL	D1, D2	Shifts the one word of the areas by "D1" and "D2" to the left.	5
F112 P112	Right shift of one hexadecimal digit (4-bit)	WBSR PWBSR	D1, D2	Shifts the one digit of the areas by "D1" and "D2" to the right.	5

Name	Availability												
	FP0 <small>Note1)</small>	FPΣ <small>Note1)</small>	FP-X <small>Note1)</small>	FP-φ	FP1 <small>Note1)</small>			FP-M <small>Note1)</small>		FP3	FP2	FP2SH	FP10SH
					C14 C16	C24 C40	C56 C72	C16	C20 C32				
F99 P99	N/A	A	A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A	A
F100 P100	A	A	A	A	A	A	A	A	A	A	A	A	A
F101 P101	A	A	A	A	A	A	A	A	A	A	A	A	A
F102 P102	N/A	A	A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A
F103 P103	N/A	A	A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A
F105 P105	A	A	A	A	A	A	A	A	A	A	A	A	A
F106 P106	A	A	A	A	A	A	A	A	A	A	A	A	A
F108 P108	N/A	A	A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A
F109 P109	N/A	A	A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A
F110 P110	A	A	A	A	A	A	A	A	A	A	A	A	A
F111 P111	A	A	A	A	A	A	A	A	A	A	A	A	A
F112 P112	A	A	A	A	A	A	A	A	A	A	A	A	A

• A: Available, N/A: Not available

Note1) For the FP0/FPΣ/FP-X/FP1/FP-M, the P type high-level instructions are not available.

Number	Name	Boolean	Operand	Description	Steps
F113 P113	Left shift of one hexadecimal digit (4-bit)	WBSL PWBSL	D1, D2	Shifts the one digit of the areas by "D1" and "D2" to the left.	5
FIFO instructions					
F115 P115	FIFO buffer define	FIFT PFIFT	n, D	The "n" words beginning from "D" are defined in the buffer.	5
F116 P116	Data read from FIFO buffer	FIFR PFIFR	S, D	The oldest data beginning from "S" that was written to the buffer is read and stored in "D".	5
F117 P117	Data write into FIFO buffer	FIFW PFIFW	S, D	The data of "S" is written to the buffer starting from "D".	5
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 rotate instructions					
F120 P120	16-bit data right rotate	ROR PROR	D, n	Rotate the "n" bits in data of "D" to the right.	5
F121 P121	16-bit data left rotate	ROL PROL	D, n	Rotate the "n" bits in data of "D" to the left.	5
F122 P122	16-bit data right rotate with carry flag (R9009) data	RCR PRCR	D, n	Rotate the "n" bits in 17-bit area consisting of "D" plus the carry flag (R9009) data to the right.	5
F123 P123	16-bit data left rotate with carry flag (R9009) data	RCL PRCL	D, n	Rotate the "n" bits in 17-bit area consisting of "D" plus the carry flag (R9009) data to the left.	5

Name	Availability												
	FP0 <small>Note1)</small>	FPΣ <small>Note1)</small>	FP-X <small>Note1)</small>	FP-φ	FP1 <small>Note1)</small>			FP-M <small>Note1)</small>		FP3	FP2	FP2SH	FP10SH
					C14 C16	C24 C40	C56 C72	C16	C20 C32				
F113 P113	A	A	A	A	A	A	A	A	A	A	A	A	A
FIFO instructions													
F115 P115	N/A	A	A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A	A
F116 P116	N/A	A	A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A	A
F117 P117	N/A	A	A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A	A
Basic function instructions													
F118	A	A	A	A	A	A	A	A	A	A	A	A	A
F119	A	A	A	A	A	A	A	A	A	A	A	A	A
Data rotate instructions													
F120 P120	A	A	A	A	A	A	A	A	A	A	A	A	A
F121 P121	A	A	A	A	A	A	A	A	A	A	A	A	A
F122 P122	A	A	A	A	A	A	A	A	A	A	A	A	A
F123 P123	A	A	A	A	A	A	A	A	A	A	A	A	A

• A: Available, N/A: Not available

Note1) For the FP0/FPΣ/FP-X/FP1/FP-M, the P type high-level instructions are not available.

Number	Name	Boolean	Operand	Description	Steps
F125 P125	32-bit data right rotate	DROR PDROR	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 P126	32-bit data left rotate	DROL PDROL	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 P127	32-bit data right rotate with carry flag (R9009) data	DRCR PDCRCR	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 P128	32-bit data left rotate with carry flag (R9009) data	DRCL PDRCL	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 P130	16-bit data bit set	BTS PBTS	D, n	Set the value of bit position “n” of the data of “D” to 1.	5
F131 P131	16-bit data bit reset	BTR PBTR	D, n	Set the value of bit position “n” of the data of “D” to 0.	5
F132 P132	16-bit data invert	BTI PBTI	D, n	Invert the value of bit position “n” of the data of “D”.	5
F133 P133	16-bit data bit test	BTT PBTT	D, n	Test the value of bit position “n” of the data of “D” and output the result to R900B.	5
F135 P135	Number of on (1) bits in 16-bit data	BCU PBCU	S, D	Store the number of on bits in the data of “S” in “D”.	5
F136 P136	Number of on (1) bits in 32-bit data	DBC PDBC	S, D	Store the number of on bits in the data of (S+1, S) in “D”.	7

Name	Availability												
	FP0 <small>Note1)</small>	FPΣ <small>Note1)</small>	FP-X <small>Note1)</small>	FP-φ	FP1 <small>Note1)</small>			FP-M <small>Note1)</small>		FP3	FP2	FP2SH	FP10SH
					C14 C16	C24 C40	C56 C72	C16	C20 C32				
F125 P125	N/A	A	A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A
F126 P126	N/A	A	A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A
F127 P127	N/A	A	A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A
F128 P128	N/A	A	A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A
Bit manipulation instructions													
F130 P130	A	A	A	A	A	A	A	A	A	A	A	A	A
F131 P131	A	A	A	A	A	A	A	A	A	A	A	A	A
F132 P132	A	A	A	A	A	A	A	A	A	A	A	A	A
F133 P133	A	A	A	A	A	A	A	A	A	A	A	A	A
F135 P135	A	A	A	A	A	A	A	A	A	A	A	A	A
F136 P136	A	A	A	A	A	A	A	A	A	A	A	A	A

• A: Available, N/A: Not available

Note1) For the FP0/FPΣ/FP-X/FP1/FP-M, the P type high-level instructions are not available.

Num- ber	Name	Boolean	Operand	Description	Steps
Basic function instruction					
F137	Auxiliary timer (16-bit)	STMR	S, D	Turn on the specified output and R900D after 0.01 s × set value.	5
Special instructions					
F138 P138	Hours, min- utes and sec- onds to seconds data	HMSS PHMSS	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 P139	Seconds to hours, minutes and seconds data	SHMS PSHMS	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 P140	Carry flag (R9009) set	STC PSTC	-	Turns on the carry flag (R9009).	1
F141 P141	Carry flag (R9009) reset	CLC PCLC	-	Turns off the carry flag (R9009).	1

Name	Availability												
	FP0 <small>Note1)</small>	FPΣ <small>Note1)</small>	FP-X <small>Note1)</small>	FP-φ	FP1 <small>Note1)</small>			FP-M <small>Note1)</small>		FP3	FP2	FP2SH	FP10SH
					C14 C16	C24 C40	C56 C72	C16	C20 C32				
Basic function instruction													
F137	A	A	A	A	N/A	N/A	A	N/A	A	A	A	A	A
Special instructions													
F138 P138	Partly N/A <small>Note2)</small>	A	A	A	N/A	A	A	N/A	A	A	A	A	A
F139 P139	Partly N/A <small>Note2)</small>	A	A	A	N/A	A	A	N/A	A	A	A	A	A
F140 P140	A	A	A	A	N/A	A	A	N/A	A	A	A	A	A
F141 P141	A	A	A	A	N/A	A	A	N/A	A	A	A	A	A

• A: Available, N/A: Not available

Note1) For the FP0/FPΣ/FP-X/FP1/FP-M, the P type high-level instructions are not available.

Note2) The instruction is available for FP0 T32 type.

Number	Name	Boolean	Operand	Description	Steps
F142 P142	Watching dog timer update	WDT PWDT	S	The time (allowable scan time for the system) of watching dog timer is changed to "S" × 0.1 (ms) for that scan.	3
F143 P143	Partial I/O update	IORF PIORF	D1, D2	Updates the I/O from the number specified by "D1" to the number specified by "D2".	5
F144	Serial data communication control	TRNS	S, n	The COM port received flag (R9038) is set to off to enable reception. Beginning at "S", "n" bytes of the data registers are sent from the COM port.	5
F145 P145	Data send	SEND PSEND	S1, S2, D, N	Sends the data to another station in the network (MEWNET).	9
F146 P146	Data receive	RECV PRECV	S1, S2, N, D	Receives the data to another station in the network (MEWNET).	9
F145 P145	Data send	SEND	S1, S2, D, N	Sends the data to the slave station as the MOD bus master.	9
F146 P146	Data receive	RECV	S1, S2, N, D	Receives the data from the slave station as the MOD bus master.	9
F145 P145	Data send	SEND	S1, S2, D, N	Sends the data to the slave station as the MEWTOCOL master.	9
F146 P146	Data receive	RECV	S1, S2, N, D	Receives the data from the slave station as the MEWTOCOL master.	9
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 P148	Self-diagnostic error set	ERR PERR	n (n: k100 to K299)	Stores the self-diagnostic error number "n" in (DT9000 for FP0/FP-e/FP1/FP-M/FP3 or DT90000 for FP0 T32/FPΣ/FP2/FP2SH/FP10SH), turns R9000 on, and turns on the ERROR LED.	3

Name	Availability												
	FP0 <small>Note1)</small>	FPΣ <small>Note1)</small>	FP-X <small>Note1)</small>	FP-φ	FP1 <small>Note1)</small>			FP-M <small>Note1)</small>		FP3	FP2	FP2SH	FP10SH
					C14 C16	C24 C40	C56 C72	C16	C20 C32				
F142 P142	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	A
F143 P143	A	A	A	A	N/A	A	A	A	A	A	A	A	A
F144	A	N/A	A	A	N/A	A	A	N/A	A	N/A	A	A	A
F145 P145	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A	A
F146 P146	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A	A
F145 P145	N/A	Partly N/A <small>Note2)</small>	A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
F146 P146	N/A	Partly N/A <small>Note2)</small>	A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
F145 P145	N/A	Partly N/A <small>Note2)</small>	Partly N/A <small>Note2)</small>	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
F146 P146	N/A	Partly N/A <small>Note2)</small>	Partly N/A <small>Note2)</small>	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
F147	A	A	A	A	N/A	A	A	N/A	A	A	A	A	A
F148 P148	A	A	A	A	N/A	A	A	N/A	A	A	A	A	A

• A: Available, N/A: Not available

Note1) For the FP0/FPΣ/FP-X/FP1/FP-M, the P type high-level instructions are not available.

