Panasonic®

PROGRAMMABLE CONTROLLER

FPΣ

User's Manual

ARCT1F333E-8

2009.2 | panasonic-electric-works.net/ac

Panasonic Electric Works

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 safety.
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.
-Battery may explode if mistreated. Do not recharge, disassemble or dispose of fire.

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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Before You Start

Operating environment
(Use the unit within the range of the general specifications when installing)
-Ambient temperatures:0 ~ +55 ℃
-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 possword 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	R9005 and R9006 is always announced when the batter error occurs. Change in the detection timing of the battery error. It is detected 2 seconds after the power is on.
12k type	V2.00	Left expansion refresh is available.
	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	R9005 and R9006 is always announced when the batter error occurs. Change in the detection timing of the battery error. It is detected 2 seconds after the power is on.
32k type	V3.00	Interrupt program can be started when the high-speed counter target value matches. Scan time display in 100us unit 10us ring counter DT90020 General-purpose communication function with TOOL port MODBUS-RTU master/slave communication function (COM1, COM2) MEWTOCOL-COM master communication function (COM1, COM2) 32k-step program capacity Enhancement of comment capacity Enhancement of security functions 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 Reverse setting function of PC link (32k type only) R9005 and R9006 is always announced when the batter error occurs. Change in the detection timing of the battery error. It is detected 2 seconds after the power is on. Real number basic compare instructions 18 types 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	<Special instructions> F230 (TMSEC) F231 (SECTM) F354 (FSCAL) <Serial data conversion> F250 (BTOA) Binary → ASCII conversion F251 (ATOB) ASCII → Binary conversion <SYS instructions> UP/DOWN switching of HSC by SYS1 instruction Addition of 8-digit password operaton by SYS1 instruction Addition of operation by SYS2 instruction MODBUS master instructions F145 (SEND) Data send F146 (RECV) Data receive MEWTOCOL master instruction F145 (SEND) Data send F146 (RECV) Data receive F356 (EZPID) Easy PID instruction <Partial I/O refresh> Partial I/O refresh for FP0 expansion <10us ring counter current value read> F0 (MV) DT90020, D <New PID instruction> F356 (EZPID)
32k type	V3.10	F182(FILTR) Time constant processing Sampling trace function (Refer to Chapter 9.) Sampling by instrucitons F155(SMPL) Sampling F156(STRG) Sampling trigger Sampling by specifying time Leading contact, trailing contact instructions ST↑ AN↑ OR↑ ST↓ AN↓ OR↓ An arbitrary device can be specified for the setting value of Timer/counter instruction. e.g.) TML 0, DT0 Other additional convenient instructions F252(ACHK) ASCII data check F284(RAMP) Inclination output Baud rate setting (300, 600, 1200 bps) by SYS instruction High-speed operaiton F0(MV) and F1(DMV) instructions Execution time: Approx. 1us Only when every operands are without index modifier. Function addition to exsiting instructions 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.6	Used	Used	Used	Used
	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.
- FPWIN Pro Ver. 4.0 can be upgraded to Ver. 4.1 or later free of charge at our web site.
- FPWIN Pro Ver. 5.0 can be upgraded to Ver. 5.1 or later free of charge at our web site.
- FPWIN Pro Ver. 6.0 can be upgraded to Ver. 6.1 or later free of charge at our web site.
- In case of using FPWIN Pro Ver. 4.0 with FPΣ 32k type, please purchase upgrade model FPWIN GR Ver.5.

Panasonic Electrics Works website address: http://panasonic-electric-works.net/

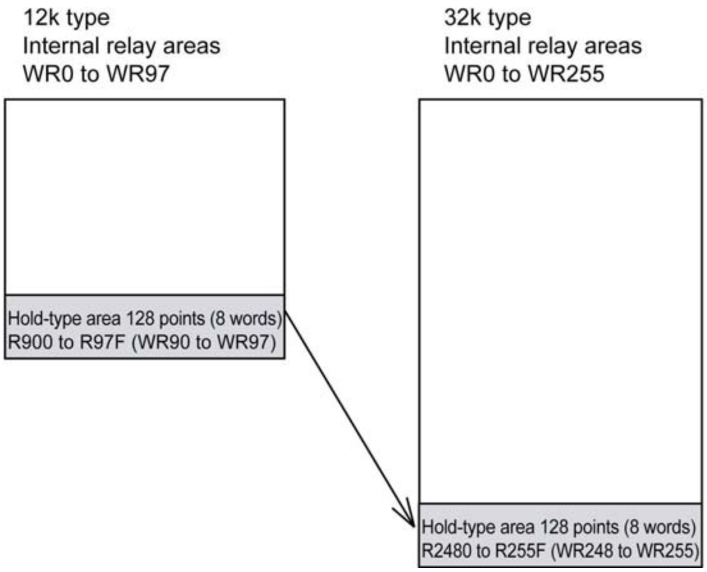
When Changing Ladder Program from 12k Type to 32k Type

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.

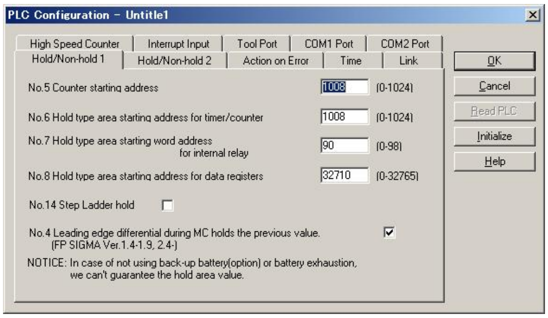
Number of points of internal relay for the 32k type is different from the 12k type.
The hold-type areas differ (automatic backup areas when the power supply was cut off) as the figure shown below.
When the hold-type area in the internal relay is used, the program for that part should be converted.
(As 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.

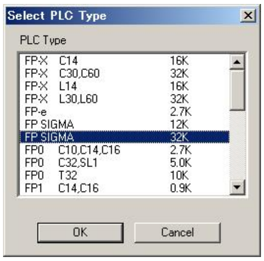


Procedure of Program Conversion

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



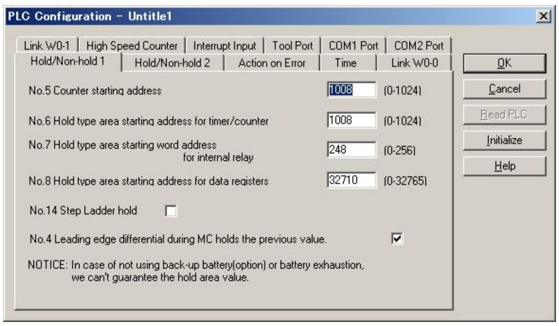
2. Select “Option” → “PLC Configuration” in the menubar.
Note down the setting value for the system registers.



3. Select “Tool” → “Change PLC Type”.

Select “FPSIGMA 32K” and click “OK” button.

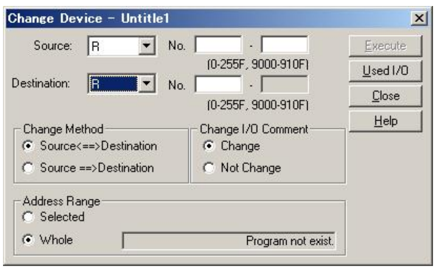
4. A message “System register formatted.” is indicated.
Click “OK” button.



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 chaging an existing program by partially adding a program without modifying the exsiting program.

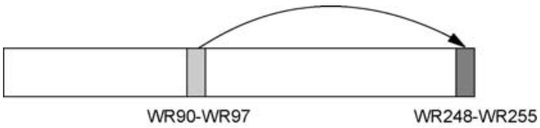
(When a programmable display is connected, it is not necessary to change the R and WR that are referred for the switches and data parts in the programmable display.)

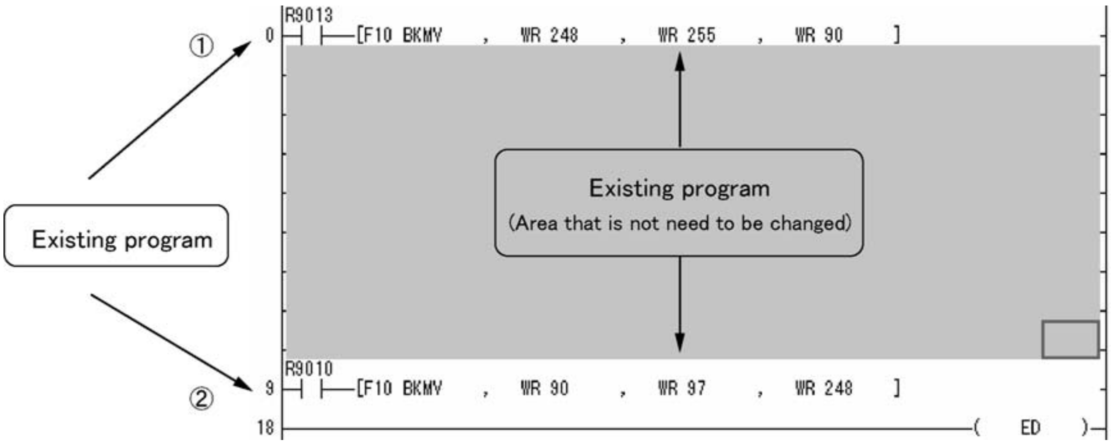
1. At the begnning of a program

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 programmabld 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(SPSH) 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

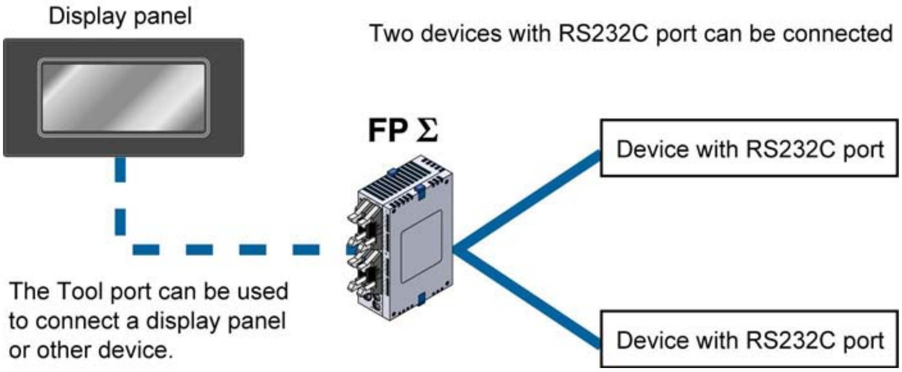
All of the functions of a mid-scale PLC are packed into the compact body size of the 32-pont type FP0. A program capacity of 12k steps or 32k steps is provided as a standard feature, so you never have to worry about how much memory is left as you're programming. In addition, 32k words are reserved for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

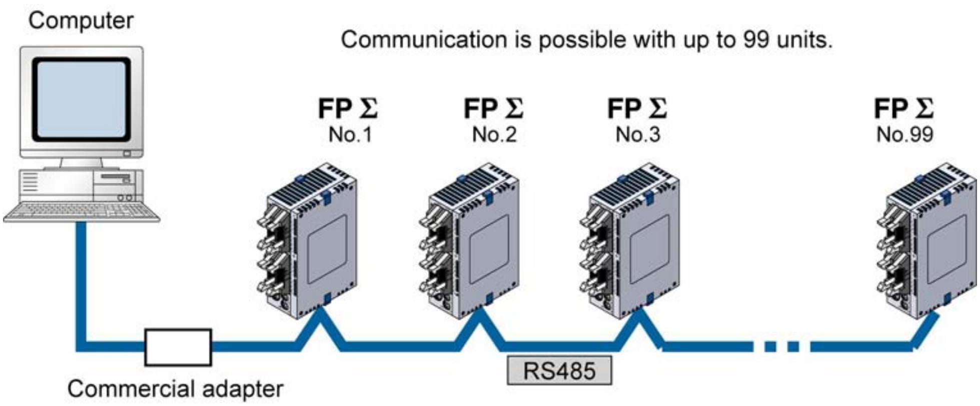
When using the 2-channel RS232C type communication cassette



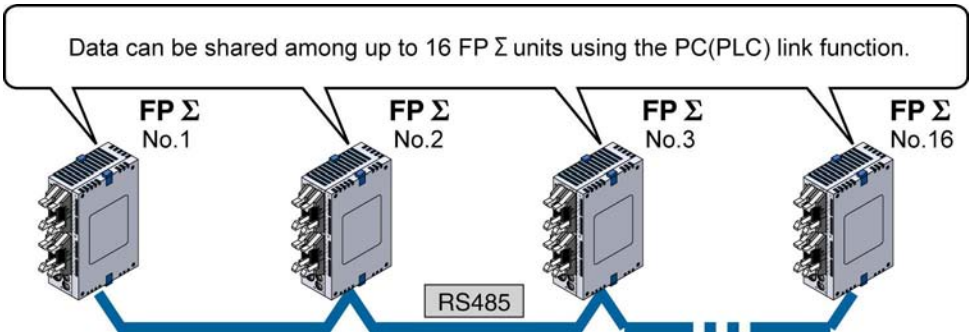
1:N communication possible with up to 99 stations (units)

When using the 1-channel RS485 type communication cassette

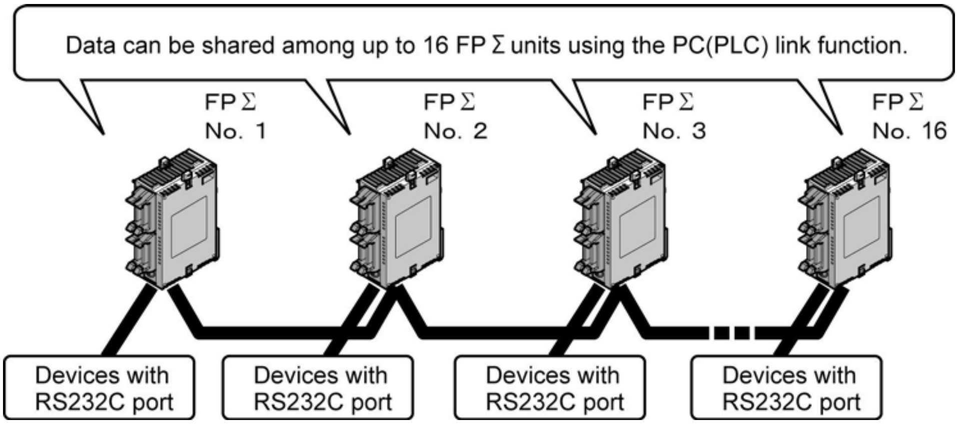
When using the 1-channel RS485 and 1-channel RS232C in combination



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



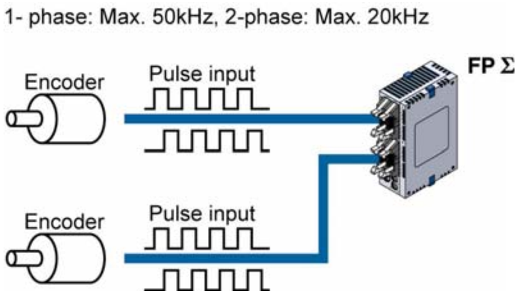
Analog control supported
An analog potentionmeter (volume dial) is provided as a standard feature. This can be used in applications such as analog timers, without using the programming tools. An analog unit is also available as the intelligent unit.

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 potetionmeter. 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 kΩ can be used.)

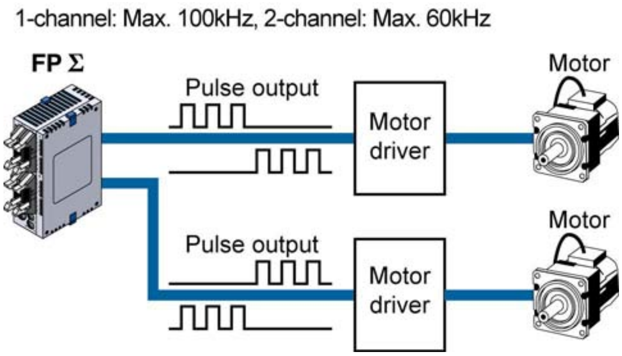
Calender timer function can be added
Optional backup battery enables the calender timer function.

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.

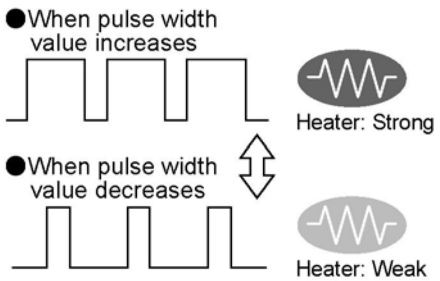
Measurement using high-speed counter supported
Increment input mode, decrement input mode, 2-phase input mode, individual input mode, and direction discrimination mode are supported.



Positioning control based on pulse output supported
Pulse/direction and clockwise/counter –clockwise output are supported.



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 alphameric 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 insturments can be performed with simple programs using the FPΣ as a master unit.
Communication with the exsiting 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-C32THTM	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-C32THTM 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
FPΣ Positioning unit RTEX	2-axis type	FPG-PN2AN	AFPG43610	ARCT1F 421E
	4-axis type	FPG-PN4AN	AFPG43620	
	8-axis type	FPG-PN8AN	AFPG43630	

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.

Expample: <FP0 User’s manual ARCT1F389>

1.2.4 Communication Cassette

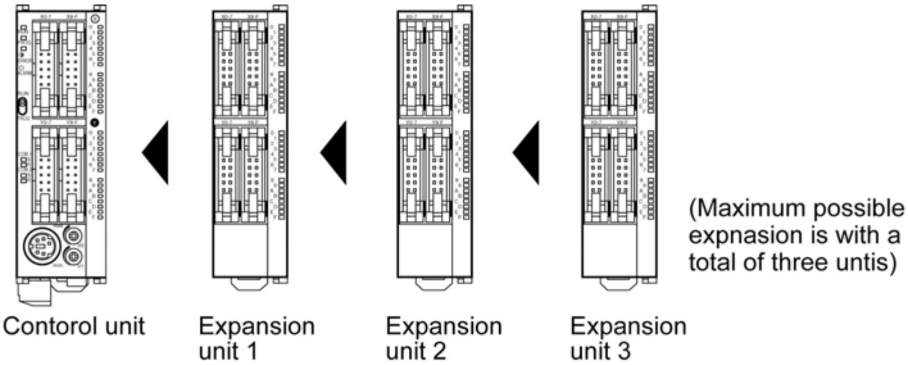
Name	Description	Part No.	Product No.
FPΣ Communication cassette 1-channel RS232C type	This communication cassette is a 1-channel unit with a five-wire RS232C port. RS/CS control is possible.	FPG-COM1	AFPG801
FPΣ Communication cassette 2-channel RS232C type	This communication cassette is a 2-channel 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.

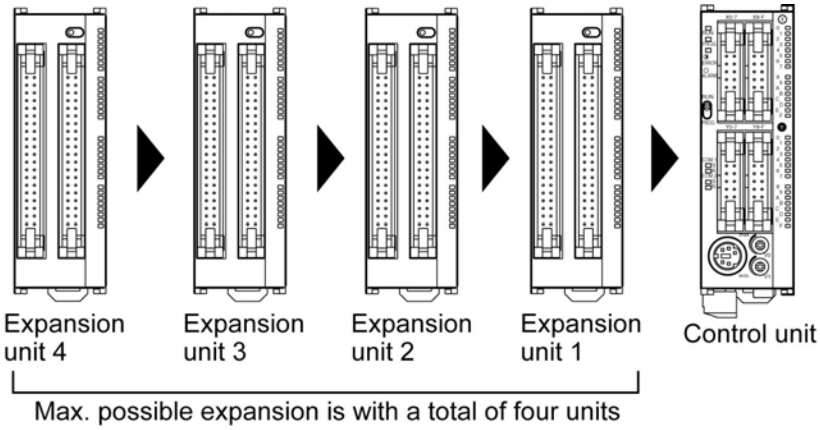
Controllable I/O points

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.
- Install the FP0 RTD unit on the right side of the other expansion units.