Note2) This instruction is available for FP-X V1.20 or later and FPΣ 32k.

Num- ber	Name	Boolean	Operand	Description	Steps
F149 P149	Message display	MSG PMSG	S	Displays the character constant of "S" in the connected programming tool.	13
F150 P150	Data read from intelligent unit	READ PREAD	S1, S2, n, D	Reads the data from the intelligent unit.	9
F151 P151	Data write into intelligent unit	WRT PWRT	S1, S2, n, D	Writes the data into the intelligent unit.	9
F152 P152	Data read from MEWNET-F slave station	RMRD PRMRD	S1, S2, n, D	Reads the data from the intelligent unit at the MEWNET-F (remote I/O) slave station.	9
F153 P153	Data write into MEWNET-F slave station	RMWT PRMWT	S1, S2, n, D	Writes the data into the intelligent unit at the MEWNET-F (remote I/O) slave station.	9
F154 P154	Machine language program call	MCAL PMCAL	n	The machine language program is called.	3
F155 P155	Sampling	SMPL PSMPL	-	Starts sampling data.	1
F156 P156	Sampling trigger	STRG PSTRG	-	When the trigger of this instruction turns on, the sampling trace stops.	1
F157 P157	Time addition	CADD PCADD	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 P158	Time subtraction	CSUB PCSUB	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 P159	Serial port communication	MTRN PMTRN	S, n, D	This is used to send data to an external device through the specified CPU COM port or MCU COM port.	7
F161 P161	MCU serial port reception	MRCV PMRCV	S, D1, D2	Data is received from external equipment via the COM port of the specified MCU.	7

Name	Availability												
	FP0 <small>Note1)</small>	FPΣ <small>Note1)</small>	FP-X <small>Note1)</small>	FP-φ	FP1 <small>Note1)</small>			FP-M <small>Note1)</small>		FP3	FP2	FP2SH	FP10SH
					C14 C16	C24 C40	C56 C72	C16	C20 C32				
F149 P149	A	A	A	A	N/A	A	A	N/A	A	A	A	A	A
F150 P150	N/A	Partly N/A <small>Note2)</small>	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A	A
F151 P151	N/A	Partly N/A <small>Note2)</small>	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A	A
F152 P152	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A	A
F153 P153	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A	A
F154 P154	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	N/A	N/A
F155 P155	N/A	Partly N/A <small>Note6)</small>	Partly N/A <small>Note5)</small>	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A	A
F156 P156	N/A	Partly N/A <small>Note6)</small>	Partly N/A <small>Note5)</small>	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A	A
F157 P157	Partly N/A <small>Note3)</small>	A	A	A	N/A	A	A	A	A	A	A	A	A
F158 P158	Partly N/A <small>Note3)</small>	A	A	A	N/A	A	A	A	A	A	A	A	A
F159 P159	N/A	A	A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Partly N/A <small>Note4)</small>	Partly N/A <small>Note4)</small>	N/A
F161 P161	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Partly N/A <small>Note4)</small>	Partly N/A <small>Note4)</small>	N/A

• A: Available, N/A: Not available

Note1) For the FP0/FPΣ/FP-X/FP1/FP-M, the P type high-level instructions are not available.

Note2) This instruction is available for FPΣ Ver. 2.0 or later.

Note3) This instruction is available for T32 type.

Note4) This instruction is available for FP2/FP2SH Ver. 1.5 or later.

Note5) This instruction is available for FP-X Ver. 2.0 or later.

Note6) This instruction is available for FPΣ Ver. 3.10 or later.

Num-ber	Name	Boolean	Operand	Description	Steps
BIN arithmetic instruction					
F160 P160	Double word (32-bit) data square root	DSQR PDSQR	S, D	$\sqrt{(S)} \rightarrow (D)$	7
Special instructions (High-speed counter instructions)					
F0	High-speed counter and Pulse output controls	MV	S, DT9052	Performs high-speed counter and Pulse output controls according to the control code specified by "S". The control code is stored in DT9052.	5
F1	Change and read of the elapsed value of high-speed counter and Pulse output	DMV	S, DT9044	Transfers (S+1, S) to high-speed counter and Pulse output elapsed value area (DT9045, DT9044).	7
			DT9044, D	Transfers value in high-speed counter and Pulse output elapsed value area (DT9045, DT9044) to (D+1, D).	7
F162	High-speed counter output set	HC0S	S, Yn	The specified external output relay (Yn) turns on when the elapsed value of the high-speed counter agrees with the specified target value (S+1, S).	7
F163	High-speed counter output reset	HC0R	S, Yn	The specified external output relay (Yn) turns off when the elapsed value of the high-speed counter agrees with the specified target value (S+1, S).	7
F164	Speed control (Pulse output and pattern output controls) (See below.)	SPD0	S	Controls conditions of outputs according to the elapsed value of the high-speed counter. Two types of output control available: - Pulse output control - Pattern output control	3
F165	Cam control	CAM0	S	Controls cam operation (on/off patterns of each cam output) according to the elapsed value of the high-speed counter.	3

Pulse output specifications for FP-M/FP1

Item	FP1 C14/C16, FP-M C16T	FP1 C24/C40	FP1 C56/C72 FP-M C20T/C20R/C32T
Pulse output terminal	Y7	Y7	Y6 and Y7 (selectable)
Pulse frequency	1440 Hz to 5 kHz/720 Hz to 5 kHz/360 Hz to 5kHz/180 Hz to 5 kHz/90 Hz to 5 kHz/45 Hz to 5 kHz (Switches between 6 ranges)		
Internal connection between pulse output and counter input	Not possible	Not possible	Possible

Switching of the pulse frequency range is supported by CPU Ver. 2.7 or later.

In versions prior to CPU Ver. 2.7, the range is fixed at 360 Hz to 5 kHz.

In Ver. 2.7 or later but prior to CPU Ver. 2.9, switching is possible among 4 ranges (360 Hz to 5 kHz/180 Hz to 5 kHz/90 Hz to 5 kHz/45 Hz to 5 kHz).

In CPU Ver. 2.9 and later versions, switching is possible among 6 ranges.

Name	Availability												
	FP0 <small>Note1)</small>	FPΣ <small>Note1)</small>	FP-X <small>Note1)</small>	FP-φ	FP1 <small>Note1)</small>			FP-M <small>Note1)</small>		FP3	FP2	FP2SH	FP10SH
					C14 C16	C24 C40	C56 C72	C16	C20 C32				
BIN arithmetic instruction													
F160 P160	N/A	A	A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A	A
Special instructions (High-speed counter instructions)													
F0	A	N/A	N/A	A	A	A	A	A	A	N/A	N/A	N/A	N/A
F1	A	N/A	N/A	A	A	A	A	A	A	N/A	N/A	N/A	N/A
F162	N/A	N/A	N/A	N/A	A	A	A	A	A	N/A	N/A	N/A	N/A
F163	N/A	N/A	N/A	N/A	A	A	A	A	A	N/A	N/A	N/A	N/A
F164	N/A	N/A	N/A	N/A	A	A	A	A	A	N/A	N/A	N/A	N/A
F165	N/A	N/A	N/A	N/A	A	A	A	N/A	A	N/A	N/A	N/A	N/A

• A: Available, N/A: Not available

Note1) For the FP0/FPΣ/FP-X/FP1/FP-M, the P type high-level instructions are not available.

Note2) The elapsed value area varies depending on the channel being used.

Num-ber	Name	Boolean	Operand	Description	Steps
High speed counter/Pulse output instruction for FP0, FP-e					
F166	High-speed counter output set (with channel specification)	HC1S	n, S, Yn	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	High-speed counter output reset (with channel specification)	HC1R	n, S, Yn	Turns output Yn off when the elapsed value of the built-in high-speed counter reaches the target value of (S+1, S).	11
F168	Positioning control (with channel specification)	SPD1	S, n	Outputs a positioning pulse from the specified output (Y0 or Y1) according to the contents of the data table beginning at "S".	5
F169	Pulse output (with channel specification)	PLS	S, n	Outputs a pulse from the specified output (Y0 or Y1) according to the contents of the data table beginning at "S".	5
F170	PWM output (with channel specification)	PWM	S, n	Performs PWM output from the specified output (Y0 or Y1) according to the contents of the data table beginning at "S".	5

Name	Availability												
	FP0 <small>Note1)</small>	FPΣ <small>Note1)</small>	FP-X <small>Note1)</small>	FP-e	FP1 <small>Note1)</small>			FP-M <small>Note1)</small>		FP3	FP2	FP2SH	FP10SH
					C14 C16	C24 C40	C56 C72	C16	C20 C32				
High speed counter/Pulse output instruction for FP0, FP-e													
F166	A	N/A	N/A	A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
F167	A	N/A	N/A	A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
F168	A	N/A	N/A	A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
F169	A	N/A	N/A	A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
F170	A	N/A	N/A	A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

• A: Available, N/A: Not available

Note1) For the FP0/FPΣ/FP-X/FP1/FP-M, the P type high-level instructions are not available.