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

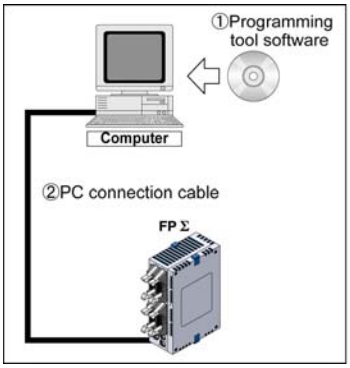
1.4.1 Tools Needed for Programming

1. Programming tool software

- The tool software can also be used with the FP series.
- “FPWIN Pro Ver.6” or “FPWIN GR Ver.2” Windows sorware 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®98/ Windows®Me/ 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://panasonic-electric-works.net/).
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.6

Type of software	OS (Operating system)	Hard disk capacity	Product No.
FPWIN Pro Ver.6 English-language menu	Windows®2000/ Windows®XP Windows Vista®	100MB or more	AFPS50560

Note1) Ver.6.0 can be upgraded to Ver. 6.1 or later free of charge at our web site (http://panasonic-electric-works.net/).
Note2) The small type can be used only for each series of FP-e, FPΣ, FP0, FP-X, FP1 and FP-M.

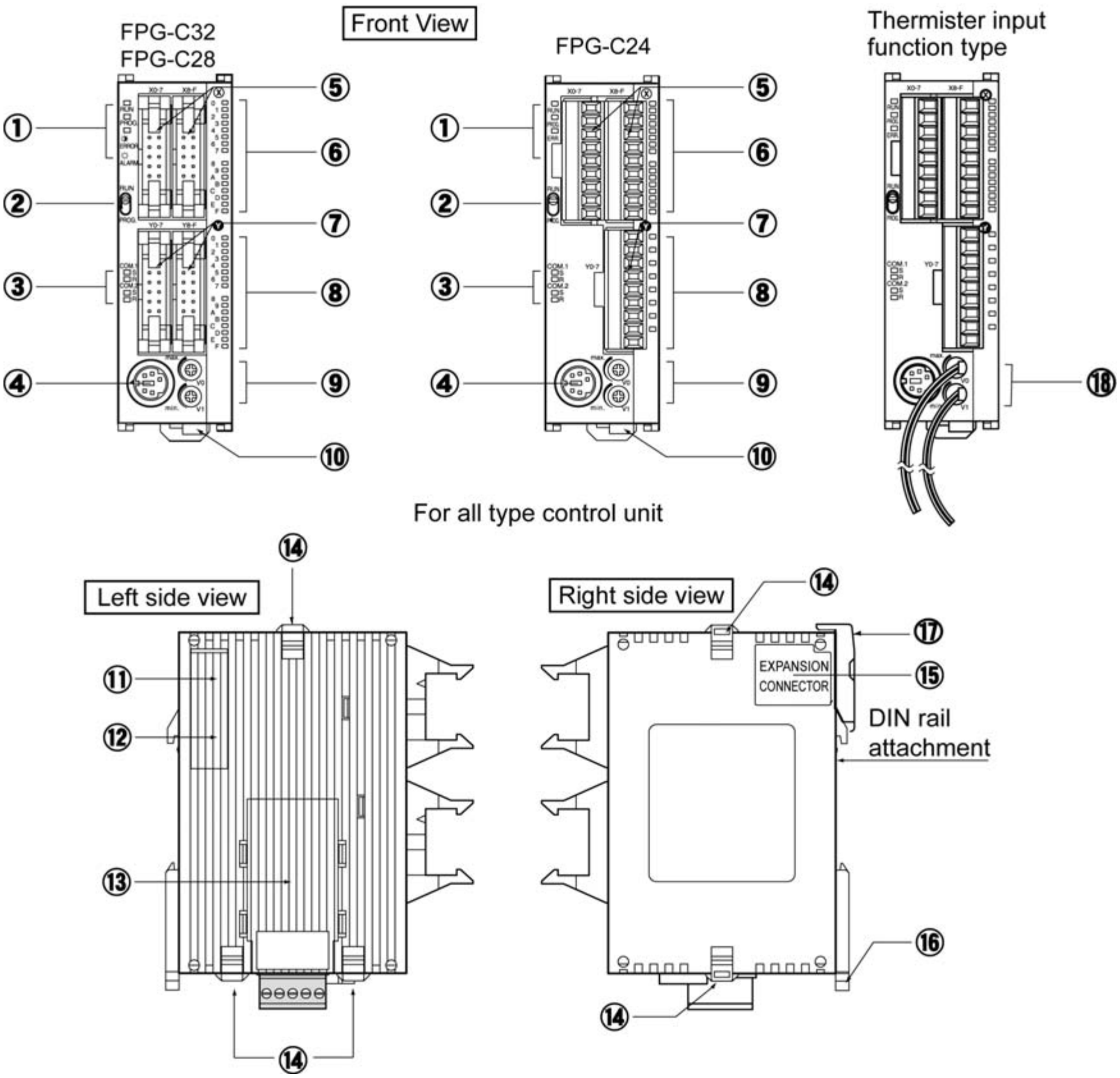
Type of computer and suitable cable

Connector	Specifications	Product No.
D-sub 9-pin	D-sub 9-pin female-Mini DIN round 5-pin	AFC8503
	D-sub 0-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 oepration 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 is executed and operation begins.
PROG. (downword)	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

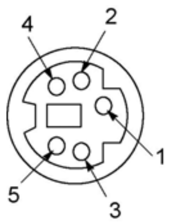
These LEDs display the communication status of the COM.1 and COM.2 ports.

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

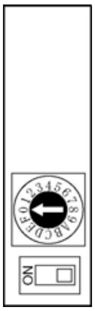
⑨ Analog potentiometer (analog dial)
(excluding the type of which part No. and product No. ends in TM)
Turning this dial chanes the values of special data register DT90040 and DT90041 within the range of K0 to K1000. It can be used for analog timers and other applications.

Expample: <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

Expample: <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.)

⑯ 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.

Expample: <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.

Expample: <2.5 Thermister input>

2.2 Input and Output Specifications

2.2.1 Input Specifications

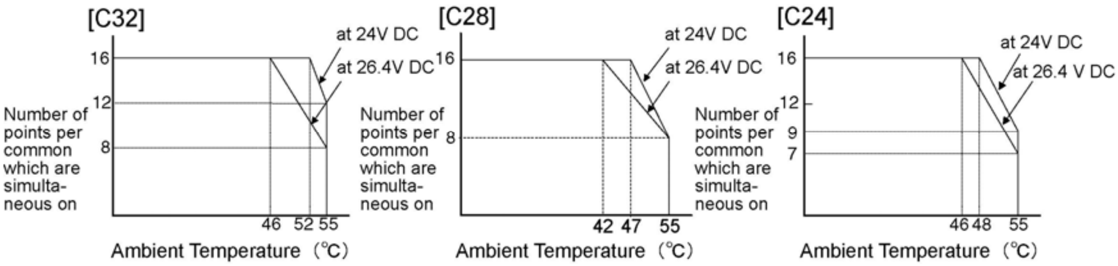
Input Specifications (for all types)

Item		Description
Insulation method		Optical coupler
Rated input voltage		24V DC
Operating voltage range		21.6 to 26.4V DC
Rated inptu 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 kΩ For X2, X5 to X7: approx. 5.6 kΩ For X8 to XF: approx. 6.8 kΩ
Response time	off→on	For input X0, X1, X3, X4: 1 ms or less: normal input 5 μs or less: high-speed counter, pulse catch, interrupt input settings Note1) For inptut X2, X5 to X7: 1 ms or less: normal input 100μs or less: high-speed counter, pulse catch, interrupt input settings Note1) For input X8 to XF 1 ms or less: normal inputonly
	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.

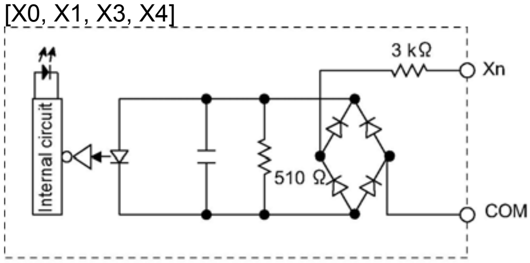
Limitations on number of simultaneous input on points

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

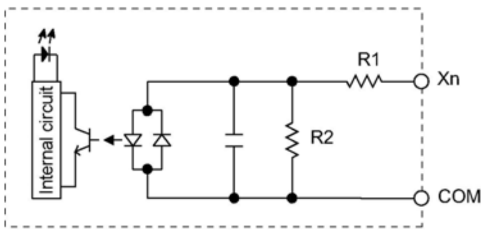


Circuit diagram

[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

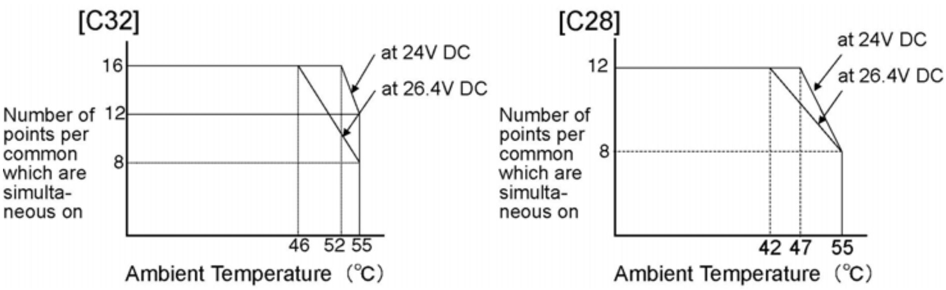
2.2.2 Output Specifications

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		100μA or less	
On state voltage drop		0.5V or less	
Response time	off→on	For Y0, Y1, Y3, Y4 (at 15mA or less): 2μs or less For Y2, Y5 or later: 0.2ms or less	
	on→off	For Y0, Y1, Y3, Y4 (at 15mA or less): 8μs 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

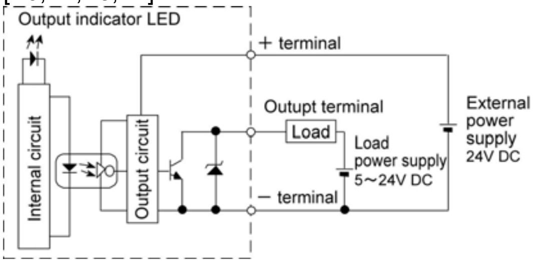
Keep the number of output points per common which are simultaneously on within the following range as determined by the ambient temperature.



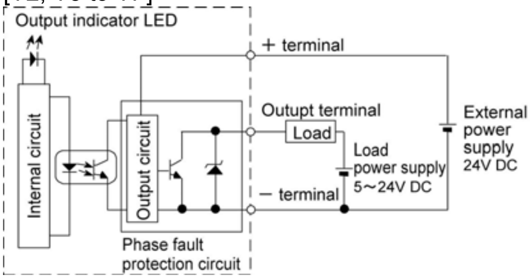
Circuit diagram

[C32]

[Y0,Y1,Y3,Y4]

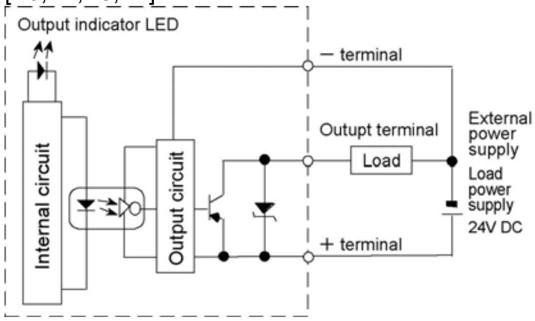


[Y2, Y5 to YF]

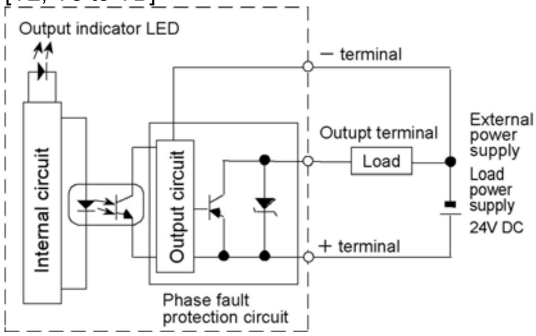


[C28]

[Y0,Y1,Y3,Y4]



[Y2, Y5 to YB]



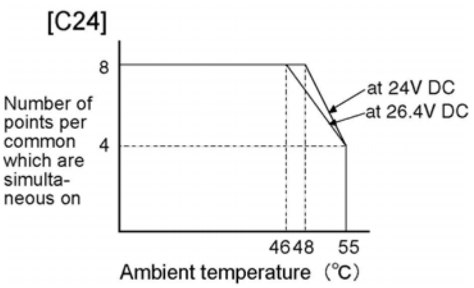
Relay output specifications (C24)

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

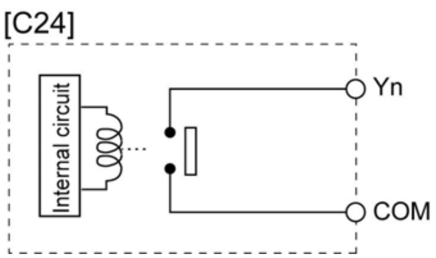
Note1) Resistance load

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.



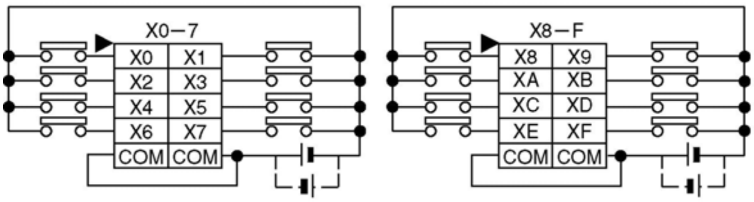
Circuit diagram

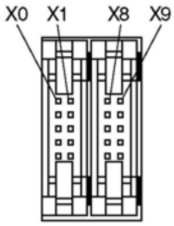


2.3 Terminal Layout Diagram

2.3.1 Control Unit (for C32)

Input

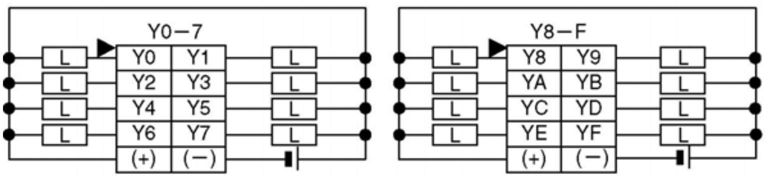


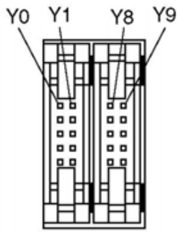


(Connector front view)

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

Output



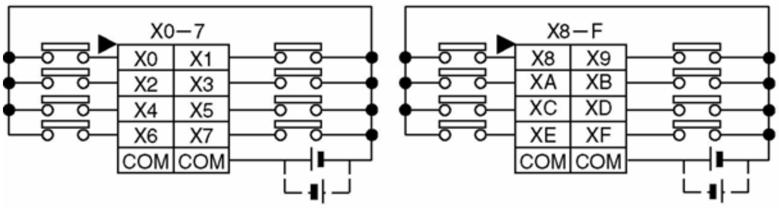


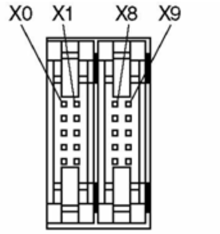
(Connector front view)

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

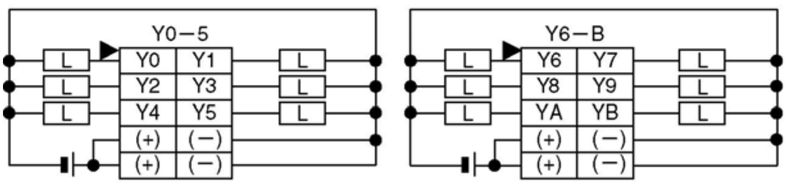


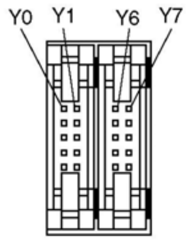


(Connector front view)

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

Output



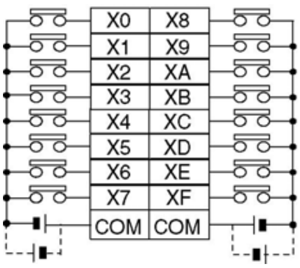


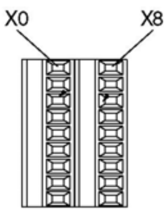
(Connector front view)

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)

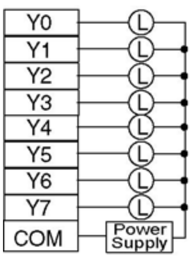
Input

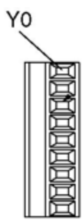




Note) The two COM terminals of input circuit are not connected internally.

Output



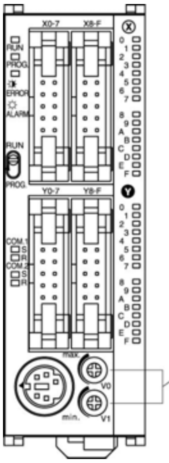


(Connector front view)

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.

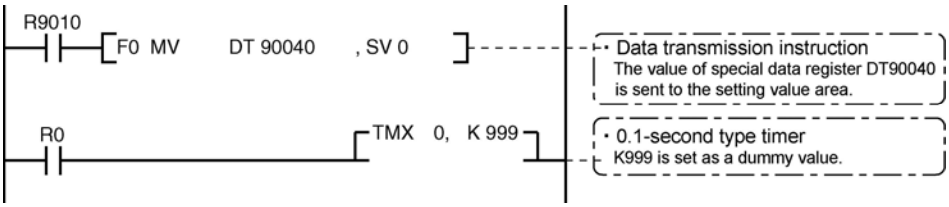
Applicable special data register

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.



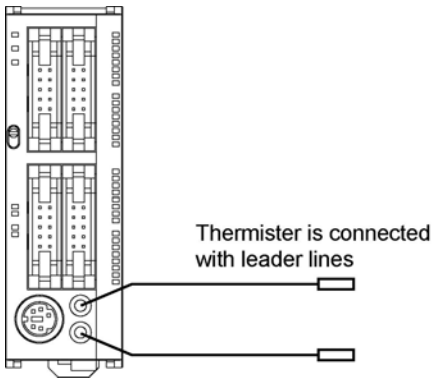
2.5 Thermister Input (Only for TM type)

2.5.1 Overview of Thermister Input

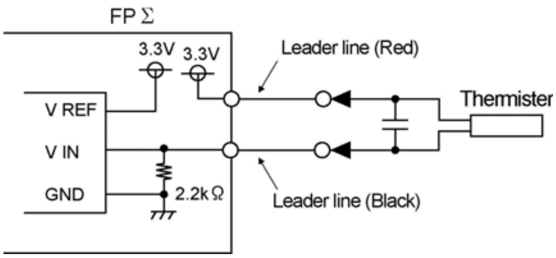
The control units of which part and product numbers end in “TM” is quipped with the leader lines which enable the thermister input instead of the analog potentiometer. The change in the termister’s resistance values can be loaded as analog values by connecting the thermister with these leader lines.

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
= (Total precision of AD converter in which microcomputer is built: ±5LSB[Note)])+(Precision of thermister)

Note) ±5LSB means there is a margin of error of ±5LSB 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 resister 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: ±5LSB)+(Precision of thermister) is not included in the above digital values.

Conversion program using scaling instruction (F282)

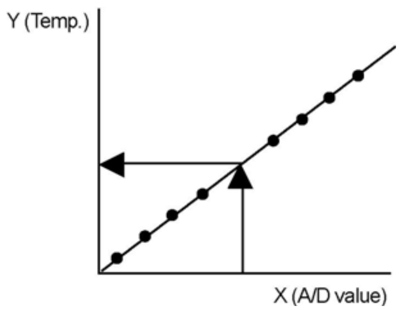
- Appropriate data which interpolated from nonlinear data can be obtained by creating converted digital values and temperature data as a data table and executing the scaling instruction (F282).

```
|
|---| |---[ F282 DT90040, DT0, DT100 ]
|
```

DT90040: Special data register
(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 paird) + 1 for DT0.

2.6 Calendar Timer

If a backup battery is installed in the FPΣ, the clock/calendar function can be used. This funcation 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

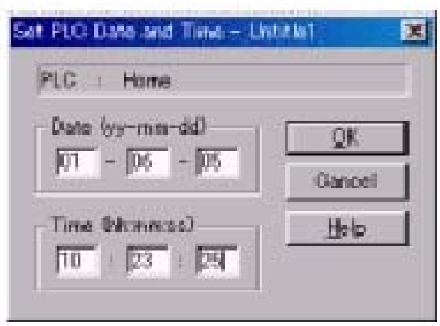
2.6.2 Setting of Clock/Calendar Function

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

Setting using FPWIN GR

1. Press the [CTRL] and [F2] keys at the same time, to switch to the [Online] screen.
2. Select “Set PLC Date and Time” under “Tool” on the menu bar.

Set PLC Date and Time dialog box



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.

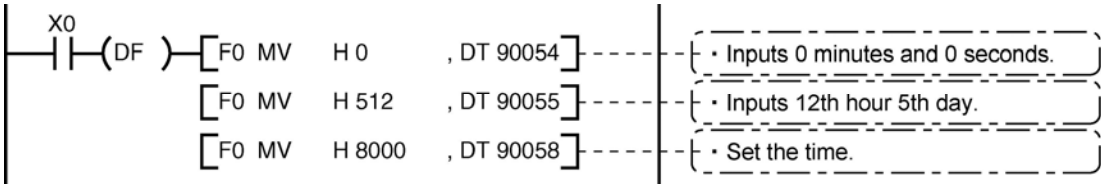
Setting and changing using program

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.

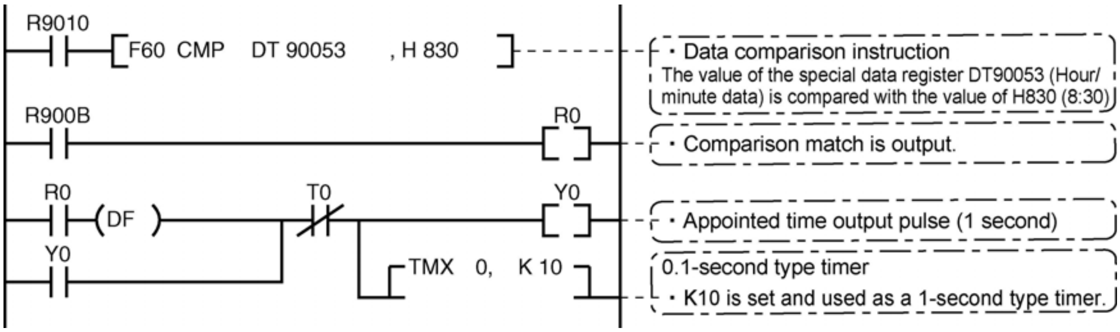
As a day of the week is not automatially set on FPWIN GR, fix what day is set to 00, and set each value for 00 to 06.

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.

```
 R9010
--| |---[ F6  DGT , DT 90054 , H 12 , DT 101 ]
        [ F6  DGT , DT 90054 , H 10 , DT 100 ]

 R9010                                          R900B     R100
--| |--+-[ F62 WIN , DT 100 , H 0  , H 29 ]-----| |-------[  ]--
       |                                        R900B     R101
       +-[ F62 WIN , DT 100 , H 30 , H 59 ]-----| |-------[  ]--

  R0             R100
--| |---( DF )---| |---[ F6  DGT , H 0    , H 10  , DT 110 ]
                       [ F6  DGT , DT 101 , H 210 , DT 110 ]
                       [ F0  MV  , DT 110 , DT 90054 ]
                       [ F0  MV  , H 8000 , DT 90058 ]

  R0             R101
--| |---( DF )---| |---[ F157 CADD , DT 90054 , H 100 , DT 110 ]
                       [ F6  DGT , H 0    , H 10  , DT 110 ]
                       [ F0  MV  , DT 110 , DT 90054 ]
                       [ F0  MV  , DT 111 , DT 90055 ]
                       [ F0  MV  , DT 112 , DT 90056 ]
                       [ F0  MV  , H 8000 , DT 90058 ]
```

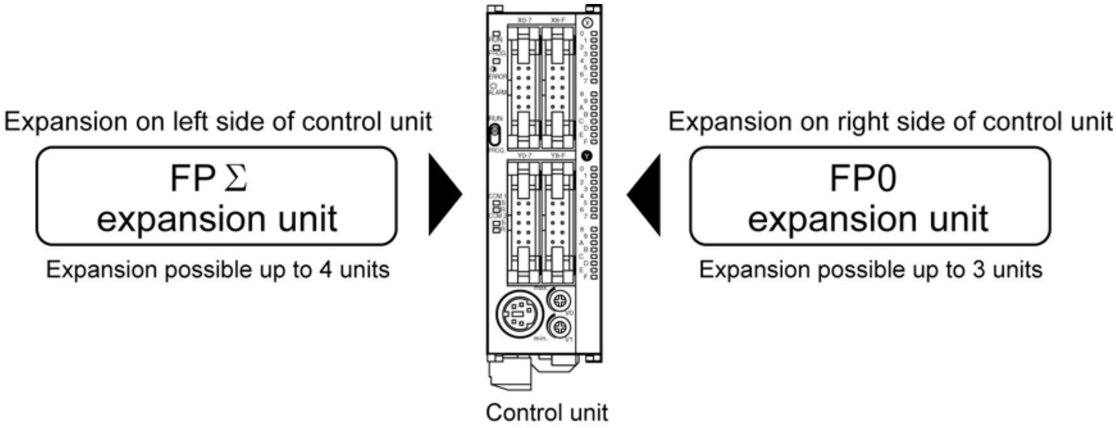
Chapter 3

Expansion

3.1 Type of Expansion Unit

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

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



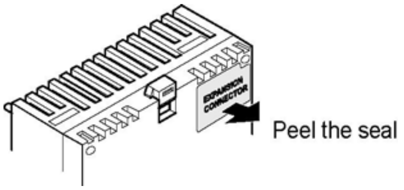
Note:

- The FPΣ expansion unit cannot be connected to FPG-C32T, FPG-C32TTM, FPG-C32TH or FPG-C32THTM. Only the FP0 expansion unit can be connected.
- Up to 2 units of FP∑ positioning unit RTEX can be installed.

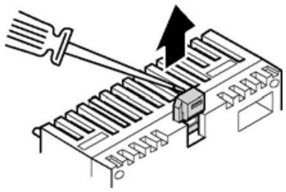
3.2 Expansion Method of Units for FP0 and FPΣ

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.

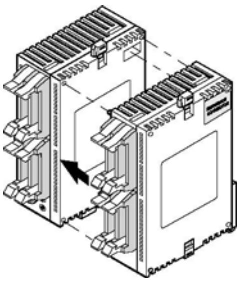
(1) Peel the seal on the side of the unit so that the internal right-side connector for FP0 expansion is exposed.



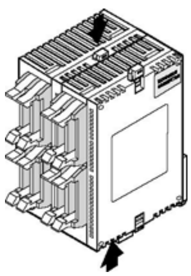
(2) Raise the expansion hooks on the top and bottom sides of the unit with a screwdriver.



(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.

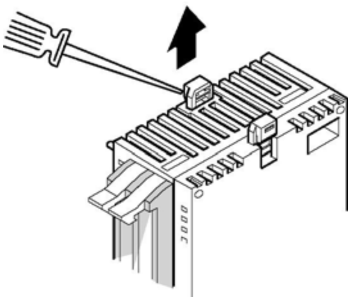


3.3 Expansion Method of FPΣ Expansion Unit

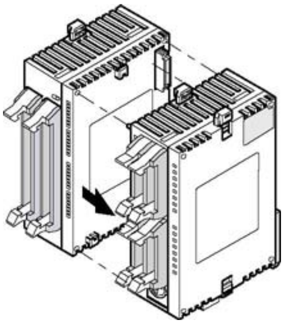
The dedicated expansion unit for FPΣ (including intelligent unit) is expanded by connecting to the left side of the control unit.
Unit expansion is done using the left-side connector for FPΣ expansion and expansion hook on the side of the unit.

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

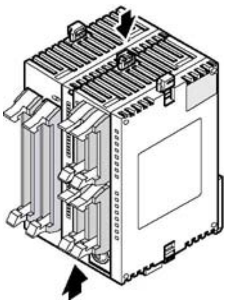
(2) Raise the expansion hooks on the top and bottom sides of the unit with a screwdriver.



(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.

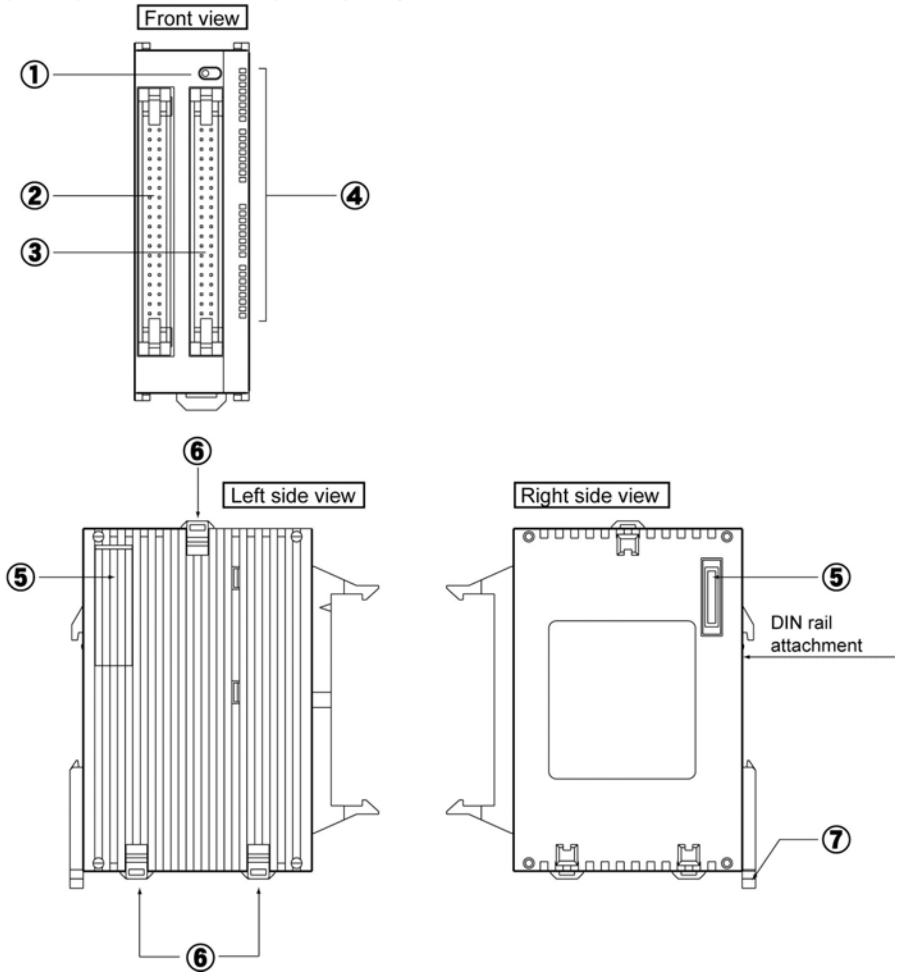


3.4 Specifications of FPΣ Expansion Unit

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

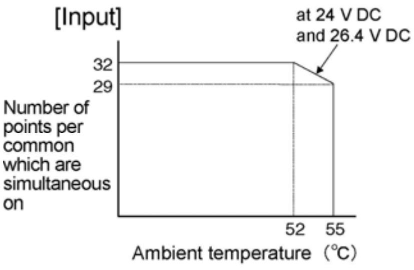
Item		Description
Insulation method		Optical coupler
Rated input voltage		24 V DC
Operating voltage range		21.6 to 26.4 V DC
Rated input current		Approx. 3.5 mA
Input points per common		32 points/common (Either the positive or negative of input power supply can be connected to common terminal.)
Min.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

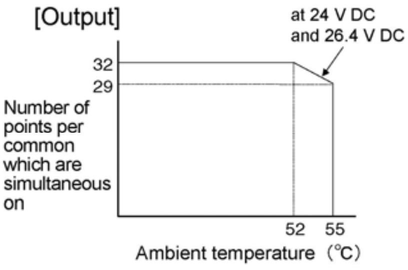
Transistor output specifications

Item		Description	
		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	

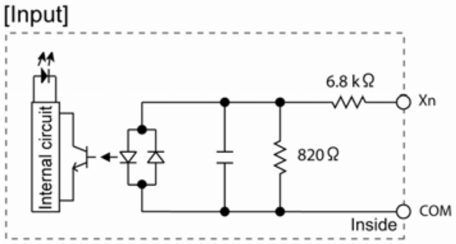
Limitations on number of simultaneous on points

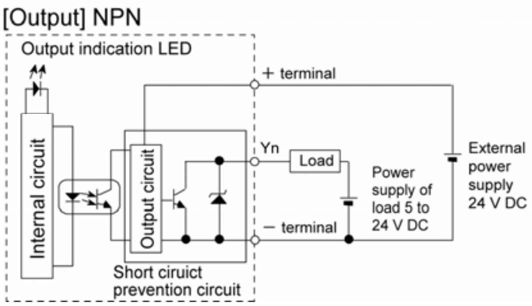
Keep the number of points which are simultaneously on within the following range as determined by the ambient temperature.

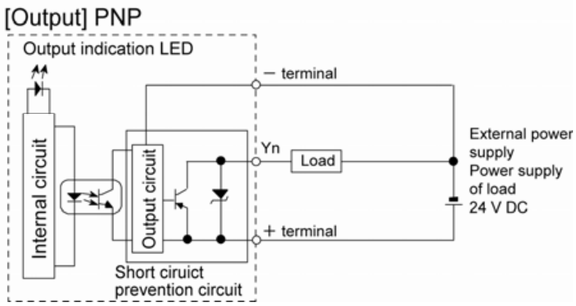




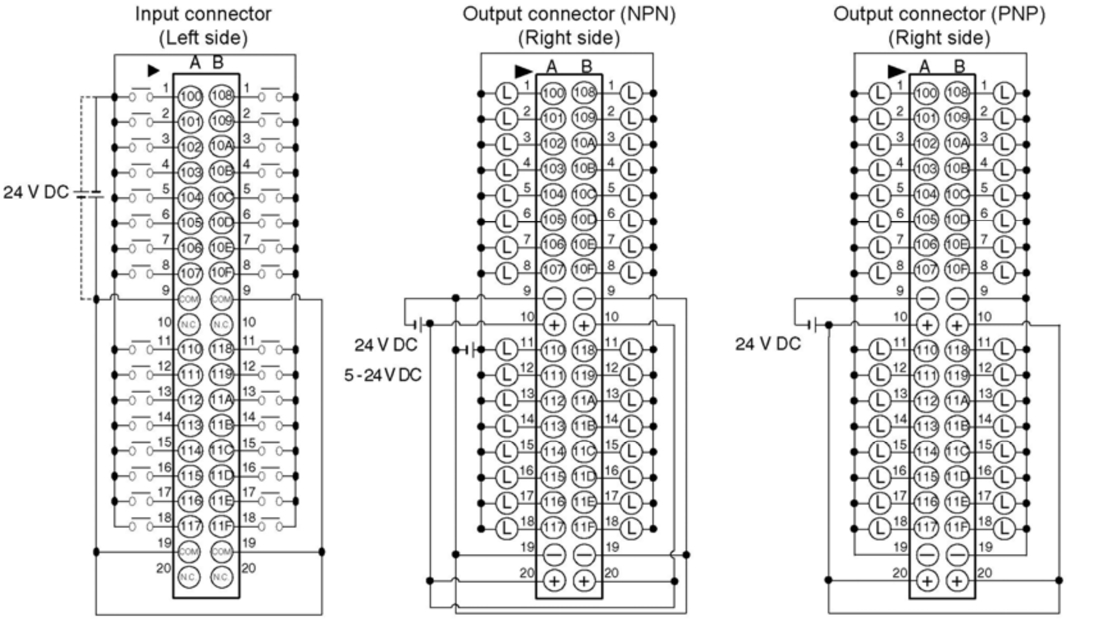
Circuit diagram







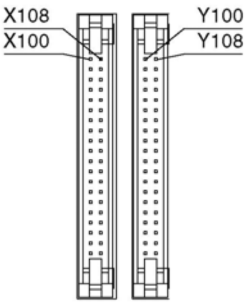
Terminal layout diagram



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.

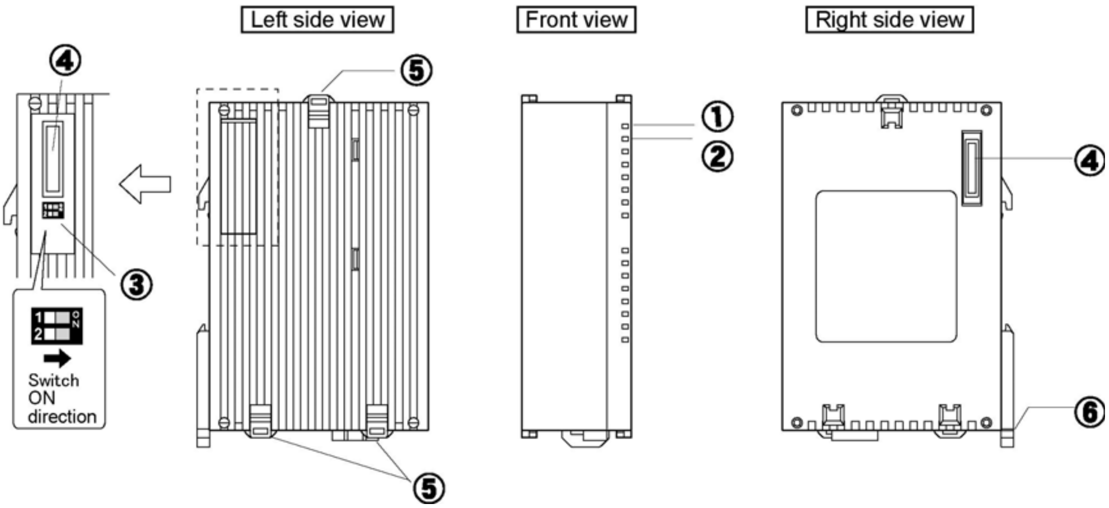


(Front view of connector)

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

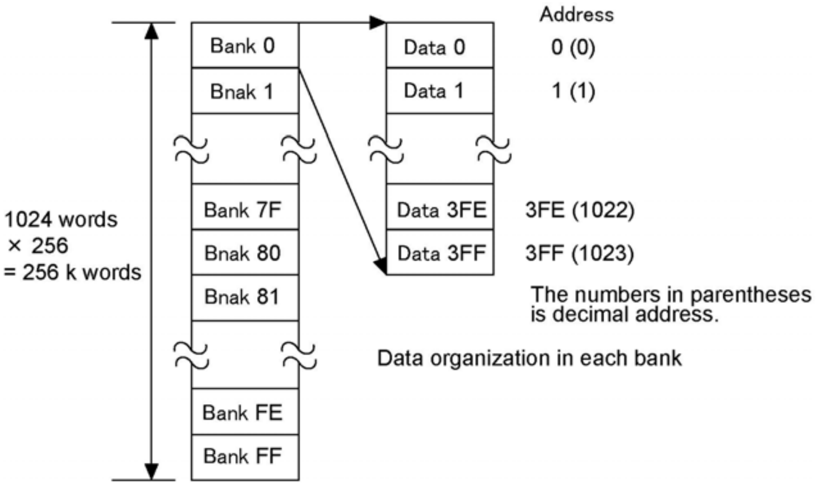
Item	Description
Memory	256 k words (1k word x 256 banks)
Battery life	5 years or more
Consumption current (5V)	100 mA or less
No of occupied I/O points	Input 16 points

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.