Note2) The elapsed value area varies depending on the channel being used.

Num-ber	Name	Boolean	Operand	Description	Steps
High speed counter/Pulse output instruction for FPΣ/FP-X					
F0	High-speed counter and Pulse output controls	MV	S, DT90052	Performs high-speed counter and Pulse output controls according to the control code specified by "S". The control code is stored in DT90052.	5
F1	Change and read of the elapsed value of high-speed counter and Pulse output	DMV	FPΣ: S, DT90044 FP-X: S, DT90300	Transfers (S+1, S) to high-speed counter and Pulse output elapsed value area (DT90045, DT90044).	7
			FPΣ: DT90044, D FP-X: DT90300, D	Transfers value in high-speed counter and Pulse output elapsed value area (DT90045, DT90044) to (D+1, D).	7
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

Name	Availability (A: Available, N/A: Not available)												
	FP0 <small>Note1)</small>	FPΣ <small>Note1)</small>	FP-X <small>Note1)</small>	FP-e	FP1 <small>Note1)</small>			FP-M <small>Note1)</small>		FP3	FP2	FP2SH	FP10SH
					C14 C16	C24 C40	C56 C72	C16	C20 C32				
High speed counter/Pulse output instruction for FPΣ/FP-X													
F0	N/A	A	A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
F1	N/A	A	A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
F166	A	A	A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
F167	A	A	A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
F171	N/A	A	A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
F172	N/A	A	A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
F173	N/A	A	A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
F174	N/A	A	A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
F175	N/A	N/A	A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
F176	N/A	A <small>Note3)</small>	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Note1) For the FP0/FPΣ/FP-X/FP1/FP-M, the P type high-level instructions are not available.

Note2) The elapsed value area differs depending on used channels.

Note3) This instruction is available for FPΣ C32T2,C28T2,C32T2H and C28T2H.

Num-ber	Name	Boolean	Operand	Description	Steps
Screen display instructions					
F180	FP-e screen display registration	SCR	S1, S2, S3, S4	Register the screen displayed on the FP-e.	9
F181	FP-e screen display switching	DSP	S	Specify the screen to be displayed on the FP-e.	3
Basic function instruction					
F182	Time constant processing	FILTR	S1, S2, S3, D	Executes the filter processing for the specified input.	9
F183	Auxiliary timer (32-bit)	DSTM	S, D	Turn on the specified output and R900D after 0.01 s. × set value.	7
Data transfer instructions					
F190 P190	Three 16-bit data move	MV3 PMV3	S1, S2, S3, D	(S1)→(D), (S2)→(D+1), (S3)→(D+2)	10
F191 P191	Three 32-bit data move	DMV3 PDMV3	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 P215	32-bit data AND	DAND PDAND	S1, S2, D	(S1+1, S1) AND (S2+1, S2)→(D+1, D)	12
F216 P216	32-bit data OR	DOR PDOR	S1, S2, D	(S1+1, S1) OR (S2+1, S2)→(D+1, D)	12
F217 P217	32-bit data XOR	DXOR PDXOR	S1, S2, D	$\{(S1+1, S1) \text{ AND } (\overline{S2+1, S2})\} \text{ OR } \{(\overline{S1+1, S1}) \text{ AND } (S2+1, S2)\} \rightarrow (D+1, D)$	12
F218 P218	32-bit data XNR	DXNR PDXNR	S1, S2, D	$\{(S1+1, S1) \text{ AND } (S2+1, S2)\} \text{ OR } \{(\overline{S1+1, S1}) \text{ AND } (\overline{S2+1, S2})\} \rightarrow (D+1, D)$	12
F219 P219	Double word (32-bit) data unites	DUNI PDUNI	S1, S2, S3, D	$\{(S1+1, S1) \text{ AND } (S3+1, S3)\} \text{ OR } \{(S2+1, S2) \text{ AND } (S3+1, S3)\} \rightarrow (D+1, D)$	16
Data conversion instructions					
F230 P230	Time data → second conversion	TMSEC PTMSEC	S, D	The specified time data (a date and time) is changed to the second data.	6
F231 P231	Second data→ time conversion	SECTM PSECTM	S, D	The specified second data is changed into time data (a date and time).	6

Name	Availability												
	FP0 <small>Note1)</small>	FP- <small>Note1)</small>	FP-X <small>Note1)</small>	FP-e	FP1 <small>Note1)</small>			FP-M <small>Note1)</small>		FP3	FP2	FP2SH	FP10SH
					C14 C16	C24 C40	C56 C72	C16	C20 C32				
Screen display instructions													
F180	N/A	N/A	N/A	A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
F181	N/A	N/A	N/A	A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Basic function instruction													
F182	N/A	Partly N/A <small>Note5)</small>	Partly N/A <small>Note4)</small>	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
F183	A	A	A	A	N/A	N/A	N/A	N/A	A	N/A	A	A	A
Data transfer instructions													
F190 P190	N/A	A	A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A
F191 P191	N/A	A	A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A
Logic operation instructions													
F215 P215	N/A	A	A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A
F216 P216	N/A	A	A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A
F217 P217	N/A	A	A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A
F218 P218	N/A	A	A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A
F219 P219	N/A	A	A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A
Data conversion instructions													
F230 P230	N/A	Partly N/A <small>Note3)</small>	Partly N/A <small>Note6)</small>	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Partly N/A <small>Note2)</small>	Partly N/A <small>Note2)</small>	N/A
F231 P231	N/A	Partly N/A <small>Note3)</small>	Partly N/A <small>Note6)</small>	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Partly N/A <small>Note2)</small>	Partly N/A <small>Note2)</small>	N/A

• A: Available, N/A: Not available

Note1) For the FP0/FPΣ/FP-X/FP1/FP-M, the P type high-level instructions are not available.

Note2) This instruction is available for FP2/FP2SH Ver. 1.5 or later.

Note3) This instruction is available for FP Σ 32k.

Note4) This function is available for FP-X Ver2.0 or later.

Note5) This instruction is available for FP Σ Ver 3.10 or later.

Note6) This instruction is available for FP-X V1.13 or later.

Num- ber	Name	Boolean	Operand	Description	Steps
F235 P235	16-bit binary data → Gray code conversion	GRY PGRY	S, D	Converts the 16-bit binary data of "S" to gray codes, and the converted result is stored in the "D".	6
F236 P236	32-bit binary data → Gray code conversion	DGRY PDGRY	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 P237	16-bit gray code → binary data conversion	GBIN PGBIN	S, D	Converts the gray codes of "S" to binary data, and the converted result is stored in the "D".	6
F238 P238	32-bit gray code → binary data conversion	DGBIN PDGBIN	S, D	Converts the gray codes of (S+1, S) to binary data, and the converted result is stored in the (D+1, D).	8
F240 P240	Bit line to bit column conversion	COLM PCOLM	S, n, D	The values of bits 0 to 15 of "S" are stored in bit "n" of (D to DC+15).	8
F241 P241	Bit column to bit line conversion	LINE PLINE	S, n, D	The values of bit "n" of (S) to (S+15) are stored in bits 0 to 15 of "D".	8
F250	Binary data → ASCII conversion	BTOA	S1, S2, n, D	Converts multiple binary data to multiple ASCII data.	12
F251	ASCII → binary data conversion	ATOB	S1, S2, n, D	Converts multiple ASCII data to multiple binary data.	12
F252	ASCII data check	ACHK	S1, S2, n	Checks the ASCII data strings to be used in F251 (ATOB) instruction.	10
Character strings instructions					
F257 P257	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 P258	Character string coupling	SADD	S1, S2, D	These instructions couple one character string with another.	12
F259 P259	Number of characters in a character string	LEN	S, D	These instructions determine the number of characters in a character string.	6
F260 P260	Search for character string	SSRC	S1, S2, D	The specified character is searched in a character string.	10
F261 P261	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

Name	Availability										A: Available, N/A: Not available		
	FP0 <small>Note1)</small>	FPΣ <small>Note1)</small>	FP-X <small>Note1)</small>	FP-φ	FP1 <small>Note1)</small>			FP-M <small>Note1)</small>		FP3	FP2	FP2SH	FP10SH
					C14 C16	C24 C40	C56 C72	C16	C20 C32				
F235 P235	N/A	A	A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A
F236 P236	N/A	A	A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A
F237 P237	N/A	A	A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A
F238 P238	N/A	A	A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A
F240 P240	N/A	A	A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A
F241 P241	N/A	A	A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A
F250	N/A	Partly N/A <small>Note2</small>	A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
F251	N/A	Partly N/A <small>Note2</small>	A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
F252	N/A	Partly N/A <small>Note4)</small>	Partly N/A <small>Note3)</small>	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Character strings instructions													
F257 P257	N/A	A	A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A
F258 P258	N/A	A	A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A
F259 P259	N/A	A	A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A
F260 P260	N/A	A	A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A
F261 P261	N/A	A	A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A

• A: Available, N/A: Not available

Note1) For the FP0/FPΣ/FP-X/FP1/FP-M, the P type high-level instructions are not available.