Data organization in each bank

Configuration of banks in 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 [F150, S1, S2, n, D]

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 [F150, H5003, K500, K10, DT100]

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 [F151, S1, S2, n, D]

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 [F151, HAB01, DT10, K10, H2FE]

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 x No. of words to read) μs
  F151 WRITE : 17.88+(0.77 x No. of words to write) μs
- 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

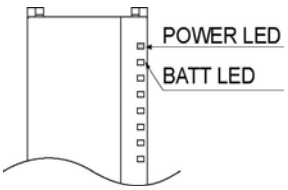
When any error occurs in a backup battery, the input will be turned on as follows.

[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

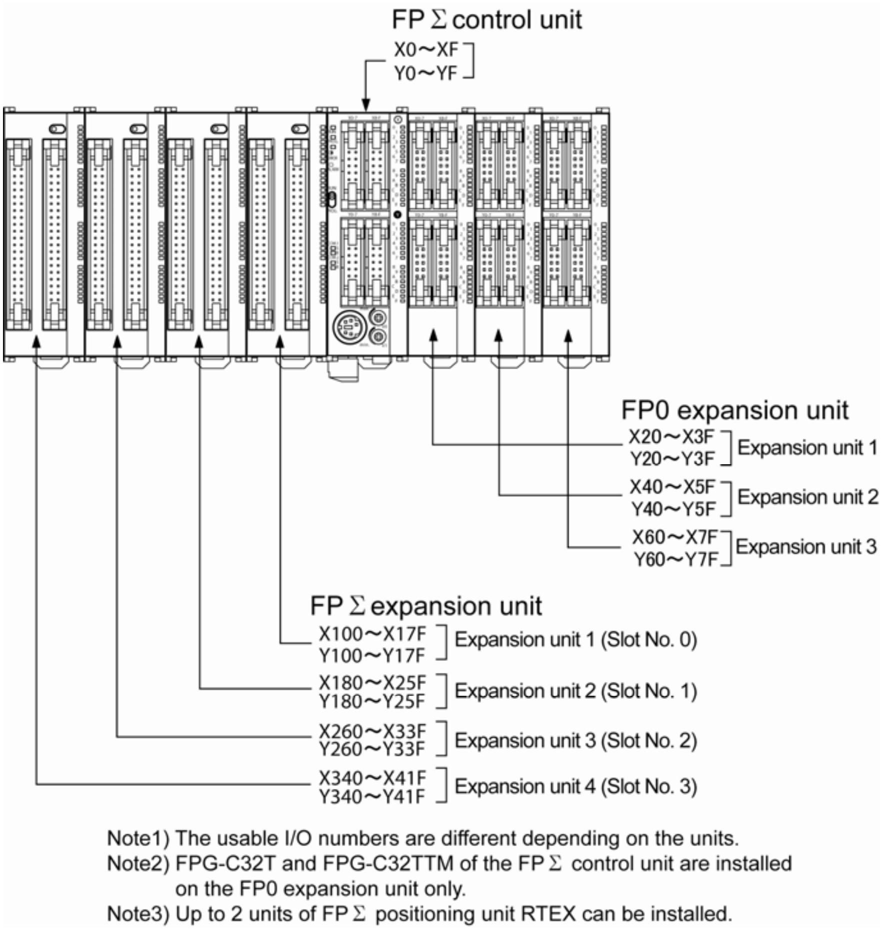
For other FPΣ expansion units, the dedicated manuals are available.

Reference: <1.2.2 FPΣ expansion unit>

Chapter 4

I/O Allocation

4.1 I/O Allocation



Regarding I/O number

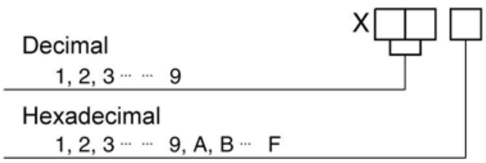
• Specifying X and Y numbers

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

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

• Expression of numbers for input/output relays

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



• 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 FPG-C32T2/FPG-C32T2TM FPG-C32TH/FPG-C32THTM	Input (16 points)	X0 to XF
	Output (16 points)	Y0 to YF
FPG-C28P2/FPG-C28P2TM FPG-C28P2H/FPG-C28P2HTM	Input (16 points)	X0 to XF
	Output (16 points)	Y0 to YB
FPG-C24R2/FPG-C24R2TM FPG-C24R2H/FPG-C24R2HTM	Input (16 points)	X0 to XF
	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
FPΣ Positioning unit RTEX Note)	FPG-PN2AN 2-axis type FPG-PN4AN 4-axis type FPG-PN8AN 8-axis type	Input 128 points	-	X100 to X17F	X180 to X25F	X260 to X33F	X340 to X41F
		Output 128 points	-	Y100 to Y17F	Y180 to Y25F	Y260 to Y33F	Y340 to Y41F

• Regarding FPΣ CC-Link slave unit, please refer to the exclusive manual.
Note) There is no restriction on installed positions, however, the number of installed units is up to 2 units.

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
	EP0-E32T/P	Input (16 points)	X20 to X2F	X40 to X4F	Y60 to Y6F
		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
FP0 RTD unit	FP0-RTD6	Input (16 points) CH0, 2, 4	WX2 (X20 to X2F)	WX4 (X40 to X4F)	WX6 (X60 to X6F)
		Input (16 points) CH1, 3, 5	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)

- 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 ℃
-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)

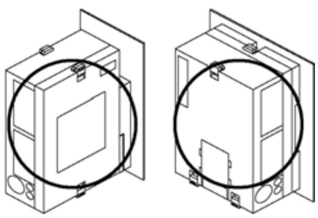
Static electricity

- 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

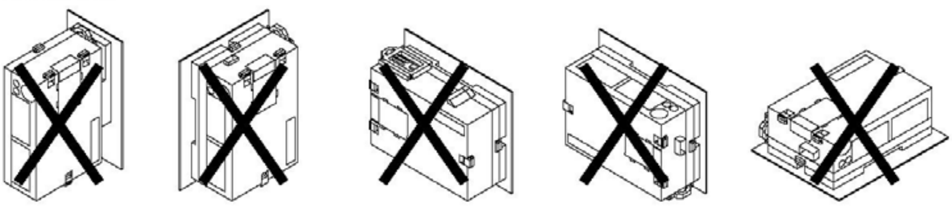
• Always install the unit orientated with the tool port facing outward on the bottom in order to prevent the generation of heat.

CORRECT



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

INCORRECT

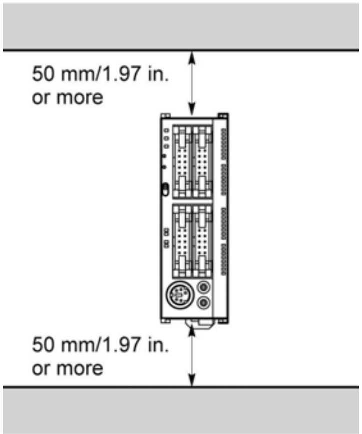


Upside-down | Upside-down | Installations such that the input and output connectors face down | Input and output connectors on top | Horizontal installation of the unit

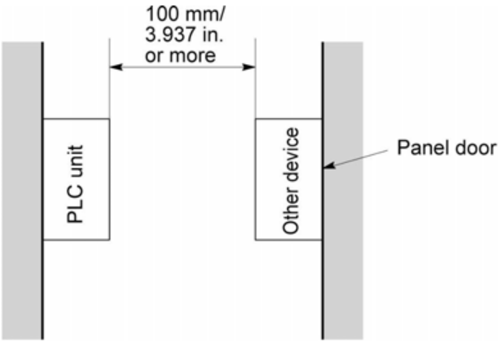
• Do not install the unit above devices which generate heat such heaters, transformers or large scale resistors.

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

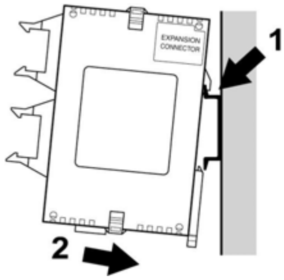
Attachment to DIN rail and removal from DIN rail

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.

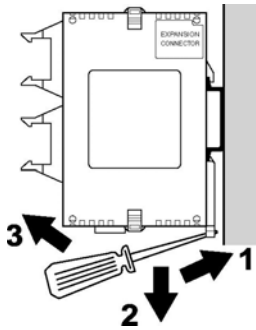


Procedure of removal method

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

(2) Pull the attachment lever downwords.

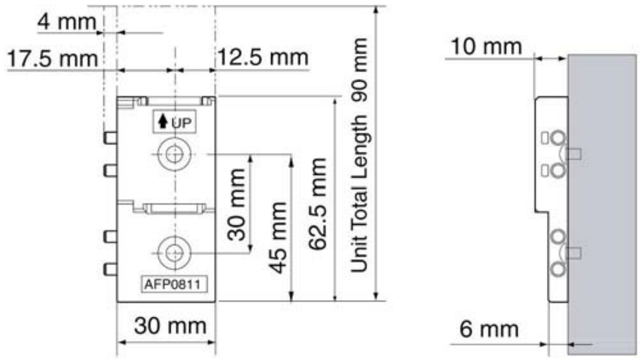
(3) Lift up the unit and remove it from the rail.



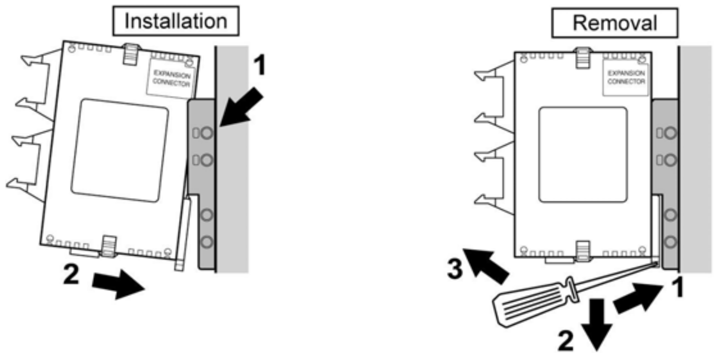
5.1.3 Installation Using the Optional Mounting Plate

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.

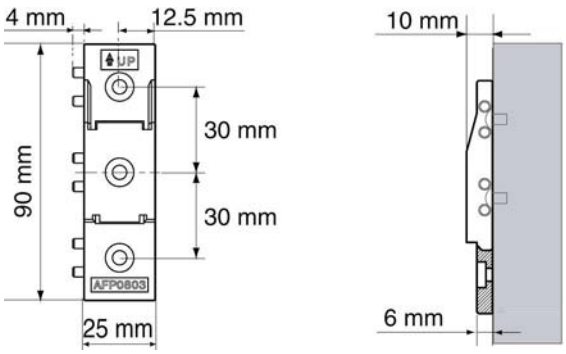


The rest of the procedure is the same as that for attaching the unit to the DIN rails.

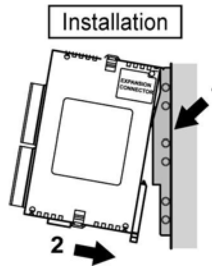


When using the slim type mounting plate (AFP0803) (for mounting FP0)

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



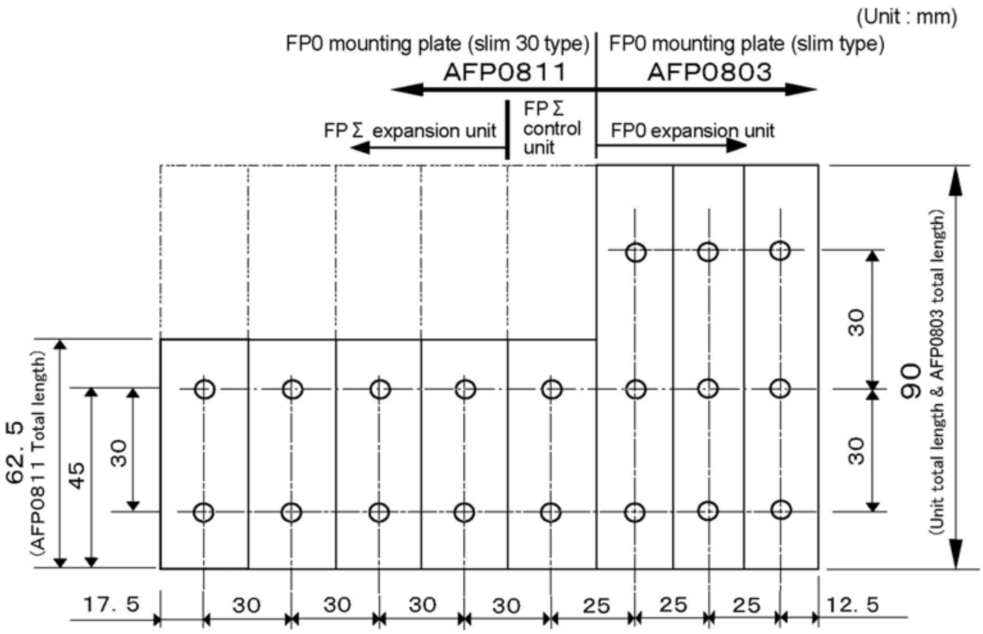
The rest of the procedure is the same as that for attaching the unit to the DIN rails.



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

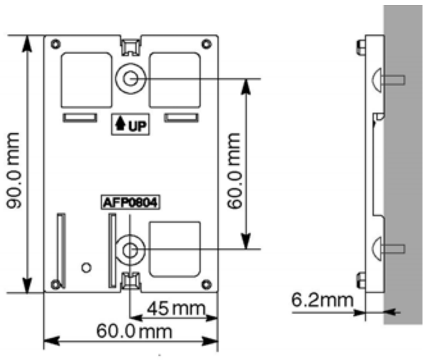
Note:
When using an expansion unit, tighten the screws after joining all of the slim type mounting plate to be connected. Tighten the screws at each of the four corners.

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



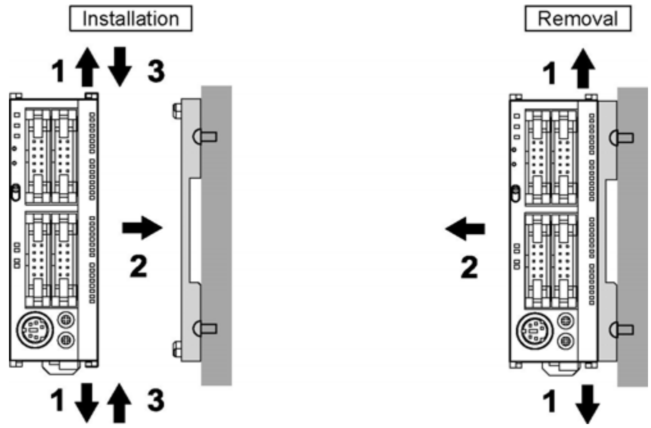
When using the flat type mounting plate (AFP0804)

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

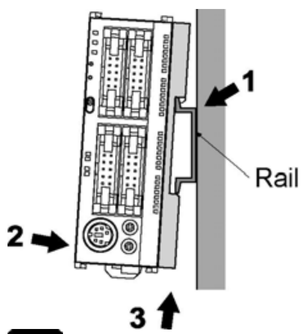


Raise the expansion hooks on the top and bottom of the unit.

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.

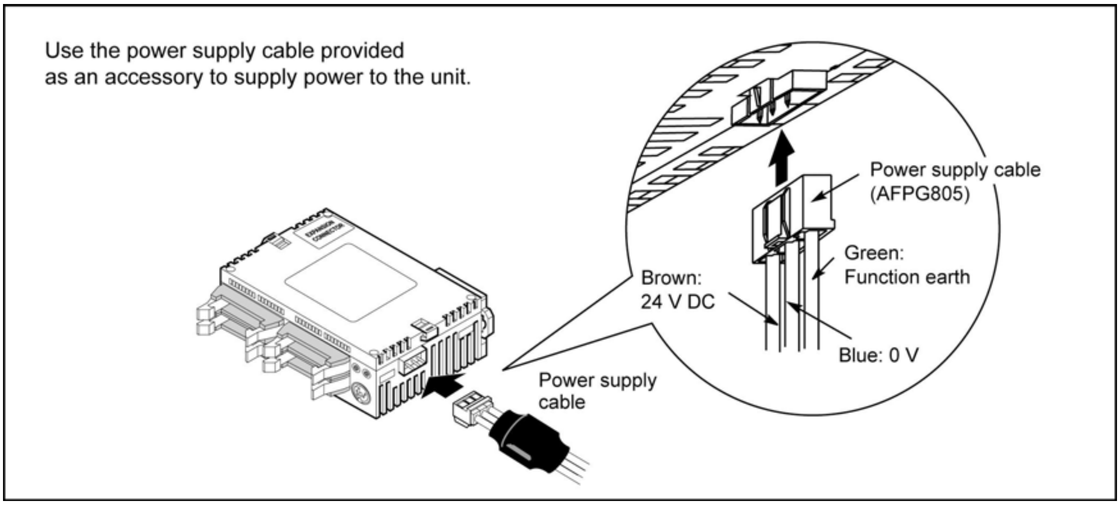


Note:

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 combinaton 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

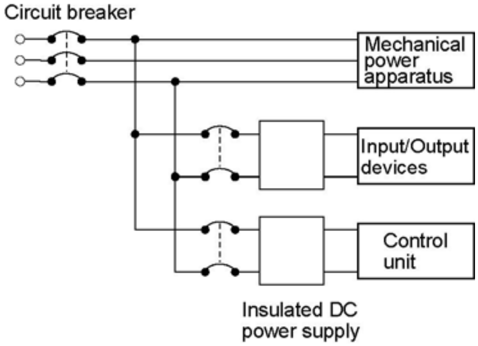
- To protect the system against erroneous voltage from the power supply line, use an insulated power supply with an internal protective circuit.
- The regulator on the unit is a non-insulated type.
- If using a power supply device without an internal protective circuit, always make sure power is supplied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

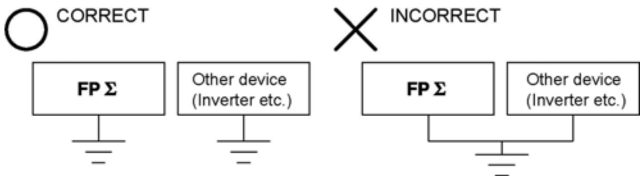
- The power supply sequence should be set up so that power to the control unit is turned off before the input/output power supplies.
- If the input/output power supplies are turned off before the power to the control unit, the control unit will detect the input fluctuations and may begin an unscheduled 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 simultaneousl 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.

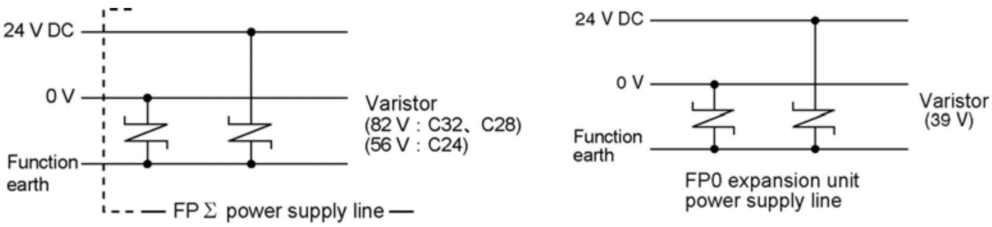
Exclusive grounding

- 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.