Note2) This instruction is available for FP Σ 32k.

Note3) This instruction is available for FP-X Ver2.0 or later.

Note4) This instruction is available for FP FP Σ Ver3.10 or later.

Num- ber	Name	Boolean	Operand	Description	Steps
F262 P262	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 P263	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 P264	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 P265	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
Integer type data processing instructions					
F270 P270	Maximum value (word data (16-bit))	MAX PMAX	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 P271	Maximum value (double word data (32-bit))	DMAX PDMAX	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 P272	Minimum value (word data (16-bit))	MIN PMIN	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 P273	Minimum value (double word data (32-bit))	DMIN PDMIN	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 P275	Total and mean values (word data (16-bit))	MEAN PMEAN	S1, S2, D	The total value and the mean value of the word data with sign from the area selected with "S1" to "S2" are obtained and stored in the "D".	8
F276 P276	Total and mean values (double word data (32-bit))	DMEAN PDMEAN	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 obtained and stored in the "D".	8

Name	Availability												
	FP0 <small>Note1)</small>	FPΣ <small>Note1)</small>	FP-X <small>Note1)</small>	FP-φ	FP1 <small>Note1)</small>			FP-M <small>Note1)</small>		FP3	FP2	FP2SH	FP10SH
					C14 C16	C24 C40	C56 C72	C16	C20 C32				
F262 P262	N/A	A	A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A
F263 P263	N/A	A	A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A
F264 P264	N/A	A	A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A
F265 P265	N/A	A	A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A
Integer type data processing instructions													
F270 P270	N/A	A	A	Partly N/A <small>Note2</small>	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A
F271 P271	N/A	A	A	Partly N/A <small>Note2</small>	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A
F272 P272	N/A	A	A	Partly N/A <small>Note2</small>	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A
F273 P273	N/A	A	A	Partly N/A <small>Note2</small>	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A
F275 P275	N/A	A	A	Partly N/A <small>Note2</small>	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A
F276 P276	N/A	A	A	Partly N/A <small>Note2</small>	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A

• A: Available, N/A: Not available

Note1) For the FP0/FPΣ/FP-X/FP1/FP-M, the P type high-level instructions are not available.

Note2) This instruction is available for FP-e Ver. 1.2 or later.

Num-ber	Name	Boolean	Operand	Description	Steps
F277 P277	Sort (word data (16-bit))	SORT PSORT	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 P278	Sort (double word data (32-bit))	DSORT PDSORT	S1, S2, S3	The double word data with sign from the area specified b "S1" ato "S2" are sorted in ascending order (the smallest word is first) or descending order (the largest word is first).	8
F282 P282	Scaling of 16-bit data	SCAL PSCAL	S1, S2, D	The toutptu value Y is found for the input value X by performing scaling for the given data table.	8
F283 P283	Scaling of 32-bit data	DSCAL PDSCAL	S1, S2, D	The toutptu value Y is found for the input value X by performing scaling for the given data table.	10
F284 P284	Inclination output of 16-bit data	RAMP	S1, S2, S3, D	Executes the linear output for the specified time from the specified initial value to the target value.	10
Integer type non-linear function instructions					
F285 P285	Upper and lower limit control (16-bit data)	LIMIT PLIMIT	S1, S2, S3, D	When $S1 > S3$, $S1 \rightarrow D$ When $S1 < S3$, $S2 \rightarrow D$ When $S1 < or = S3 < or = S2$, $S3 \rightarrow D$	10
F286 P286	Upper and lower limit control (32-bit data)	DLIMIT PDLIMIT	S1, S2, S3, D	When $(S1+1, S1) > (S3+1, S3)$, $(S1+1, S1) \rightarrow (D+1, D)$ When $(S2+1, S2) < (S3+1, S3)$, $(S2+1, S2) \rightarrow (D+1, D)$ When $(S1+1, S1) < or = (S3+1, S3) < or = (S2+1, S2)$, $(S3+1, S3) \rightarrow (D+1, D)$	16
F287 P287	Deadband control (16-bit data)	BAND PBAND	S1, S2, S3, D	When $S1 > S3$, $S3 - S1 \rightarrow D$ When $S2 < S3$, $S3 - S2 \rightarrow D$ When $S1 < or = S3 < or = S2$, $0 \rightarrow D$	10
F288 P288	Deadband control (32-bit data)	DBAND PDBAND	S1, S2, S3, D	When $(S1+1, S1) > (S3+1, S3)$, $(S3+1, S3) - (S1+1, S1) \rightarrow (D+1, D)$ When $(S2+1, S2) < (S3+1, S3)$, $(S3+1, S3) - (S2+1, S2) \rightarrow (D+1, D)$ When $(S1+1, S1) < or = (S3+1, S3) < or = (S2+1, S2)$, $0 \rightarrow (D+1, D)$	16
F289 P289	Zone control (16-bit data)	ZONE PZONE	S1, S2, S3, D	When $S3 < 0$, $S3 + S1 \rightarrow D$ When $S3 = 0$, $0 \rightarrow D$ When $S3 > 0$, $S3 + S2 \rightarrow D$	10
F290 P290	Zone control (32-bit data)	DZONE PDZONE	S1, S2, S3, D	When $(S3+1, S3) < 0$, $(S3+1, S3) + (S1+1, S1) \rightarrow (D+1, D)$ When $(S3+1, S3) = 0$, $0 \rightarrow (D+1, D)$ When $(S3+1, S3) > 0$, $(S3+1, S3) + (S2+1, S2) \rightarrow (D+1, D)$	16

Name	Availability												
	FP0 <small>Note1)</small>	FP Σ <small>Note1)</small>	FP-X <small>Note1)</small>	FP- ϕ	FP1 <small>Note1)</small>			FP-M <small>Note1)</small>		FP3	FP2	FP2SH	FP10SH
					C14 C16	C24 C40	C56 C72	C16	C20 C32				
F277 P277	N/A	A	A	Partly N/A <small>Note2)</small>	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A
F278 P278	N/A	A	A	Partly N/A <small>Note2)</small>	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A
F282 P282	N/A	A	A	Partly N/A <small>Note2)</small>	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A
F283 P283	N/A	A	A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A
F284 P284	N/A	N/A	Partly N/A <small>Note3)</small>	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Integer type non-linear function instructions													
F285 P285	N/A	A	A	Partly N/A <small>Note2)</small>	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A
F286 P286	N/A	A	A	Partly N/A <small>Note2)</small>	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A
F287 P287	N/A	A	A	Partly N/A <small>Note2)</small>	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A
F288 P288	N/A	A	A	Partly N/A <small>Note2)</small>	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A
F289 P289	N/A	A	A	Partly N/A <small>Note2)</small>	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A
F290 P290	N/A	A	A	Partly N/A <small>Note2)</small>	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A

• A: Available, N/A: Not available

Note1) For the FP0/FP Σ /FP-X/FP1/FP-M, the P type high-level instructions are not available.

Note2) This instruction is available for FP-e Ver. 1.2 or later.

Note3) This instruction is available for FP-X Ver 2.0 or later and FPsigma Ver.3.10 or later.

Num- ber	Name	Boolean	Operand	Description	Steps
BCD type real number operation instructions					
F300 P300	BCD type sine operation	BSIN PBSIN	S, D	$\text{SIN}(S1+1, S1) \rightarrow (D+1, D)$	6
F301 P301	BCD type cosine operation	BCOS PBCOS	S, D	$\text{COS}(S1+1, S1) \rightarrow (D+1, D)$	6
F302 P302	BCD type tangent operation	BTAN PBTAN	S, D	$\text{TAN}(S1+1, S1) \rightarrow (D+1, D)$	6
F303 P303	BCD type arcsine operation	BASIN PBASIN	S, D	$\text{SIN}^{-1}(S1+1, S1) \rightarrow (D+1, D)$	6
F304 P304	BCD type arccosine operation	BACOS PBACOS	S, D	$\text{COS}^{-1}(S1+1, S1) \rightarrow (D+1, D)$	6
F305 P305	BCD type arctangent operation	BATAN PBATAN	S, D	$\text{TAN}^{-1}(S1+1, S1) \rightarrow (D+1, D)$	6

Name	Availability												
	FP0 <small>Note1)</small>	FPΣ <small>Note1)</small>	FP-X <small>Note1)</small>	FP-φ	FP1 <small>Note1)</small>			FP-M <small>Note1)</small>		FP3	FP2	FP2SH	FP10SH
					C14 C16	C24 C40	C56 C72	C16	C20 C32				
BCD type real number operation instructions													
F300 P300	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A
F301 P301	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A
F302 P302	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A
F303 P303	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A
F304 P304	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A
F305 P305	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A

• A: Available, N/A: Not available

Note1) For the FP0/FPΣ/FP-X/FP1/FP-M, the P type high-level instructions are not available.