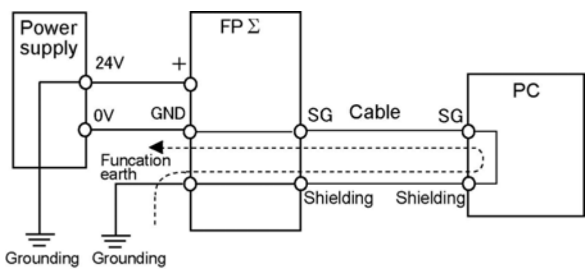


Note:
Depending on the surroundings in which the equipment is used, grounding may cause problems.

[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 shieldingare 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.

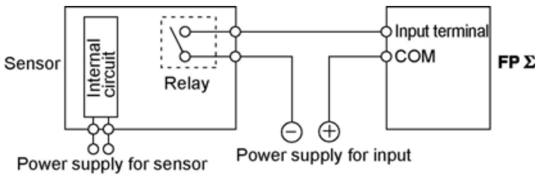


5.3 Wiring of Input and Output

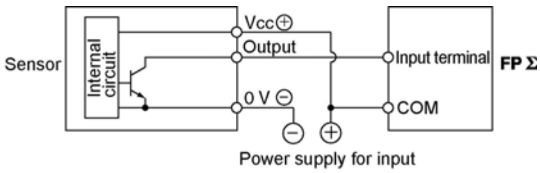
5.3.1 Input Wiring

Connection of photoelectric sensor and proximity sensor

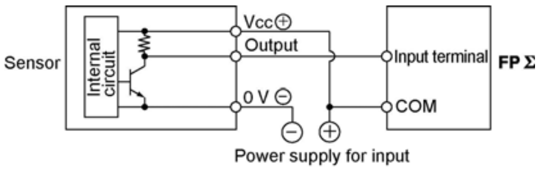
Relay output type



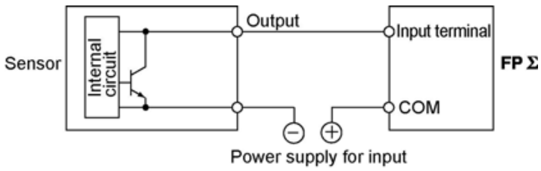
NPN open collector output type



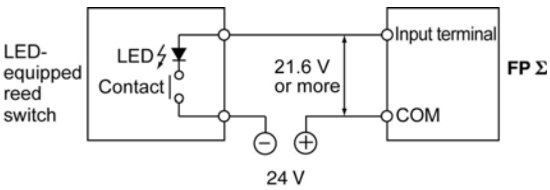
Voltage output type



Two-wire output type

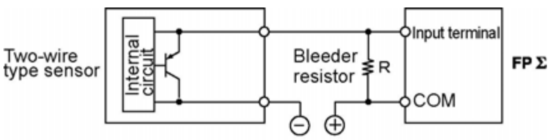


Precaution when using LED-equipped reed switch



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.

$$I \times \frac{5.6R}{5.6R + R} \leqq 2.4 \qquad \text{Therefore,}$$

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

The wattage W of the resistor is:

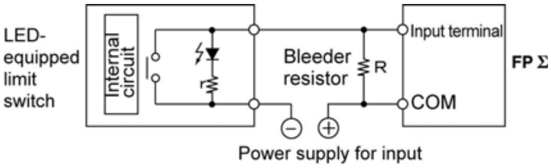
$$W = \frac{(\text{Power supply voltage})^2}{R}$$

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



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

r : Internal resistor of limit switch (kΩ)
R : Bleeder resistor (kΩ)

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

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

The resistance R of the bleeder resistor is:

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

The wattage W of the resistor is:

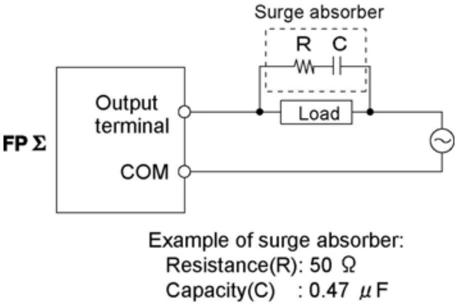
$$W = \frac{(\text{Power supply voltage})^2}{R} \times (3 \text{ to } 5 \text{ times})$$

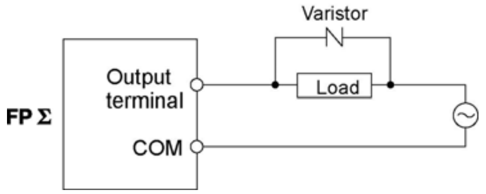
5.3.2 Output Wiring

Protective circuit for inductive loads

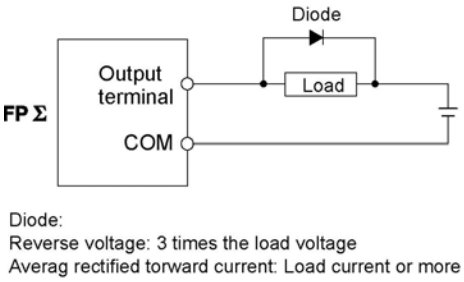
- With an inductive load, a protective circuit should be installed in parallel with the load.
- When switching DC inductive loads with relay output type, be sure to connect a diod across the ends of the load.

When using an AC inductive load



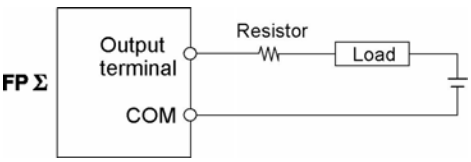


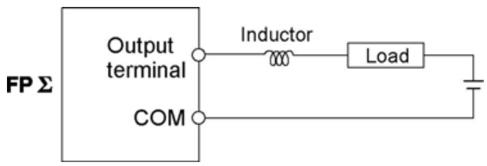
When using a DC inductive load



Precautions when using capacitive loads

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





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)

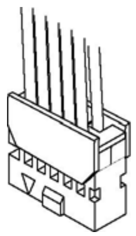
5.3.3 Precautions Regarding Input and Output Wirings

- 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)

Manufacturer	Type and product No.	
Panasonic Electric Works, Co., Ltd.	Housing	10-pin type only
	Semi-cover	AXW61001A
	Welder (contact)	AXW7221 (For AWG#22, 24) [Note)]

Note) For using wires of AWG#26 or #28, purchase AXW7231 (for AWG#26 and #28) separately.

Supplied connector (AFP2801)

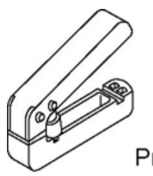
Manufacturer	Type and product No.	
Panasonic Electric Works, Co., Ltd.	Housing	AXW1404A
	Semi-cover	AXW64001A
	Welder (contact)	AXW7221 (For AWG#22, 24) [Note2)]

Note1) Packed with the Expansion I/O unit.

Note2) For using wires of AWG#26 or #28, purchase AXW7231 (for AWG#26 and #28) separately.

Pressure connection tool

Manufacturer	Product No.
Panasonic Electric Works, Co., Ltd.	AXY52000

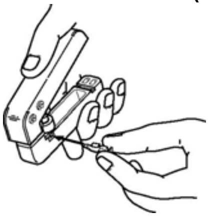


Pressure connection tool

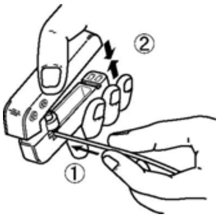
Procedure of assembly (Wiring method)

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

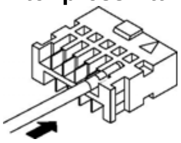
(1) Bend the welder (contact) back from the carrier, and set it in the pressure connection tool.



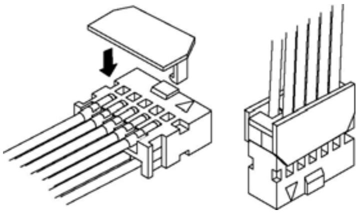
(2) Insert the wire without removing its insulation until it stops, and lightly grip the tool.



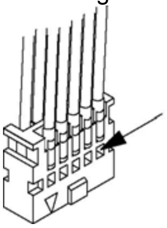
(3) After press-fitting the wire, insert it into the housing.



(4) When all wires has 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.



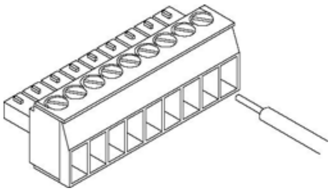
Key Point:

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 #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

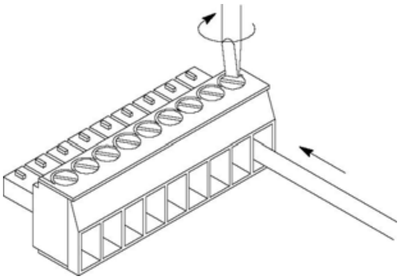
For tightening the terminal block

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

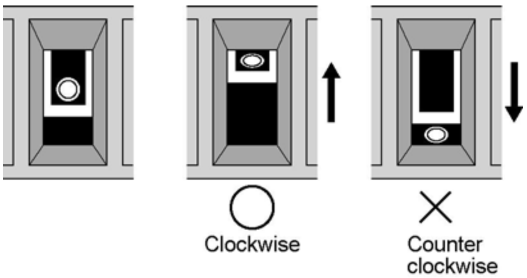
(1) Remove a portion of the wire's insulation.

(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

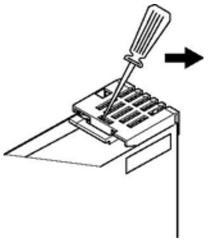
Installing a backup battery in the FPΣ makes it possible to access clock/calender functions for use, in addition to backing up data registers and other data.

Battery (Option)

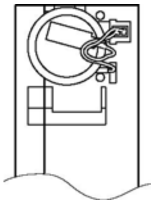
Name	Product No.
Battery for FPΣ	AFPG804

5.7.1 Installation of Backup Battery

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

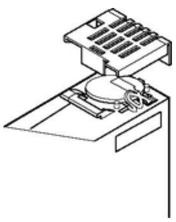


(2) Connect the connector, and place the battery so that the battery terminal fits between the two tabs.



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

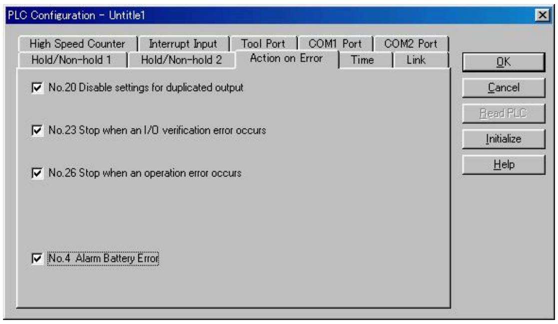
Setting of the battery error alarm

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 FPWIN GR

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

PLC Configuration setting dialog box



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 FPWIN 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 <u>effective for about a week</u> 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

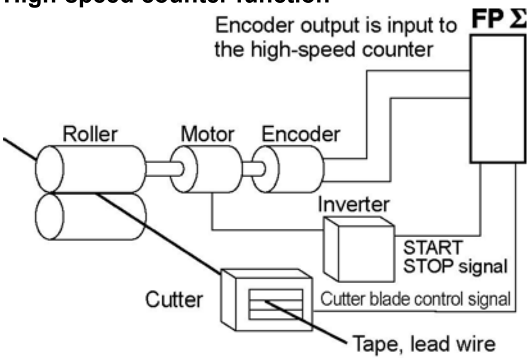
High-speed counter, Pulse Output and PWM Output functions

6.1 Overview of Each Functions

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

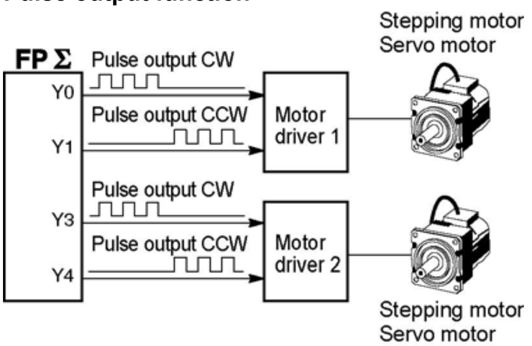
There are three functions available when using the high-speed counter built into the FPΣ.

High-speed counter function



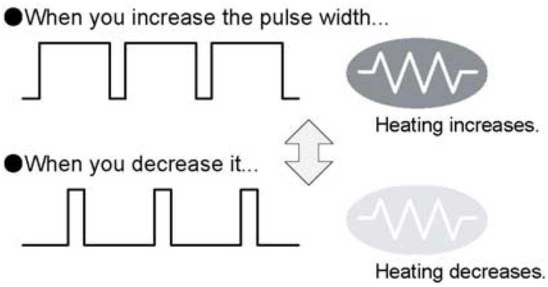
The high-speed counter function counts external inputs such as those from sensors or encoders. When the count reaches the target value, this function turns on/off the desired output.

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.

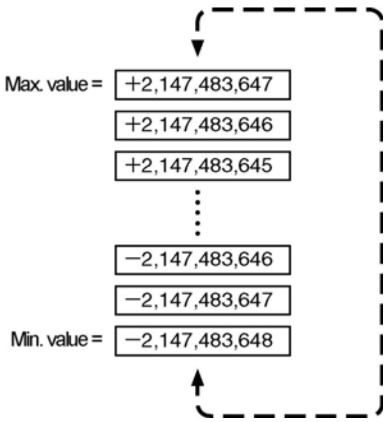
6.1.2 Performance of Built-in High-speed Counter

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: Input contact number (value in parenthesis is reset input) Note1)	Memory area being used: Control flag	Memory area being used: Elapsed value area	Memory area being used: Target value area	Performance specifications: Minimum input pulse width Note2)	Performance specifications: Maximu←m counting speed
[Single phase] Incre-mental, Decre-mental	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 out-put	CCW or dire-ction out-put	Devi-ation coun-ter clear out-put	Home input	Near home input Note4)	Con-trol flag	Elapsed value area	Target value area
Indepen-dence	CH0	Y0	Y1	Y2	X2	DT90052 <bit4>	R903A	DT90044 to DT90045	DT90046 to DT90047
	CH2	Y3	Y4	Y5	X5	DT90052 <bit4>	R903C	DT90020 to DT90201	DT90202 to DT90203
Inter-polation	Li-near	Y0 Y3	Y1 Y4	Y2 Y5 Note3)	X2 X5 Note3)	DT90052 <bit4>	R903A R903C	DT90044 to DT90045 DT90200 to DT90201	DT90046 to DT90047 DT90202 to DT90203
	Cir-cular	Y0 Y3	Y1 Y4	Y2 Y5 Note3)	X2 X5 Note3)	DT90052 <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 opera-tion
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%) -When resolution = 100, 15.6 kHz to 41.7 kHz (0 to 99%)	F0(MV) (High-speed counter control) F1(DMV) (Read/write of elapsed value of high-speed counter) F173(PWMH) (PWM output)
CH2	Y3	R903C		

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		Interpo-lation	Single phase	2-phase	Inde-pen-dence	Inter-pola-tion
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		Interpo-lation	Single phase	2-phase	Inde-pen-dence	Inter-pola-tion
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 : Pulse/direction is set :	Approx. 200 μs (with 30 steps) Approx. 400 μs (with 60 steps) Approx. 500 μs (with 30 steps) Note) Approx. 700 μs (with 60 steps) Note)
Pulse output instruction F172 (PLSH) JOG operation	CW/CCW is set : Pulse/direction is set :	Approx. 20 μs Approx. 320 μs Note)
Pulse output instruction F174 (SP0H) Data table control	CW/CCW is set : Pulse/direction is set :	Approx. 30 μs Approx. 330 μs Note)
PWM output instruction F173 (PWMH)	Approx. 30 μs	

Note) If pulse/direction is set, a waiting time (approx. 300 μs) 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

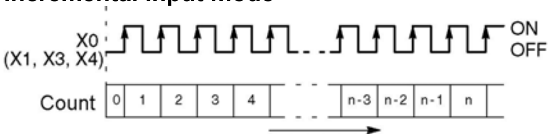
- The high-speed counter function counts the input signals, and when the count reaches the target value, turns on and off the desired output.
- To turn on an output when the target value is matched, use the target value match ON instruction F166 (HC1S). To turn off an output, use the target value match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

Setting the system register

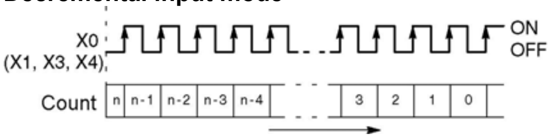
In order to use the high-speed counter function, it is necessary to set system register numbers nos. 400 and 401.

6.3.2 Input Modes and Count

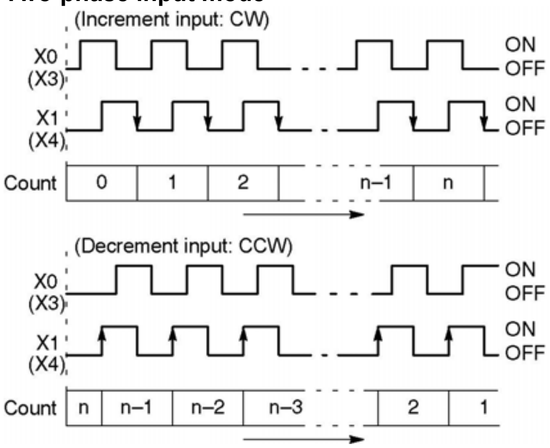
Incremental input mode



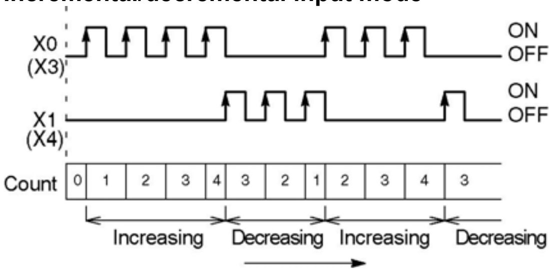
Decremental input mode



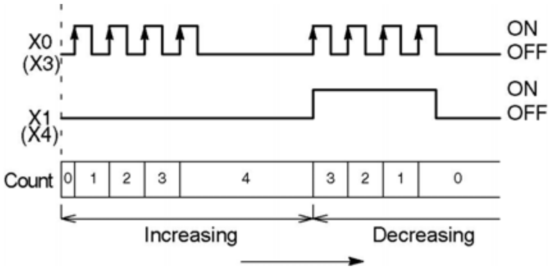
Two-phase input mode



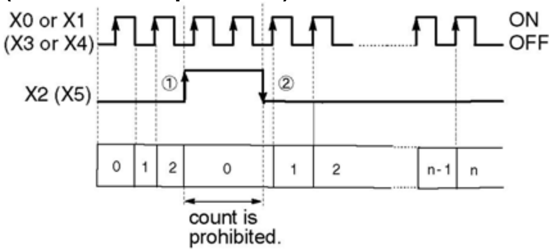
Incremental/decremental input mode



Direction discrimination



Count for reset input
(Incremental input mode)

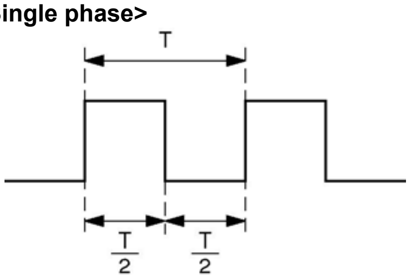


The reset input is executed by the interruption at (1) on (edge)
and (2) off (edge).
(1) on (edge) … Count disable, Elapsed value clear
(2) off (edge) … Count enable
DT90052 (bit2): “able/disable” setting of the input can be set
by the reset input.

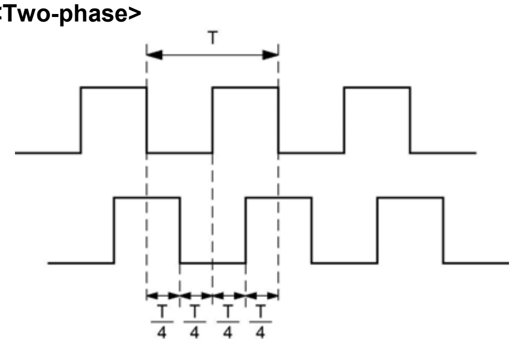
6.3.3 Minimum Input Pulse Width

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>



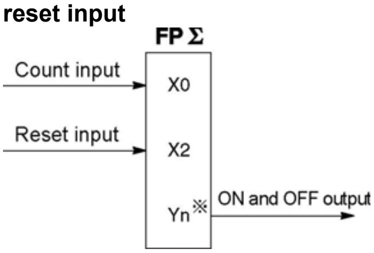
<Two-phase>



6.3.4 I/O Allocation

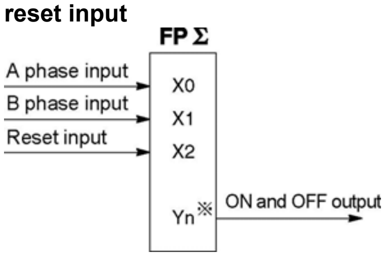
- As shown in the table in the previous section “6.2.1”, the inputs and outputs used will differ depending on the channel number being used.
- The output turned on and off can be specified from Y0 to Y7 as desired with instructions F166 (HC1S) and F167 (HC1R).

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)

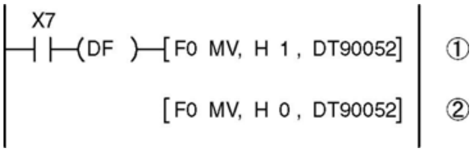
- This instruction is used for counter operations such as software reset and count disable.
- Specify this instruction together with the special data register DT90052.
- Once this instruction is executed, the settings will remain until this instruction is executed again.

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

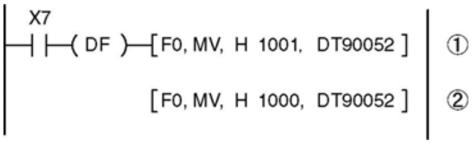
Example: Performing a software reset

In case of CH0

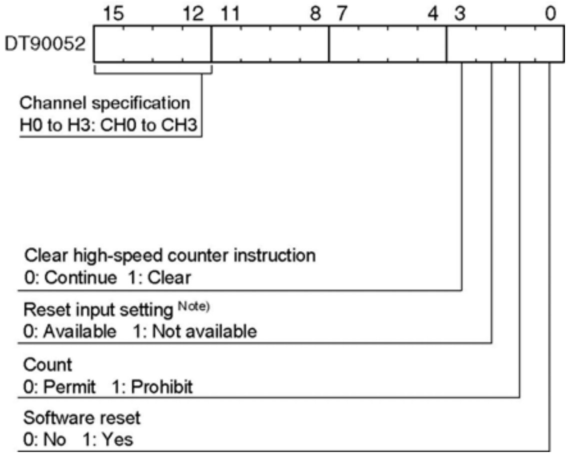


In the above program, the reset is performed in step (1) and 0 is entered just after that in step (2). The count is now ready for operation. If it is only reset, counting will not be performed.

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

```
  X7
─┤├─(DF )─[F1 DMV, K3000, DT90044  ]
```

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

Example 2: Reading the elapsed value

```
  X7
─┤├─(DF )─[F1 DMV, DT90044, DT100  ]
```

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

Target value match ON instruction (F166)

Example 1:

```
  XA
─┤├─(DF )─[F166 HC1S, K0, K10000, Y7]
```

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

Example 2:

```
  XB
─┤├─(DF )─[F166 HC1S, K2, K20000, Y6]
```

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

Target value match OFF instruction (F167)

Example 1:

```
  XC
─┤├─(DF )─[F167 HC1R, K1, K30000, Y4]
```

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

Example 2:

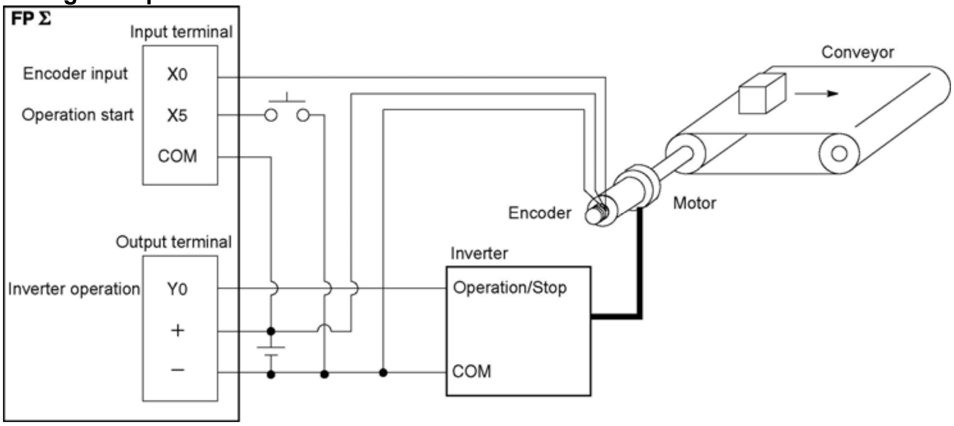
```
  XD
─┤├─(DF )─[F167 HC1R, K3, K40000, Y5]
```

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

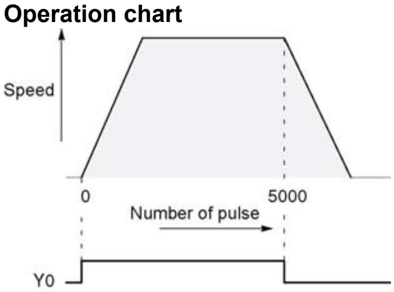
6.3.6 Sample program

Positioning operations with a single speed inverter

Wiring example



Operation chart

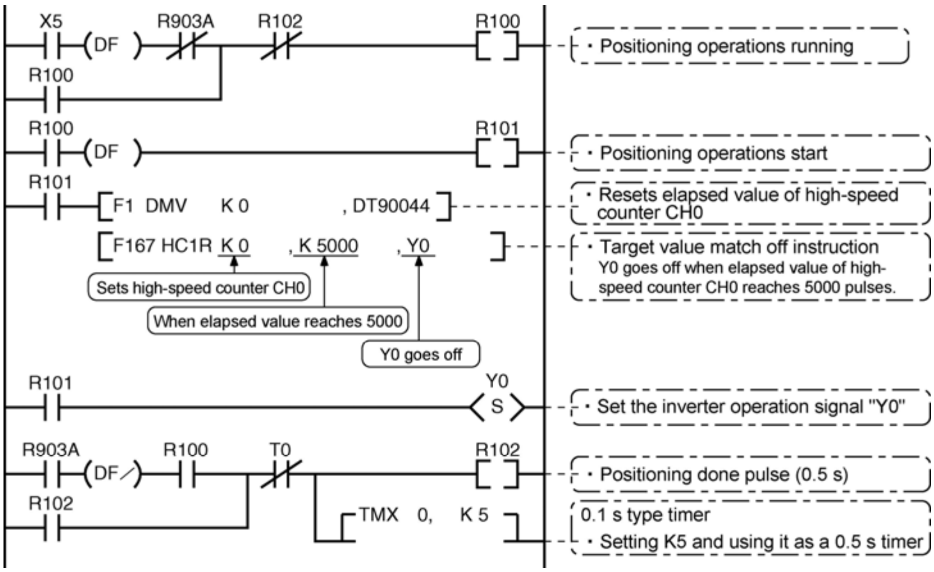


I/O allocation

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

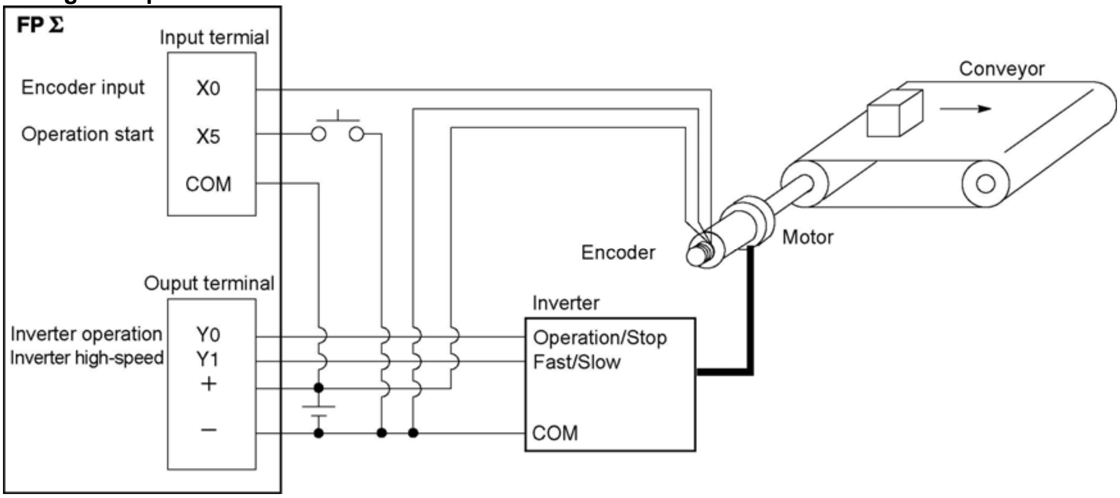
Program

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.

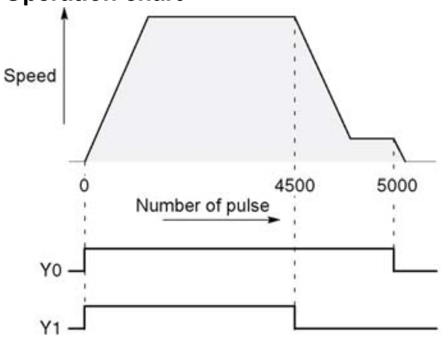


Positioning operations with a double speed inverter

Wiring example



Operation chart

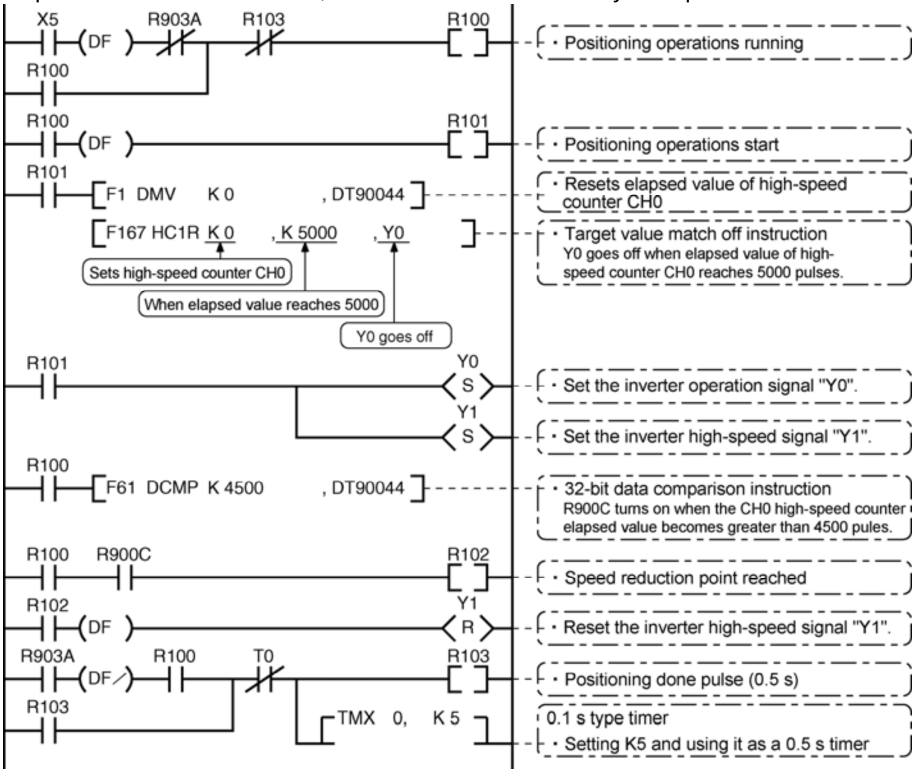


I/O allocation

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 instru-ction	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:

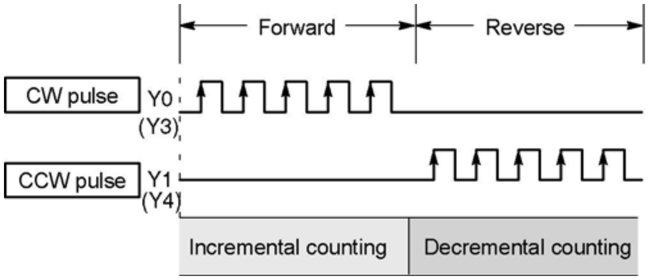
- The thermister input type for various units is included.
- The pulse output function can be used with the transistor output type only.

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”.

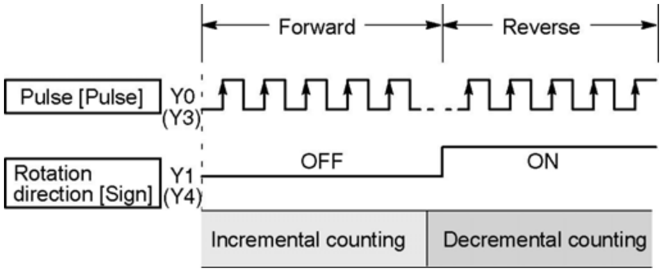
6.4.2 Types of Pulse Output Method and Operation Modes

Clockwise/counter-clockwise output method



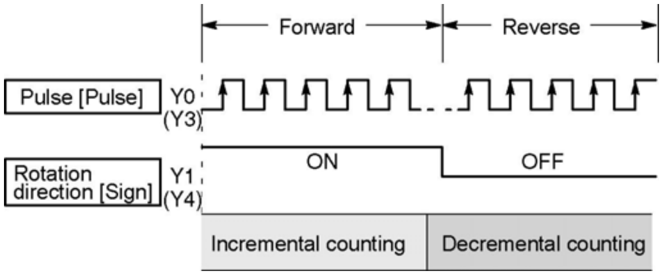
Control is carried out using two pulses: a forward rotation pulse and a reverse rotation pulse.

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

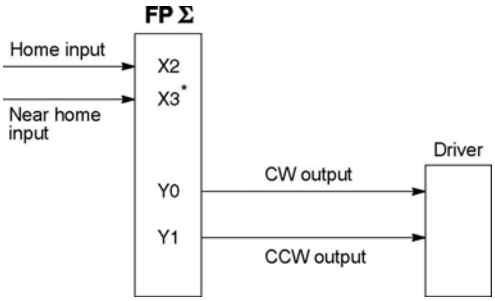
- Pulses are output from the specified channel while the trigger for F172 (PLSH) instruction is in the ON state. Also, the pulse output can be stopped when the specified target value is matched.
- The direction output and output frequency are specified by F172 (PLSH) instruction.

6.4.3 I/O Allocation

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

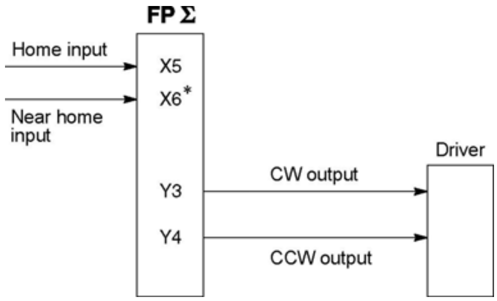
- Two output contacts are used as a pulse output for “CW, CCW”.
- The I/O allocation of pulse output terminal and home input is determined by the channel used.
- Set the control code for F171 (SPDH) instruction to “CW/CCW”.

<When using CH0>



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

<When using CH2>

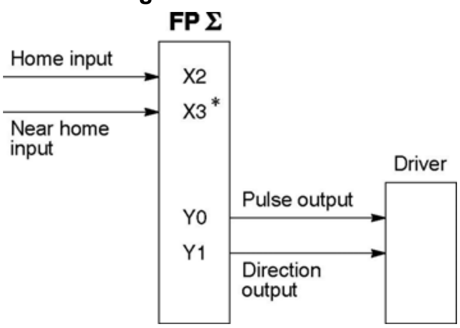


* X6 or any other input can be specified for the near home input.

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

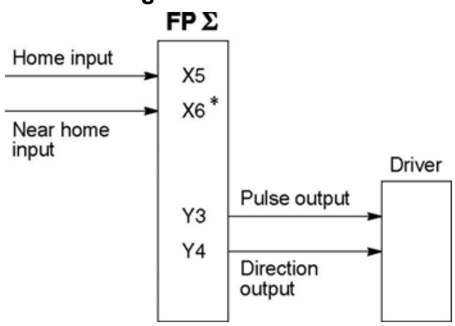
- One output point is used as a pulse output and the other output is used as a direction output.
- The I/O allocation of pulse output terminal, direction output terminal, and home input is determined by the channel used.
- Near home input is substituted by allocating the desired contact and turning on 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>

6.4.4 Pulse output control instructions (F0) (F1)

Pulse output control instruction (F0)

- This instruction is used for resetting the built-in high-speed counter, stopping the pulse output, and setting and resetting the near home input.
- Specify this F0 (MV) instruction together with special data register DT90052.
- Once this instruction is executed, the settings will remain until this instruction is executed again.

Example 1:
Enable the near home input during home return operations and begin deceleration.
In case of CH0

```
  X3
--| |--(DF )--[ F0 MV, H 10 , DT90052]   ①

              [ F0 MV, H 0  , DT90052]   ②
```

In case of CH2

```
  X4
--| |--(DF )--[ F0 MV, H2010, DT90052 ]  ①

              [ F0 MV, H2000, DT90052 ]  ②
```

In these programs, the near home input is enabled in step (1) and 0 is entered just after that in step (2) to perform the preset operations.

Example 2:
Performing a forced stop of the pulse output.
In case of CH0

```
  X7
--| |--(DF )--[F0 MV, H 8  , DT90052]

              [F0 MV, H 0  , DT90052]
```

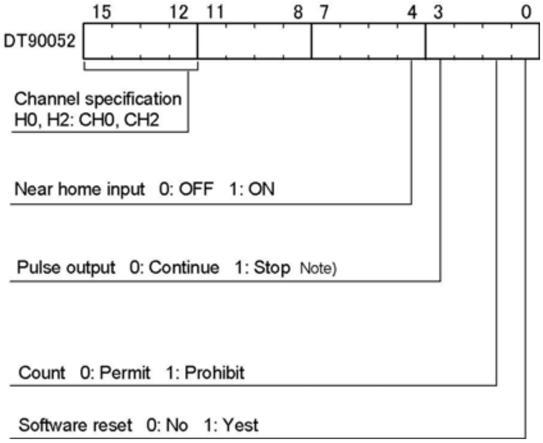
In case of CH2

```
  X8
--| |--(DF )--[F0 MV,H2008, DT90052]

              [F0 MV,H2000, DT90052]
```

The output counting value of the elapsed value area may be different from the input counting value of the motor side if the forced stop is executed by these programs.

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.

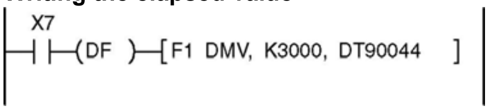
Reference: <6.2.1 Table of specifications> for information on the special data register.