Num- ber	Name	Boolean	Operand	Description	Steps
Floating-point type real number operation instructions					
F309 P309	Floating- point type data move	FMV PFMV	S, D	$(S+1, S) \rightarrow (D+1, D)$	8
F310 P310	Floating- point type data addition	F+ PF+	S1, S2, D	$(S1+1, S1) + (S2+1, S2) \rightarrow (D+1, D)$	14
F311 P311	Floating- point type data subtraction	F- PF-	S1, S2, D	$(S1+1, S1) - (S2+1, S2) \rightarrow (D+1, D)$	14
F312 P312	Floating- point type data multiplication	F* PF*	S1, S2, D	$(S1+1, S1) \times (S2+1, S2) \rightarrow (D+1, D)$	14
F313 P313	Floating- point type data division	F% PF%	S1, S2, D	$(S1+1, S1) \div (S2+1, S2) \rightarrow (D+1, D)$	14
F314 P314	Floating- point type data sine operation	SIN PSIN	S, D	$\text{SIN}(S+1, S) \rightarrow (D+1, D)$	10
F315 P315	Floating- point type data cosine operation	COS PCOS	S, D	$\text{COS}(S+1, S) \rightarrow (D+1, D)$	10
F316 P316	Floating- point type data tangent operation	TAN PTAN	S, D	$\text{TAN}(S+1, S) \rightarrow (D+1, D)$	10
F317 P317	Floating- point type data arcsine operation	ASIN PASIN	S, D	$\text{SIN}^{-1}(S+1, S) \rightarrow (D+1, D)$	10
F318 P318	Floating- point type data arccosine operation	ACOS PACOS	S, D	$\text{COS}^{-1}(S+1, S) \rightarrow (D+1, D)$	10

Name	Availability												
	FP0 <small>Note1)</small>	FPΣ <small>Note1)</small>	FP-X <small>Note1)</small>	FP-φ	FP1 <small>Note1)</small>			FP-M <small>Note1)</small>		FP3	FP2	FP2SH	FP10SH
					C14 C16	C24 C40	C56 C72	C16	C20 C32				
Floating-point type real number operation instructions													
F309 P309	A	A	A	A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A
F310 P310	A	A	A	A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A
F311 P311	A	A	A	A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A
F312 P312	A	A	A	A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A
F313 P313	A	A	A	A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A
F314 P314	A	A	A	A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A
F315 P315	A	A	A	A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A
F316 P316	A	A	A	A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A
F317 P317	A	A	A	A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A
F318 P318	A	A	A	A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A

• A: Available, N/A: Not available

Note1) For the FP0/FPΣ/FP-X/FP1/FP-M, the P type high-level instructions are not available.

Number	Name	Boolean	Operand	Description	Steps
F319 P319	Floating-point type data arctangent operation	ATAN PATAN	S, D	$\text{TAN}^{-1}(S+1, S) \rightarrow (D+1, D)$	10
F320 P320	Floating-point type data natural logarithm	LN PLN	S, D	$\text{LN}(S+1, S) \rightarrow (D+1, D)$	10
F321 P321	Floating-point type data exponent	EXP PEXP	S, D	$\text{EXP}(S+1, S) \rightarrow (D+1, D)$	10
F322 P322	Floating-point type data logarithm	LOG PLOG	S, D	$\text{LOG}(S+1, S) \rightarrow (D+1, D)$	10
F323 P323	Floating-point type data power	PWR PPWR	S1, S2, D	$(S1+1, S1) ^ (S2+1, S2) \rightarrow (D+1, D)$	14
F324 P324	Floating-point type data square root	FSQR PFSQR	S, D	$\sqrt{(S+1, S)} \rightarrow (D+1, D)$	10
F325 P325	16-bit integer data to floating-point type data conversion	FLT PFLT	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 P326	32-bit integer data to floating-point type data conversion	DFLT PDFLT	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

Name	Availability												
	FP0 <small>Note1)</small>	FPΣ <small>Note1)</small>	FP-X <small>Note1)</small>	FP-φ	FP1 <small>Note1)</small>			FP-M <small>Note1)</small>		FP3	FP2	FP2SH	FP10SH
					C14 C16	C24 C40	C56 C72	C16	C20 C32				
F319 P319	A	A	A	A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A
F320 P320	A	A	A	A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A
F321 P321	A	A	A	A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A
F322 P322	A	A	A	A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A
F323 P323	A	A	A	A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A
F324 P324	A	A	A	A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A
F325 P325	A	A	A	A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A
F326 P326	A	A	A	A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A

• A: Available, N/A: Not available

Note1) For the FP0/FPΣ/FP-X/FP1/FP-M, the P type high-level instructions are not available.

Num- ber	Name	Boolean	Operand	Description	Steps
F327 P327	Floating-point type data to 16-bit integer conversion (the largest integer not exceeding the floating-point type data)	INT PINT	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 P328	Floating-point type data to 32-bit integer conversion (the largest integer not exceeding the floating-point type data)	DINT PDINT	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 P329	Floating-point type data to 16-bit integer conversion (rounding the first decimal point down to integer)	FIX PFIX	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 P330	Floating-point type data to 32-bit integer conversion (rounding the first decimal point down to integer)	DFIX PDFIX	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

Name	Availability												
	FP0 <small>Note1)</small>	FPΣ <small>Note1)</small>	FP-X <small>Note1)</small>	FP-φ	FP1 <small>Note1)</small>			FP-M <small>Note1)</small>		FP3	FP2	FP2SH	FP10SH
					C14 C16	C24 C40	C56 C72	C16	C20 C32				
F327 P327	A	A	A	A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A
F328 P328	A	A	A	A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A
F329 P329	A	A	A	A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A
F330 P330	A	A	A	A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A

• A: Available, N/A: Not available

Note1) For the FP0/FPΣ/FP-X/FP1/FP-M, the P type high-level instructions are not available.

Num- ber	Name	Boolean	Operand	Description	Steps
F331 P331	Floating-point type data to 16-bit integer conversion (rounding the first decimal point off to integer)	ROFF PROFF	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 P332	Floating-point type data to 32-bit integer conversion (rounding the first decimal point off to integer)	DROFF PDROFF	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 P333	Floating-point type data rounding the first decimal point down	FINT PFINT	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 P334	Floating-point type data rounding the first decimal point off	FRINT PFRINT	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 P335	Floating-point type data sign changes	F+/- PF+/-	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 P336	Floating-point type data absolute	FABS PFABS	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 P337	Floating-point type data degree → radian	RAD PRAD	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

Name	Availability												
	FP0 <small>Note1)</small>	FPΣ <small>Note1)</small>	FP-X <small>Note1)</small>	FP-φ	FP1 <small>Note1)</small>			FP-M <small>Note1)</small>		FP3	FP2	FP2SH	FP10SH
					C14 C16	C24 C40	C56 C72	C16	C20 C32				
F331 P331	A	A	A	A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A
F332 P332	A	A	A	A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A
F333 P333	A	A	A	A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A
F334 P334	A	A	A	A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A
F335 P335	A	A	A	A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A
F336 P336	A	A	A	A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A
F337 P337	A	A	A	A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A

• A: Available, N/A: Not available

Note1) For the FP0/FPΣ/FP-X/FP1/FP-M, the P type high-level instructions are not available.

Num- ber	Name	Boolean	Operand	Description	Steps
F338 P338	Floating- point type data radian → degree	DEG PDEG	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
Floating-point type real number data processing instructions					
F345 P345	Floating- point type data compare	FCMP PFCMP	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 P346	Floating- point type data band compare	FWIN PFWIN	S1, S2, S3	(S1+1, S1)>(S3+1, S3)→ R900A: on (S2+1, S2)<or =(S1+1, S1)<or =(S3+1, S3) → R900B on (S1+1, S1)<(S2+1, S2)→ R900C: on	14
F347 P347	Floating- point type data upper and lower limit control	FLIMIT PFLIMIT	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)<or = (S3+1, S3)<or =(S2+1, S2), (S3+1, S3)→(D+1, D)	17
F348 P348	Floating- point type data dead- band control	FBAND PFBAND	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)<or = (S3+1, S3)<or =(S2+1, S2), 0.0→(D+1, D)	17
F349 P349	Floating- point type data zone control	FZONE PFZONE	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)	17
F350 P350	Floating- point type data maxi- mum value	FMAX PFMAX	S1, S2, D	Searches the maximum value in the real number data table between the area selected with “S1” and “S2”, and stores it in the (D+1, D). The address relative to “S1” is stored in (D+2).	8

Name	Availability												
	FP0 <small>Note1)</small>	FP Σ <small>Note1)</small>	FP-X <small>Note1)</small>	FP- ϕ	FP1 <small>Note1)</small>			FP-M <small>Note1)</small>		FP3	FP2	FP2SH	FP10SH
					C14 C16	C24 C40	C56 C72	C16	C20 C32				
F338 P338	A	A	A	A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A
Floating-point type real number data processing instructions													
F345 P345	N/A	A	A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A
F346 P346	N/A	A	A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A
F347 P347	N/A	A	A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A
F348 P348	N/A	A	A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A
F349 P349	N/A	A	A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A
F350 P350	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A

• A: Available, N/A: Not available

Note1) For the FP0/FP Σ /FP-X/FP1/FP-M, the P type high-level instructions are not available.

Number	Name	Boolean	Operand	Description	Steps
F351 P351	Floating-point type data minimum value	FMIN PFMIN	S1, S2, D	Searches the minimum value in the real number data table between the area selected with "S1" and "S2", and stores it in the (D+1, D). The address relative to "S1" is stored in (D+2).	8
F352 P352	Floating-point type data total and mean values	FMEAN PFMEAN	S1, S2, D	The total value and the mean value of the real number data from the area selected with "S1" to "S2" are obtained. The total value is stored in the (D+1, D) and the mean value is stored in the (D+3, D+2).	8
F353 P353	Floating-point type data sort	FSORT PFSORT	S1, S2, S3	The real number data from the area specified by "S1" to "S2" are stored in ascending order (the smallest word is first) or descending order (the largest word is first).	8
F354 P354	Scaling of real number data	FSCAL PFSCAL	S1, S2, D	Scaling (linearization) on a real number data table is performed, and the output (Y) to an input value (X) is calculated.	12
Time series processing 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
F356	Eaay PID	EZPID	S1, S2, S3, S4	Temperature control (PID) can be easily performed using the image of a temperaautre controller.	10
Compare instructions					
F373 P373	16-bit data revision detection	DTR PDTR	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 P374	32-bit data revision detection	DDTR PDDTR	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

Name	Availability												
	FP0 <small>Note1)</small>	FP Σ <small>Note1)</small>	FP-X <small>Note1)</small>	FP- ϕ	FP1 <small>Note1)</small>			FP-M <small>Note1)</small>		FP3	FP2	FP2SH	FP10SH
					C14 C16	C24 C40	C56 C72	C16	C20 C32				
F351 P351	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A
F352 P352	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A
F353 P353	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A
F354 P354	N/A	Partly N/A <small>Note3)</small>	Partly N/A <small>Note5)</small>	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Partly N/A <small>Note2)</small>	Partly N/A <small>Note2)</small>	N/A
Time series processing instruction													
F355	A	A	A	A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A
F356	N/A	Partly N/A <small>Note4)</small>	Partly N/A <small>Note4)</small>	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Compare instructions													
F373 P373	N/A	A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A
F374 P374	N/A	A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A

• A: Available, N/A: Not available

Note1) For the FP0/FP Σ /FP-X/FP1/FP-M, the P type high-level instructions are not available.