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.

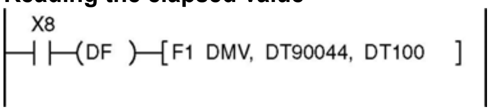
Example 1:

Writing the elapsed value



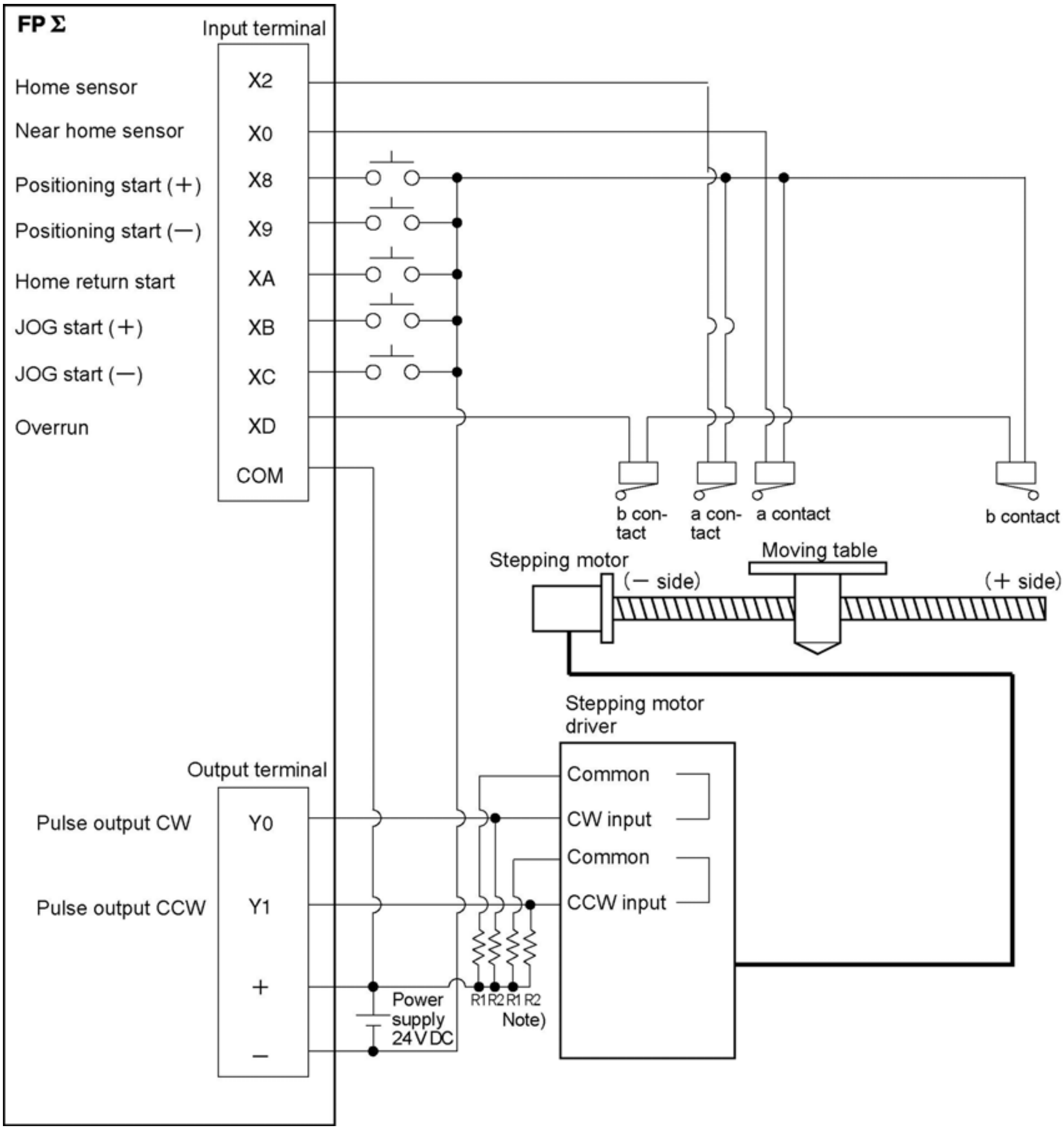
Set the initial value of K3000 in the high-speed counter.

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 resister of 2 kΩ (1/2 W) to R1, and connect a resistor of 2 kΩ (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     ]
```

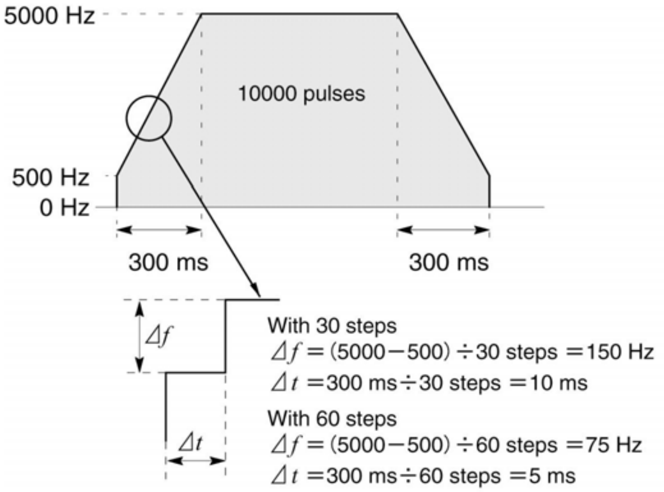
Pulses are generated from output Y0 at an initial speed of 500 Hz, a maximum speed of 5000 Hz, an acceleration/deceleration time of 300 ms, and a movement amount of 10000 pulses.

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 [ms] $\geqq$ (No. of steps × 1000)/Initial speed $f0$ [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) : Aceleration/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

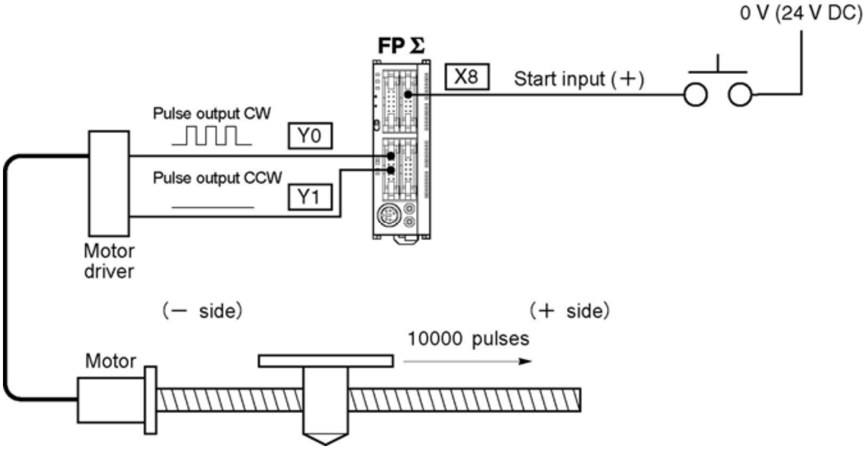
(*5) : When the time is not specified in 30 ms units nor 60 ms units, it will be automatically corrected to the multiple value (larger value) of 30 ms or 60 ms.

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

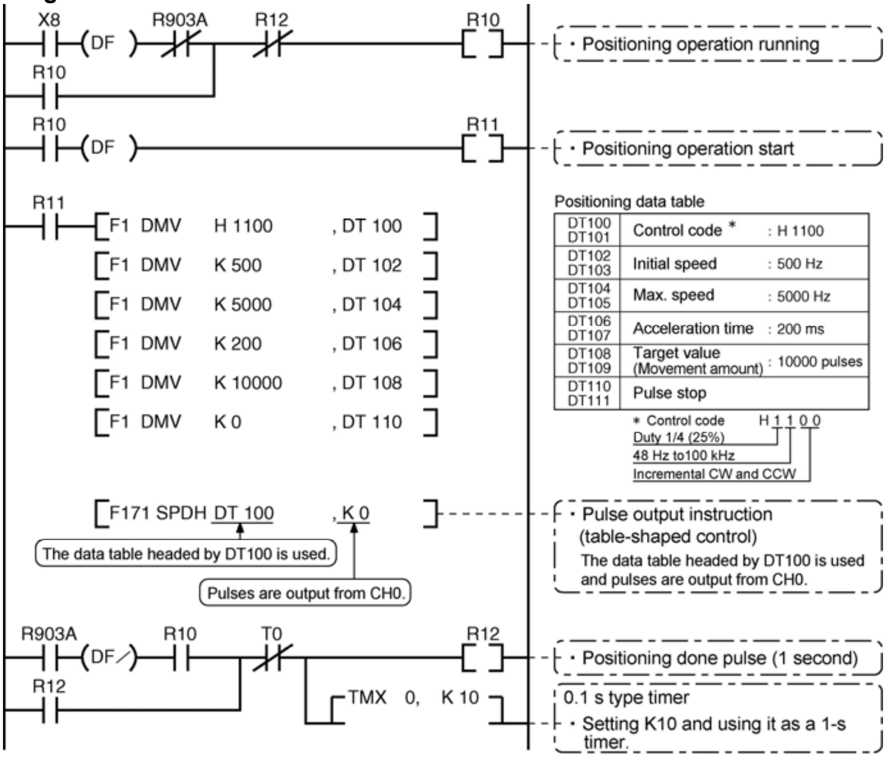
Sample program

Incremental Position Control Operation: Plus Direction

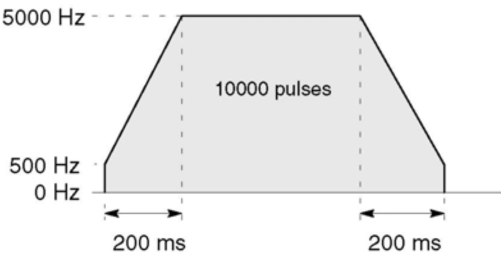
When X8 turns on, the pulse is output from CW output Y0 of the specified channel CH0.



Program

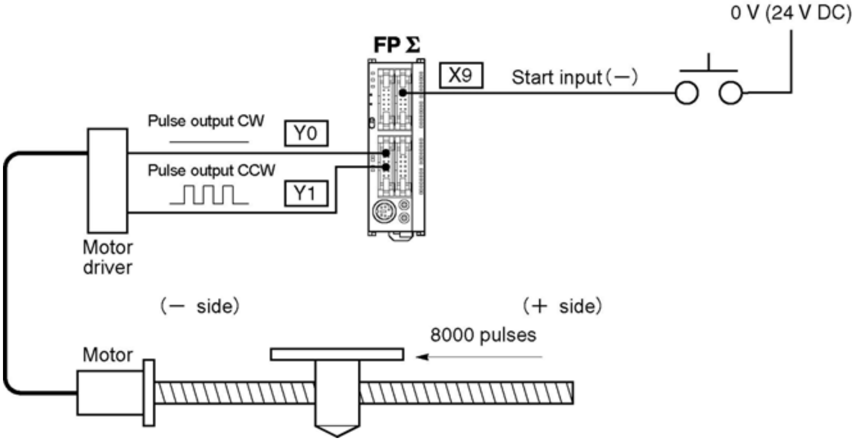


Pulse output diagram

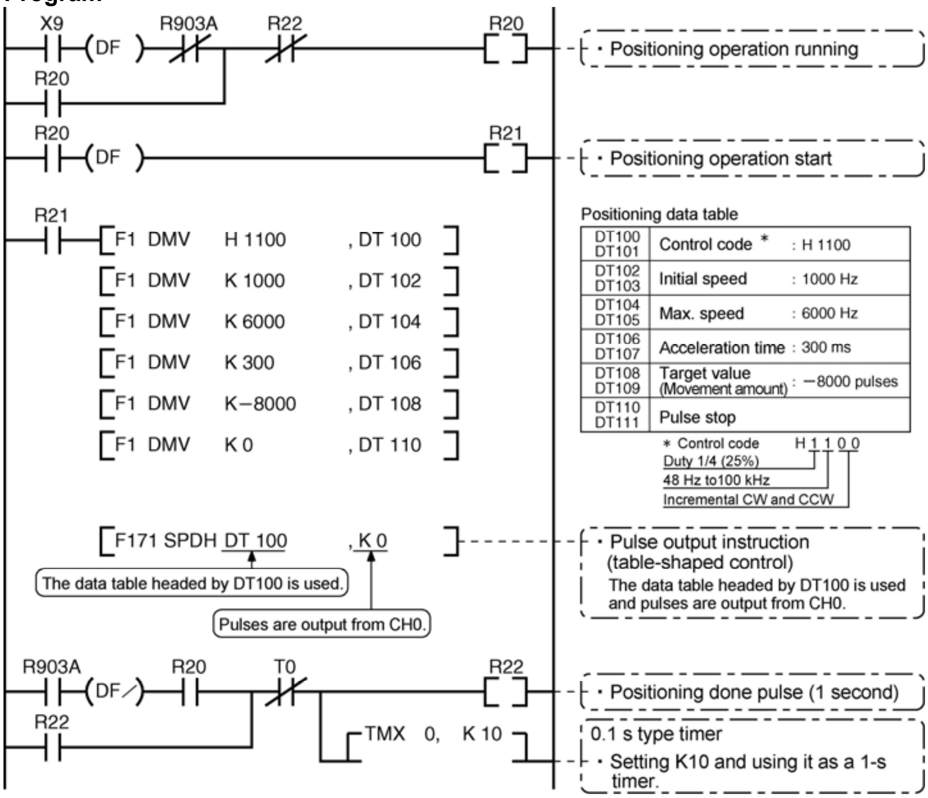


Incremental Position Control Operation: Minus Direction

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



Program

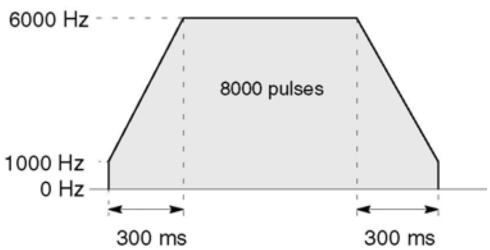


Positioning data table

DT100 DT101	Control code *	: H 1100
DT102 DT103	Initial speed	: 1000 Hz
DT104 DT105	Max. speed	: 6000 Hz
DT106 DT107	Acceleration time	: 300 ms
DT108 DT109	Target value (Movement amount)	: −8000 pulses
DT110 DT111	Pulse stop	

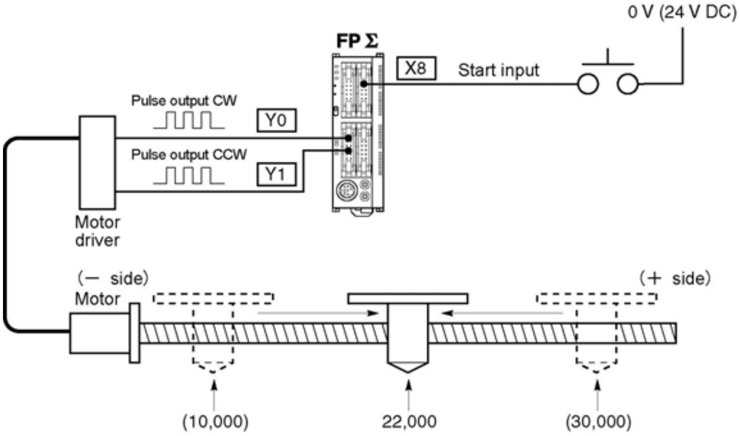
* Control code H 1 1 0 0
Duty 1/4 (25%)
48 Hz to100 kHz
Incremental CW and CCW

Pulse output diagram



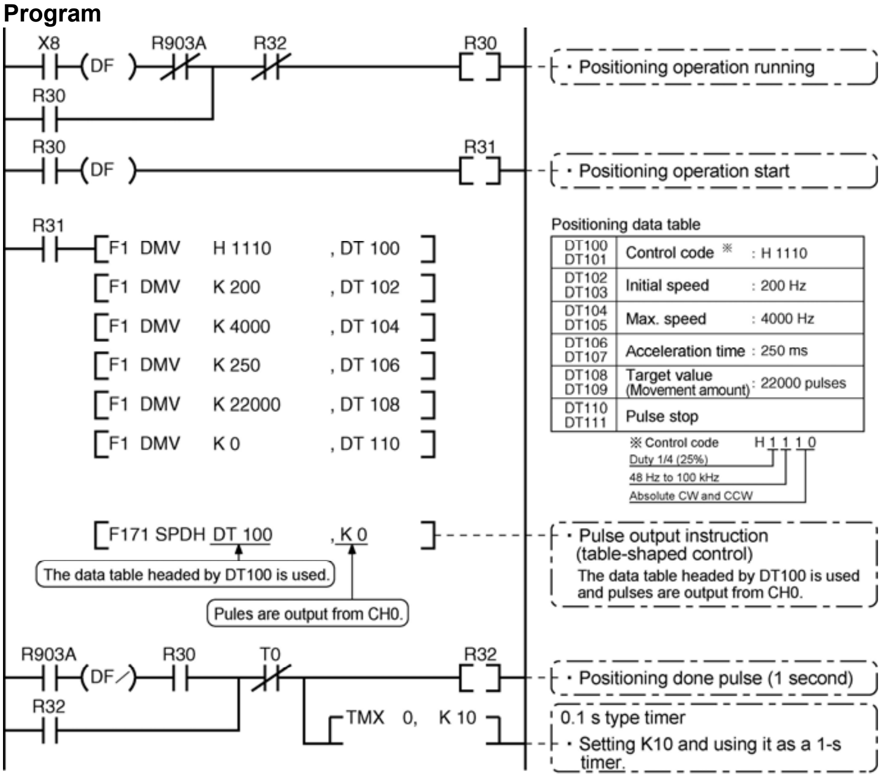
Absolute position control operation

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.



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

Program

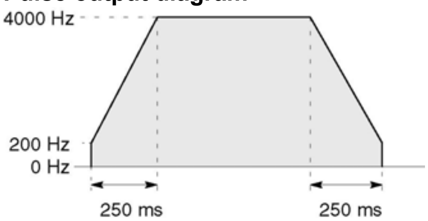


Positioning data table

DT100 DT101	Control code ※	: H 1110
DT102 DT103	Initial speed	: 200 Hz
DT104 DT105	Max. speed	: 4000 Hz
DT106 DT107	Acceleration time	: 250 ms
DT108 DT109	Target value (Movement amount)	: 22000 pulses
DT110 DT111	Pulse stop	

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

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
-| |-(DF )-[F1  DMV, H1125,  DT200  ]
           [F1  DMV, K200,   DT202  ]
           [F1  DMV, K2000,  DT204  ]
           [F1  DMV, K150,   DT206  ]
           [F1  DMV, K10,    DT208  ]
           [F171 SPDH, DT200, K0    ]
```

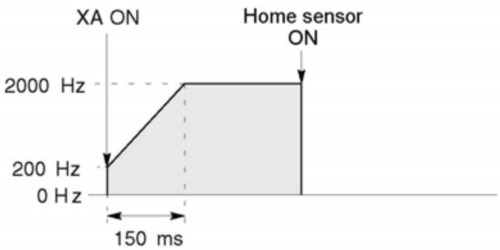
Pulses are output from Y1 and a return to the home position is carried out at an initial speed of 200 Hz, a maximum speed of 2000 Hz, and an acceleration/deceleration time of 150 ms.

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

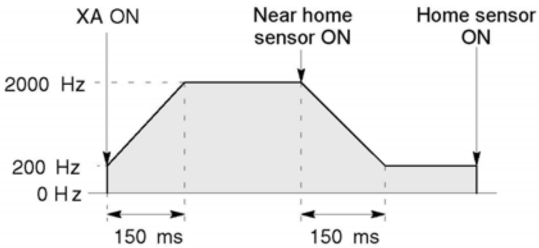
●Positioning data table

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 clear signal output time *4	: 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
$t\ [ms] \geqq (\text{No. of steps} \times 1000) / \text{Initial speed } f0\ [Hz]$

(*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%).