Note2) This instruction is available for FP2/FP2SH CPU Ver. 1.5 or later.

Note3) This instruction is available for FP Σ 32k.

Note4) This instruction is available for FP-X V1.20 or later and FP Σ 32k.

Note5) This instruction is available for FP-X V1.13 or later.

Num- ber	Name	Boolean	Operand	Description	Steps
Index register bank processing instructions					
F410 P410	Setting the index register bank number	SETB PSETB	n	Index register (I0 to ID) bank number change over.	4
F411 P411	Changing the index register bank number	CHGB PCHGB	n	Index register (I0 to ID) bank number change over with remembering preceding bank number.	4
F412 P412	Restoring the index register bank number	POPB PPOPB	-	Changes index register (I0 to ID) bank number back to the bank before F411 (CHGB)/P411 (PCHGB) instruction.	2
File register bank processing instructions					
F414 P414	Setting the file register bank number	SBFL PSBFL	n	File register bank number change over.	4
F415 P415	Changing the file register bank number	CBFL PCBFL	n	File register bank number change over with remembering preceding bank number.	4
F416 P416	Restoring the file register bank number	PBFL PPBFL	-	Changes file register bank number back to the bank before F415 (CBFL)/P415 (PCBFL) instruction.	2

Name	Availability												
	FP0 <small>Note1)</small>	FPΣ <small>Note1)</small>	FP-X <small>Note1)</small>	FP-e	FP1 <small>Note1)</small>			FP-M <small>Note1)</small>		FP3	FP2	FP2SH	FP10SH
					C14 C16	C24 C40	C56 C72	C16	C20 C32				
Index register bank processing instructions													
F410 P410	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	A
F411 P411	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	A
F412 P412	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	A
File register bank processing instructions													
F414 P414	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	N/A
F415 P415	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	N/A
F416 P416	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	N/A

• A: Available, N/A: Not available

Note1) For the FP0/FPΣ/FP-X/FP1/FP-M, the P type high-level instructions are not available.

14.4 Table of Error codes

■ Difference in ERROR display

There are differences in the way errors are displayed depending on the model.

Model	Display		Display method
FP1,FP-M,FP2,FP3,FP10SH	LED	ERROR.	Continually lit
FP Σ ,FP0, FP-X	LED	ERROR/ALARM	Flashes/continually lit
FP-e	Screen display	ERR.	Continually lit

■ Error Confirmation When ERROR Turns ON

When the "ERROR" on the control unit (CPU unit) turns on or flashes, a self-diagnostic error or syntax check error has occurred. Confirm the contents of the error and take the appropriate steps.

-Error Confirmation Method

Procedure:1.Use the programming tool software to call up the error code.

By executing the "STATUS DISPLAY", the error code and content of error are displayed.

2.Check the error contents in the table of error codes using the error code ascertained above.

-Syntax check error

This is an error detected by the total check function when there is a syntax error or incorrect setting written in the program. When the mode selector is switched to the RUN mode, the total check function automatically activates and eliminates the possibility of incorrect operation from syntax errors in the program.

When a syntax check error is detected

-ERROR turns on or flashes.

-Operation will not begin even after switching to the RUN mode.

-Remote operation cannot be used to change to RUN mode.

Clearing a syntax check error

By changing to the PROG.mode, the error will clear and the ERROR will turn off.

Steps to take for syntax error

Change to the PROG. mode, and then execute the total check function while online mode with the programming tool connected. This will call up the content of error and the address where the error occurred.

Correct the program while referring to the content of error.

-Self-diagnostic Error

This error occurs when the control unit (CPU unit) self-diagnostic function detects the occurrence of an abnormality in the system. The self-diagnostic function monitors the memory abnormal detection, I/O abnormal detection, and other devices.

When a self-diagnostic error occurs

- The ERROR turns on or flashes.
- The operation of the control unit (CPU unit) might stop depending on the context of error and the system register setting.
- The error codes will be stored in the special data register DT9000(DT90000).
- In the case of operation error, the error address will be stored in the DT9017(DT90017) and DT9018(DT90018).

Clearing the self-diagnostic error

At the "STATUS DISPLAY", execute the "error clear". Error codes 43 and higher can be cleared.

-You can use the initialize/test switch to clear an error. However, this will also clear the contents of operation memory.

-Errors can also be cleared by turning off and on the power while in the PROG.mode.

However, the contents of operation memory, not stored with the hold type data, will also be cleared.

-The error can also be cleared depending on the self-diagnostic error set instruction F148(ERR).

Steps to take for self-diagnostic error

The steps to be taken will differ depending on the error contents. For more details, use the error code obtained above and consult the table of self-diagnostic error codes.

■ MEWTOCOL-COM Transmission Errors

These are error codes from a PC or other computer device that occur during an abnormal response when communicating with a PLC using MEWTOCOL-COM.

Table of Syntax Check Error

Error code	Name	Operation status	Description and steps to take	FP0	FP-9	FPΣ	FP-X	FP1/FP-M	FP2	FP2SH	FP10SH	FP3
E1	Syntax error	Stops	A program with a syntax error has been written. ⇒ Change to PROG. mode and correct the error.	A	A	A	A	A	A	A	A	A
E2 (Note)	Duplicated output error	Stops	Two or more OT(Out) instructions and KP(Keep) instructions are programmed using the same relay.Also occurs when using the same timer/counter number. ⇒ Change to PROG. mode and correct the program so that one relay is not used for two or more OT instructions.Or, set the duplicated output to "enable" in system register20. A timer/counter instructon double definition error will be detected even if double output permission has been selected.	A	A	A	A	A	A	A	A	A
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.	A	A	A	A	A	A	A	A	A
E4	Para-meter 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.	A	A	A	A	A	A	A	A	A
E5 (Note)	Program area error	Stops	An instruction which must be written in 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.	A	A	A	A	A	A	A	A	A

A:Available

Note) This error is also detected if you attempt to execute a rewrite containing a syntax error during RUN.
In this case, nothing will be written to the CPU and operation will continue.

Error code	Name	Operation status	Description and steps to take	FP0	FP-e	FPΣ	FP-X	FP1/FP-M	FP2	FP2SH	FP10SH	FP3
E6	Compile memory full error	Stops	The program is too large to compile in the program memory. ⇒ Change to PROG. mode and reduce the total number of steps for the program. -FP10SH If memory expansion is possible, compilation will become possible when the memory is expanded.	A	A	A	A	A		A	A	
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 only at the leading edge are triggered separately.			A	A		A	A	A	A
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.	A	A	A	A	A	A	A	A	A
E9	No program error	Stops	Program may be damaged. ⇒ Try to send the program again.							A	A	
E10	Rewrite during RUN syntax error	Continues	When inputting with the programming tool software, a deletion, addition or change of order of an instruction (ED, LBL, SUB, RET, INT, IRET, SSTP, and STPE) that cannot perform a rewrite during RUN is being attempted. Nothing is written to the CPU.						A	A	A	A

A: Available

Table of Self-Diagnostic Error

Error code	Name	Operation status	Description and steps to take	FP0	FP-e	FPΣ	FP-X	FP1/FP-M	FP2	FP2SH	FP10SH	FP3
E20	CPU error	Stops	Probably a hardware abnormality ⇒Please contact your dealer.						A	A	A	A
E21	RAM error1	Stops	Probably an abnormality in the internal RAM. ⇒Please contact your dealer.						A	A	A	A
E22	RAM error2											
E23	RAM error3											
E24	RAM error4											
E25	RAM error5											
E25	Master memory model unmatch error	Stops	The models of master memories are different. Use the master memories created with the same model.				A Note1)					
E26	User's ROM error	Stops	FP-e,FP0,FPΣ,and FP1 C14,C16:Probably a hardware abnormality. ⇒ Please contact your dealer.	A	A	A	A	A	A	A	A	A
			FP-X: When the master memory cassette is mounted, the master memor cassette may be damaged. Remove the master memory, and check whether the ERROR turns off. When the ERROR turned off, rewrite the master memory as its contents are damaged, and use it again. When the ERROR does not turn off, please contact your dealer.									
			FP1 C24,C40,C56,C72,and FP-M: Probably an abnormality in the memory unit ⇒Program the memory unit again and try to operate. If the same error is detected, try to operate with another memory unit.									
E26	User's ROM error	Stops	FP2,FP2SH,FP10SH,and FP3: There may be a problem with the installed ROM. -ROM is not installed. -ROM contens are damaged. -Program size stored on the ROM is larger than the capacity of the ROM ⇒Check the contents of the ROM	A	A	A	A	A	A	A	A	A
E27	Unit installation error	Stops	Units installed exceed the limitations.(i.e.,4 or more link units) ⇒ Turn off the power and re-configure units referring to the hardware manual.			A	A		A	A	A	A
E28	System register error	Stops	Probably an abnormality in the system register. ⇒ Check the system register setting or initialize the system registers.						A			A

Note1) This error occurs on FP-X Ver2.0 or later.

A:Available

Error code	Name	Operation status	Description and steps to take	FP0	FP-e	FPΣ	FP-X	FP1/FP-M	FP2	FP2SH	FP10SH	FP3
E29	Configuration parameter error	Stops	A parameter error was detected in the MEWNET-W2 configuration area. Set a correct parameter.						A	A		
E30	Interrupt error 0	Stops	Probably a hardware abnormality. ⇒ Please contact your dealer.									A
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.	A	A	A	A	A	A	A	A	A
E32	Interrupt error 2	Stops	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..	A	A	A	A	A	A	A	A	A
E33	Multi-CPU data unmatch error	CPU2 Stops	This error occurs when a FP3/FP10SH is used as CPU2 for a multi-CPU system. ⇒Refer to "Multi-CPU system Manual".							A	A	
E34	I/O status error	Stops	An abnormal unit is installed. -FPΣ, FP-X, FP2,FP2SH and FP10SH: Check the contents of special data register DT90036 and locate the abnormal unit.Then turn off the power and replace the unit with a new one. -FP3: Check the contents of special data register DT9036 and locate the abnormal unit. Then turn off the power and replace the unit with a new one.			A	A	A		A	A	A
E35	MEWNET-F slave illegal unit error	Stops	A unit, which cannot be installed on the slave station of the MEWNET-F link system,is installed on the slave station. ⇒Remove the illegal unit from the slave station.						A	A	A	A
E36	MEWNET-F (remote I/O) limitation error	Stops	The number of slots or I/O points used for MEWNET-F(remote I/O) system exceeds the limitation. ⇒Re-configure the system so that the number of slots and I/O points is within the specified range.						A	A	A	A
E37	MEWNET-F I/O mapping error	Stops	I/O overlap or I/O setting that is over the range is detected in the allocated I/O and MEWNET-F I/O map. ⇒Re-configure the I/O map correctly						A	A	A	A

A:Available

Error code	Name	Operation status	Description and steps to take	FP0	FP-e	FPΣ	FP-X	FP1/FP-M	FP2	FP2SH	FP10SH	FP3
E38	MEWNET-F slave I/O terminal mapping error	Stops	I/O mapping for remote I/O terminal boards, remote I/O terminal units and I/O link is not correct. ⇒ Re-configure the I/O map for slave stations according to the I/O points of the slave stations.						A	A	A	A
E39	IC card read error	Stops	When reading in the program from the IC memory card (due to automatic reading because of the dip switch setting or program switching due to F14(PGRD) instruction): - IC memory card is not installed. - There is no program file or it is damaged. - Writing is disabled. - There is an abnormality in the AUTOEXEC.SPG file. - Program size stored on the card is larger than the capacity of the CPU. ⇒ Install an IC memory card that has the program properly recorded and execute the read once again.							A	A	
E40	I/O error	Selectable	Abnormal I/O unit. FPΣ, FP-X: Check the contents of special data register DT90002 and abnormal FPΣ expansion unit (application cassette for FP-X). Then check the unit. FP2 and FP2SH: Check the contents of special data registers DT90002, DT90003 and abnormal I/O unit. Then check the unit. Selection of operation status using system register 21: - to continue operation, set 1 - to stop operation, set 0 Verification is possible in FPWIN GR/Pro at "I/O error" in the status display function.			A	A		A	A	A	A
			MEWNET-TR communication error FP3 and FP10SH: Check the contents of special data registers (FP3: DT90002, DT90003, FP10SH: DT90002, DT90003) and the erroneous master unit and abnormal I/O unit. Then check the unit. Selection of operation status using system register 21: - to continue operation, set 1 - to stop operation, set 0 Verification is possible in FPWIN GR/Pro at "I/O error" in the status display function.									

A: Available

Error code	Name	Operation status	Description and steps to take	FP0	FP-e	FPΣ	FP-X	FP1/FP-M	FP2	FP2SH	FP10SH	FP3
E41	Intelligent unit error	Selectable	<p>An abnormality in an intelligent unit.</p> <p>FPΣ, FP-X: Check the contents of special data register "DT90006" and locate the abnormal FP intelligent unit (application cassette for FP-X).</p> <p>FP2,FP2SH,and FP10SH: Check the contents of special data registers DT90006,DT90007 and locate the abnormal intelligent unit.Then check the unit referring to its manual..</p> <p>Selection of operation status using system register22: -to continue operation,set 1 -to stop operation,set 0</p> <p>FP3: Check the contents of special data registers DT90006,DT90007 and locate the abnormal intelligent unit.Then check the unit referring to its manual..</p> <p>Selection of operation status using system register22: -to continue operation,set 1 -to stop operation,set 0</p> <p>Verification is possible in FPWIN GR/Pro at "I/O error" in the status display function.</p>			A	A		A	A	A	A
E42	I/O unit verify error	Selectable	<p>I/O unit(Expansion unit) wiring condition has changed compared to that at time of power-up.</p> <p>⇒ Check the contents of special data register (FP0: DT9010, FPΣ, FP-X: DT90010,DT90011) and locate the erroneous expansion unit. It checks whether an expansion connector is in agreement.</p> <p>⇒ Check the contents of special data register (FP2,FP2SH,and FP10SH:DT90010,DT90011,FP3 DT9010,DT9011)</p> <p>Selection of operation status using system register23: -to continue operation,set 1 -to stop operation,set 0</p> <p>Verification is possible in FPWIN GR/Pro at "I/O error" in the status display function.</p>	A		A	A		A	A	A	A

A:Available

Error code	Name	Operation status	Description and steps to take	FP0	FP-e	FPΣ	FP-X	FP1/FP-M	FP2	FP2SH	FP10SH	FP3
E43	System watching dog timer error	Selectable	Scan time required for program execution exceeds the setting of the system watching dog timer. ⇒ Check the program and modify it so that the program can execute a scan within the specified time. Selection of operation status using system register24: -to continue operation,set 1 -to stop operation,set 0							A	A	
E44	Slave station connecting time error for MEWNET-F system	Selectable	The time required for slave station connection exceeds the setting of the system register 35. Selection of operation status using system register25: -to continue operation,set 1 -to stop operation,set 0						A	A	A	A
E45	Operation error	Selectable	Operation became impossible when a high-level instruction was executed. Selection of operation status using system register26: -to continue operation,set K1 -to stop operation,set K0 In the FP2,FP2SH,and FP10SH,Check the contents of special data registers DT90017,DT90018 to find the instruction address where the operation error occurred. Then correct the program. In the FP3,Check the contents of special data registers DT9017,and DT9018 to find the instruction address where the operation error occurred.Then correct the program. Verification is possible in FPWIN GR/Pro at"I/O error" in the status display function.	A	A	A	A	A	A	A	A	A

A:Available

Error code	Name	Operation status	Description and steps to take	FP0	FP-e	FPΣ	FP-X	FP1/FP-M	FP2	FP2SH	FP10SH	FP3
E46	Remote I/O communication error	Selectable	S-LINK error Occurs only in FP0-SL1 When one of the S-LINK errors (ERR1, 3 or 4) has been detected, error code E46 (remote I/O (S-LINK) communication error) is stored. Selection of operation status using system register27: -to continue operation, set K1 -to stop operation, set K0	A								
		Selectable	MEWNET-F communication error A communication abnormally was caused by a transmission cable or during the power-down of a slave station. FP2, FP2SH, and FP10SH: Check the contents of special data registers DT90131 to DT90137 and locate the abnormal slave station and recover the communication condition. FP3: Check the contents of special data registers DT9131 to DT9137 and locate the abnormal slave station and recover the communication condition. Selection of operation status using system register27: -to continue operation, set K1 -to stop operation, set K0					A	A	A	A	A
E47	MEW-NET-F attribute error	Selectable	In the unit on the slave station, an abnormality such as: -missing unit -abnormal intelligent unit was detected. FP2, FP2SH, and FP10SH: Check the contents of special data registers DT90131 to DT90137 and locate the abnormal slave station and recover the slave condition. FP3: Check the contents of special data registers DT9131 to DT9137 and locate the abnormal slave station and recover the slave condition. Selection of operation status using system register28: -to continue operation, set 1 -to stop operation, set 0						A	A	A	A
E49	Expansion unit power supply sequence error	Stops	The power supply for the expansion unit was turned on after the control unit. Turn on the power supply for the expansion unit at the same time or before the control unit is turend on.				A					

A:Available

Error code	Name	Operation status	Description and steps to take	FP0	FP-e	FPΣ	FP-X	FP1/FP-M	FP2	FP2SH	FP10SH	FP3
E50	Backup battery error	Continues	The voltage of the backup battery lowered or the backup battery of control unit is not installed. ⇒ Check the installation of the backup battery and then replace battery if necessary. By setting the system register 4, you can disregard this self-diagnostic error.		A	A	A	A (Note)	A	A	A	A
E51	MEWNET-F terminal station error	Continues	Terminal station setting was not properly performed. Check stations at both ends of the communication path, and set them in the terminal station using the dip switches.						A	A	A	A
E52	MEWNET-F I/O update synchronous error	Continues	Set the INITIALIZE/TEST selector to 1 in mjbgycfrde892 r to the INITIALIZE position while keeping the mode selector in the RUN position. If the same error occurs after this, please contact your dealer.						A	A	A	A
E53	Multi-CPU I/O registration error (CPU2 only)	Continues	Abnormality was detected when the multi-CPU system was used. Please contact your dealer.								A	A
E54	IC memory card backup battery error	Continues	The voltage of the backup battery for the IC memory card lowered. The BATT.LED does not turn on. Charge or replace the backup battery of IC memory card. (The contents of the IC memory card cannot be guaranteed.)							A	A	
E55	IC memory card backup battery error	Continues	The voltage of the backup battery for IC memory card lowers. The BATT.LED does not turn on. Charge or replace the backup battery of IC memory card. (The contents of the IC memory card cannot be guaranteed.)							A	A	
E56	Incompatible IC memory card error	Continues	The IC memory card installed is not compatible. Replace the IC memory card compatible with FP2SH/FP10SH.							A	A	
E57	No unit for the configuration	Continues	MEWNET-W2 The MEWNET-W2 link unit is not installed in the slot specified using the configuration data. Either install a unit in the specified slot or change the parameter.						A	A		

A:Available

Error code	Name	Operation status	Description and steps to take	FP0	FP-ø	FPΣ	FP-X	FP1/FP-M	FP2	FP2SH	FP10SH	FP3
E100 to E199	Self-diagnostic error set by F148 (ERR)/P148 (PERR) instruction	Stop	The error specified by the F148 (ERR)/P148(PERR) instruction is occurred. ⇒ Take steps to clear the error condition according to the specification you chose.	A	A	A	A	A	A			
E200 to E299		Continues		A	A	A	A	A	A			

A:Available

Note) Available PLC:FP1 C24,C40,C56,C76,and FP-M

■ Table of MEWTOCOL-COM Communication Error

Error code	Name	Description
I21	NACK error	Link system error
I22	WACK error	Link system error
I23	Unit No. overlap	Link system error
I24	Transmission format error	Link system error
I25	Link unit hardware error	Link system error
I26	Unit No. setting error	Link system error
I27	No support error	Link system error
I28	No response error	Link system error
I29	Buffer closed error	Link system error
I30	Time-out error	Link system error
I32	Transmission impossible error	Link system error
I33	Communication stop	Link system error
I36	No destination error	Link system error
I38	Other communication error	Link system error
I40	BCC error	A transfer error occurred in the received data.
I41	Format error	A command was received that does not fit the format.
I42	No support error	A command was received that is not supported.
I43	Multiple frames procedure error	A different command was received when processing multiple frames.
I50	Link setting error	A route number that does not exist was specified. Verify the route number by designating the transmission station.
I51	Transmission time-out error	Transmission to another device not possible because transmission buffer is congested.
I52	Transmit disable error	Transmission processing to another device is not possible.(Link unit runaway,etc.)
I53	Busy error	Command process cannot be received because of multiple frame processing.Or,cannot be received because command being processed is congested.
I60	Parameter error	Content of specified parameter does not exist or cannot be used.
I61	Data error	There was a mistake in the contact,data area,data number designation,size designation,range,or format designation.
I62	Registration over error	Operation was does when number of registrations was exceeded or when there was no registration.
I63	PC mode error	PC command that cannot be processed was executed during RUN mode.

Error code	Name	Description
!64	External memory error	An abnormality occurred when loading RAM to ROM/IC memory card. There may be a problem with the ROM or IC memory card. -When loading, the specified contents exceeded the capacity. -Write error occurs. -ROM or IC memory card is not installed. -ROM or IC memory card does not conform to specifications -ROM or IC memory card board is not installed.
!65	Protect error	A program or system register write operation was executed when the protect mode (password setting or DIP switch, etc.) or ROM operation mode was being used.
!66	Address error	There was an error in the code format of the address data. Also, when exceeded or insufficient of address data, there was a mistake in the range designation.
!67	No program error and No data error	Cannot be read because there is no program in the program area or the memory contains an error. Or, reading was attempted of data that was not registered.
!68	Rewrite during RUN error	When inputting with programming tool software, editing of an instruction (ED, SUB, RET, INT, IRET, SSTP, and STPE) that cannot perform a rewrite during RUN is being attempted. Nothing is written to the CPU.
!70	SIM over error	Program area was exceeded during a program write process.
!71	Exclusive access control error	A command that cannot be processed was executed at the same time as a command being processed.

14.5 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 contact. - 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.

14.6 Hexadecimal/Binary/BCD

Decimal	Hexadecimal	Binary data	BCD data (Binary Coded Decimal)
0	0000	00000000 00000000	0000 0000 0000 0000
1	0001	00000000 00000001	0000 0000 0000 0001
2	0002	00000000 00000010	0000 0000 0000 0010
3	0003	00000000 00000011	0000 0000 0000 0011
4	0004	00000000 00000100	0000 0000 0000 0100
5	0005	00000000 00000101	0000 0000 0000 0101
6	0006	00000000 00000110	0000 0000 0000 0110
7	0007	00000000 00000111	0000 0000 0000 0111
8	0008	00000000 00001000	0000 0000 0000 1000
9	0009	00000000 00001001	0000 0000 0000 1001
10	000A	00000000 00001010	0000 0000 0001 0000
11	000B	00000000 00001011	0000 0000 0001 0001
12	000C	00000000 00001100	0000 0000 0001 0010
13	000D	00000000 00001101	0000 0000 0001 0011
14	000E	00000000 00001110	0000 0000 0001 0100
15	000F	00000000 00001111	0000 0000 0001 0101
16	0010	00000000 00010000	0000 0000 0001 0110
17	0011	00000000 00010001	0000 0000 0001 0111
18	0012	00000000 00010010	0000 0000 0001 1000
19	0013	00000000 00010011	0000 0000 0001 1001
20	0014	00000000 00010100	0000 0000 0010 0000
21	0015	00000000 00010101	0000 0000 0010 0001
22	0016	00000000 00010110	0000 0000 0010 0010
23	0017	00000000 00010111	0000 0000 0010 0011
24	0018	00000000 00011000	0000 0000 0010 0100
25	0019	00000000 00011001	0000 0000 0010 0101
26	001A	00000000 00011010	0000 0000 0010 0110
27	001B	00000000 00011011	0000 0000 0010 0111
28	001C	00000000 00011100	0000 0000 0010 1000
29	001D	00000000 00011101	0000 0000 0010 1001
30	001E	00000000 00011110	0000 0000 0011 0000
31	001F	00000000 00011111	0000 0000 0011 0001
.	.	.	.
.	.	.	.
.	.	.	.
63	003F	00000000 00111111	0000 0000 0110 0011
.	.	.	.
.	.	.	.
.	.	.	.
255	00FF	00000000 11111111	0000 0010 0101 0101
.	.	.	.
.	.	.	.
.	.	.	.
9999	270F	00100111 00001111	1001 1001 1001 1001

14.7 ASCII Codes

								b7								
								b6	0	0	0	0	1	1	1	1
								b5	0	0	1	1	0	0	1	1
								b4	0	1	0	1	0	1	0	1
b7	b6	b5	b4	b3	b2	b1	b0	R \ C	0	1	2	3	4	5	6	7
0	0	0	0	0	0	0	0	0	NUL	DEL	SPACE	0	@	P	`	p
0	0	0	1	0	0	0	0	1	SOH	DC1	!	1	A	Q	a	q
0	0	1	0	0	0	0	0	2	STX	DC2	"	2	B	R	b	r
0	0	1	1	0	0	0	0	3	ETX	DC3	#	3	C	S	c	s
0	1	0	0	0	0	0	0	4	EOT	DC4	\$	4	D	T	d	t
0	1	0	1	0	0	0	0	5	ENQ	NAK	%	5	E	U	e	u
0	1	1	0	0	0	0	0	6	ACK	SYN	&	6	F	V	f	v
0	1	1	1	0	0	0	0	7	BEL	ETB	'	7	G	W	g	w
1	0	0	0	0	0	0	0	8	BS	CAN	(	8	H	X	h	x
1	0	0	1	0	0	0	0	9	HT	EM	)	9	I	Y	i	y
1	0	1	0	0	0	0	0	A	LF	SUB	*	:	J	Z	j	z
1	0	1	1	0	0	0	0	B	VT	ESC	+	;	K	[	k	{
1	1	0	0	0	0	0	0	C	FF	FS	,	<	L	¥	l	|
1	1	0	1	0	0	0	0	D	CR	GS	-	=	M	]	m	}
1	1	1	0	0	0	0	0	E	SO	RS	.	>	N	^	n	~
1	1	1	1	0	0	0	0	F	SI	US	/	?	O	_	o	DEL

Record of changes

Manual No.	Date	Description of changes
ARCT1F333E	Sepr.2001	First edition
ARCT1F333E-1	Feb.2002	2 nd edition -Additions: Control units FPG-C32T2,FPG-C24R2 Expansion unit FPG-XY64D2T Tool software FPWIN Pro Ver.4
ARCT1F333E-2	Nov.2002	3 rd edition Additions : Control units FPG-C28P2(PNP output) Thermistor input function type (part number ending in TM) Expansion units Add information about intelligent units
ARCT1F333E-3	May.2004	4 th edition Additions:Communication cassette AFPG806 Expansion unit FPG-XY64D2P(PNP type) Expansion Data Memory Unit FPG-EM1 Change of a chapter <div style="display: flex; align-items: center;"> <div style="margin-right: 10px;"> -Communication cassette -Computer Link -General-purpose Serial communication -PLC link </div> <div style="font-size: 3em; margin-right: 10px;">}</div> <div> → Chapter7 Communication cassette </div> </div>
ARCT1F333E-4	Apr.2006	5 th edition Additions : FPΣ 32k Type
ARCT1F333E-5	Jan.2007	6 th edition
ARCT1F333E-6	Jun.2007	7 th edition Function addition only of FPΣ 32k Type Ver.3.10 or more
ARCT1F333E-7	Jun.2008	8 th edition

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