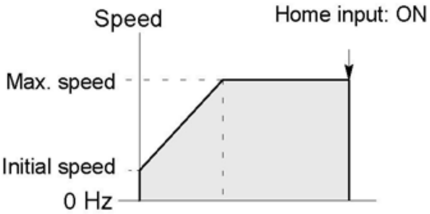
Home return operation modes

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

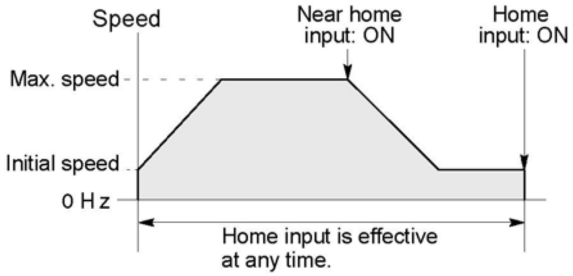
Type I home return

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

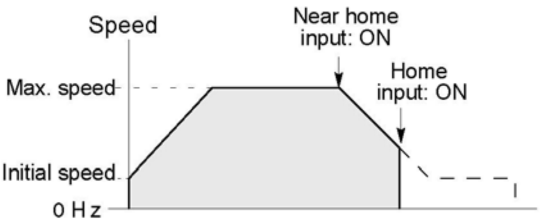
・Without near home input



・With near home input

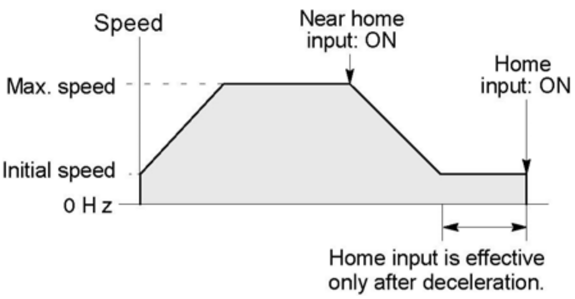


・Home input ON during deceleration



Type II home return

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



Reference:

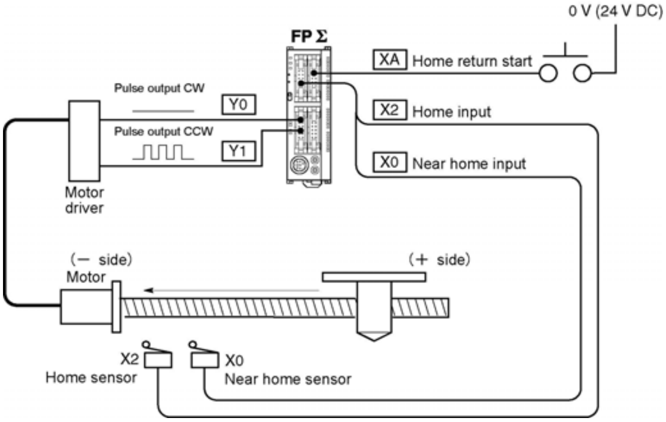
The Pulse output control instruction (F0) is used for the near home input.

<6.4.4 Pulse output control instructions (F0) (F1)>.

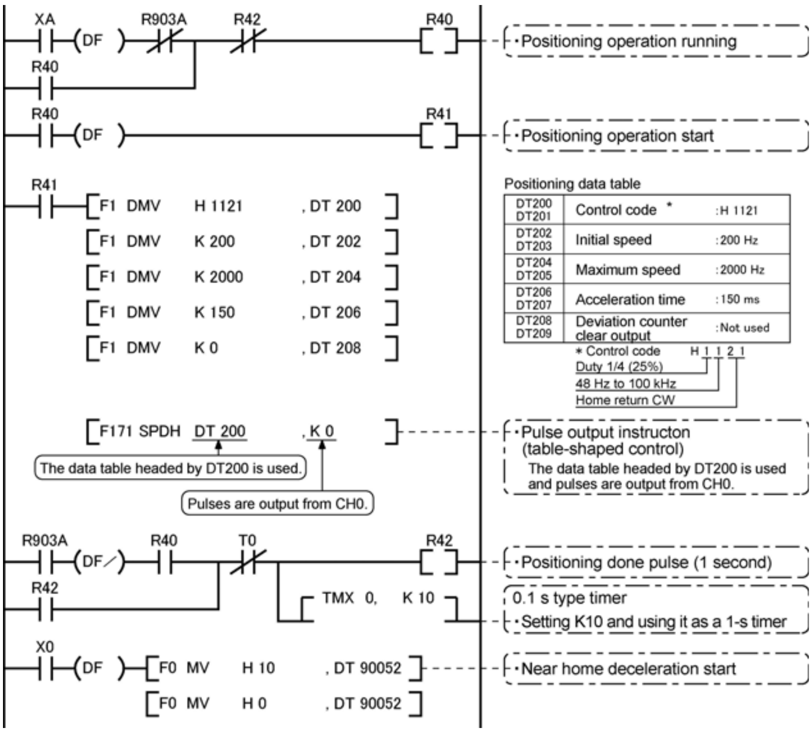
Sample program

Home return operation using CH0: Minus direction

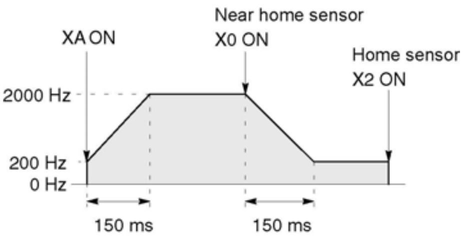
When XA turns on, a pulse is output from CCW output Y1 of the specified channel CH0 and the return to home begins. When X0 turns on, deceleration begins, and when X2 turns on, home return is completed. After the return to home is completed, the elapsed value areas DT90044 and DT90045 are cleared to 0.



Program



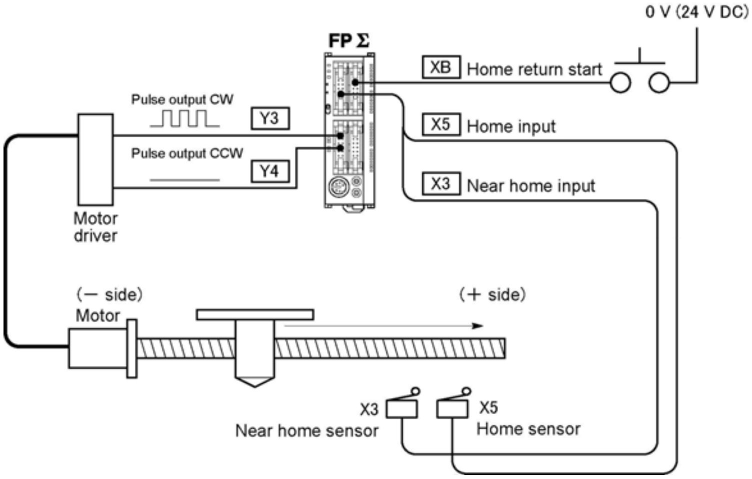
Pulse output diagram



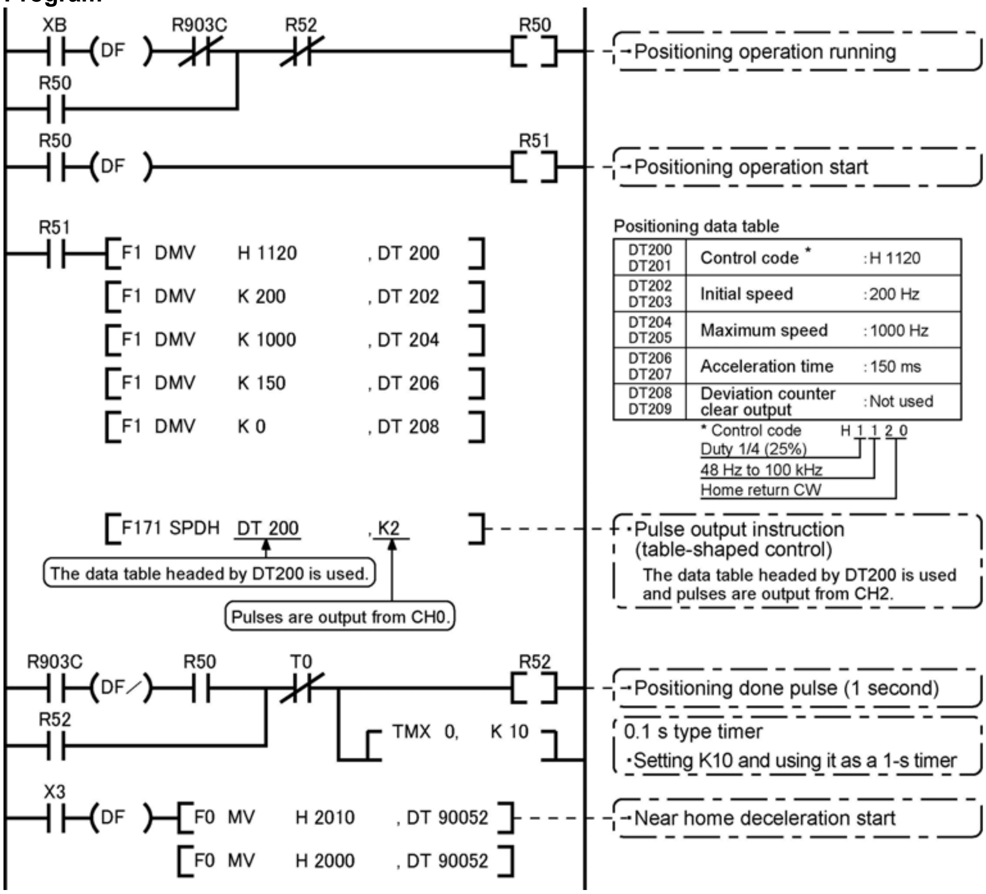
Sample program

Home return operation using CH2: Plus direction

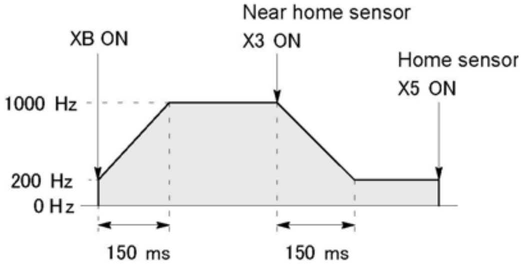
When XB turns on, a pulse is output from CW output Y3 of the specified channel CH2 and the return to home begins. When X3 turns on, deceleration begins, and when X5 turns on, home return is completed. After the return to home is completed, the elapsed value areas DT90200 and DT90201 are cleared to 0.



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.

```
 XB
─┤ ├───[F1 DMV , H1110, DT300     ]
       [F1 DMV , K300,  DT302     ]
       [F172 PLSH, DT300, K0      ]
```

While XB is in the on state, a pulse of 300 Hz is output from Y0.
When the program runs, the data table and the pulse output diagram will be as shown below.

●Data table

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

●Pulse output diagram

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

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%).

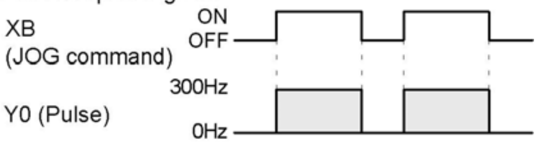
Key Point:
The FPΣ supports two operation modes for JOG operation, one in which no target value is specified, and one in which feed stops when the target value is reached.

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

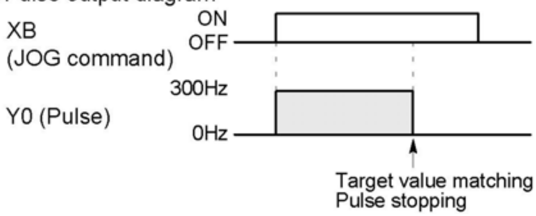


Output stops when target value is reached (FPΣ Ver 1.4 or later)
With FPΣ Ver 1.4 or later, a target value at which pulse output stops can be specified for jogging operation. As shown below, this mode is selected in the control code, and the target value (an absolute value) is specified in the data table.

●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

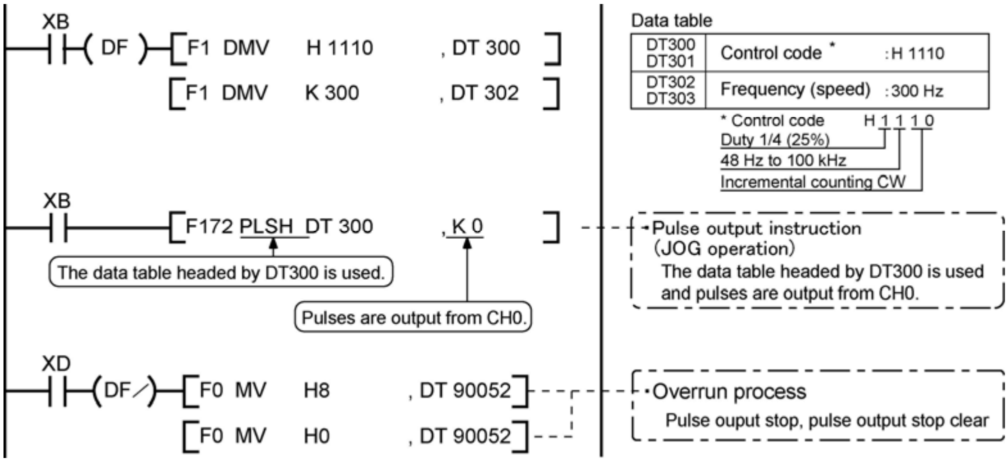


Sample program

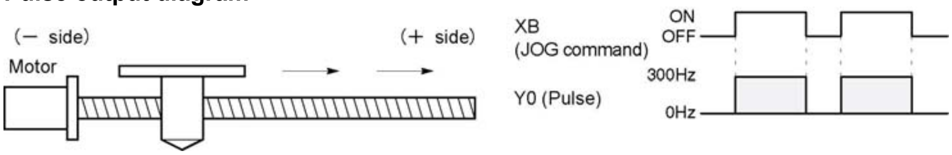
JOG operation : Plus direction

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

Program



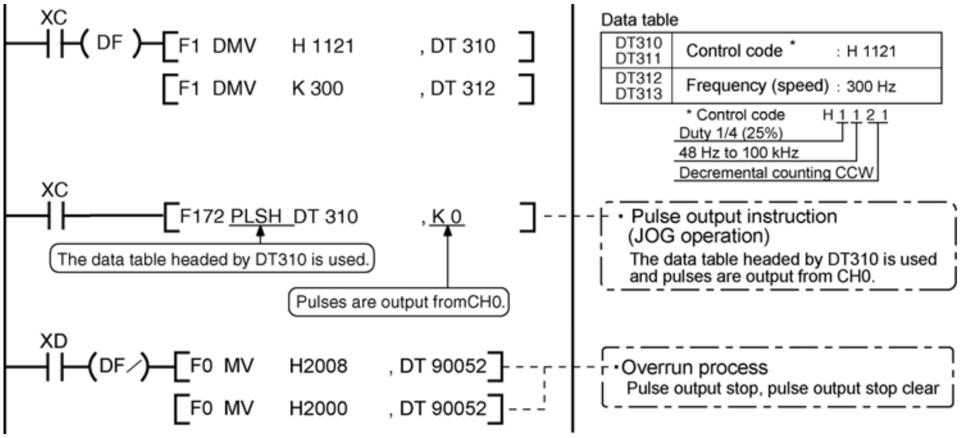
Pulse output diagram



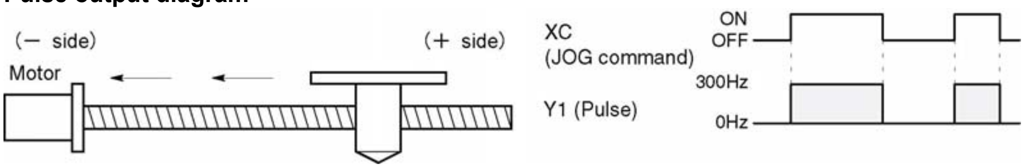
JOG operation : Minus direction

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.

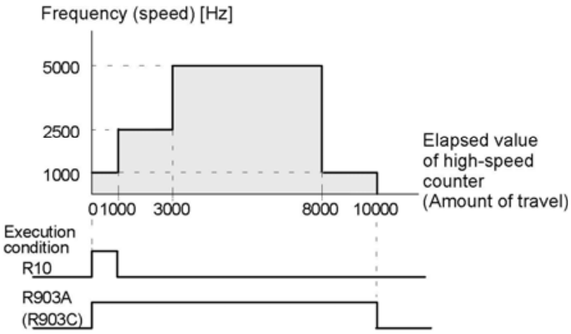
```
 R0
─┤ ├─[F1 DMV , H 1200, DT400]      Control code "H1200"
     [F1 DMV , K 1000, DT402]      Frequency 1: 1000 Hz
     [F1 DMV , K 1000, DT404]      Targe value 1: 1000 pulses
     [F1 DMV , K 2500, DT406]      Frequency 2: 2500 Hz
     [F1 DMV , K 2000, DT408]      Target value 2: 2000 pulses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

When the execution condition R10 goes on, pulses are output from Y0 at a frequency of 1000 Hz, and positioning begins.
At the point when 1000 pulses have been counted, the frequency switches to 2500 Hz. Positioning is then carried out sequentially in accordance with the values of the data table, until it stops at the data table containing the pulse output stop value (K0).
When the program runs, the data table and pulse output diagram are as shown below.

● Positioning data table

DT400 DT401	Control code *1	: H 1200
DT402 DT403	Frequency 1 *2	: 1000 Hz
DT404 DT405	Target value 1 *3	: 1000 pulses
DT406 DT407	Frequency 2	: 2500 Hz
DT408 DT409	Target value 2	: 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>

H □□□□□□□□

■Upper word
0: Fixed

■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

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

■Output method

0:	CW	(Incremental counting)
1:	CCW	(Decremental counting)
2:	Pulse and direction (forward off)	(Incremental counting)
3:	Pulse and direction (reverse on)	(Decremental counting)
4:	Pulse and direction (forward on)	(Incrementa counting)
5:	Pulse and direction (reverse off)	(Decremental counting)

(*2) : Freqency (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

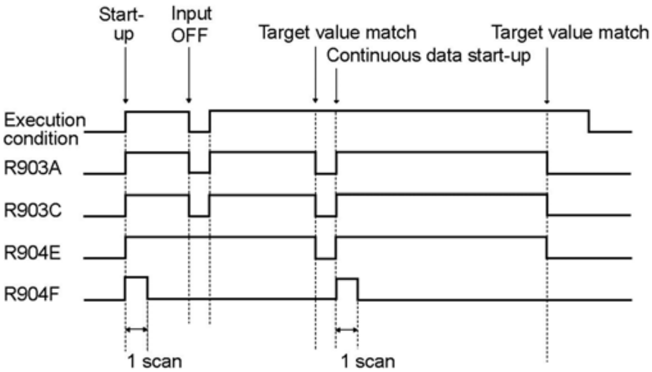
Key Point:
Can be used with C32T2, C28P2, C32T2H and C28P2H only.

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 hen 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

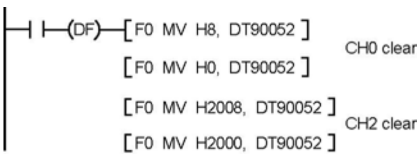


Action when the execution conditions turn OFF

- 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.

$$\boxed{Fv\ (Hz) \leqq r\ (pulse) \times 10/t\ (ms)}$$

Fv : Composite speed (Hz)
R : Radius (pulse)
t : Scan time (ms)
Example: Radius r: 1000 (pulse), Scan time 5ms

$$Fv \leqq 1000\ (p) \times 10/5\ (ms) = 2000\ Hz$$

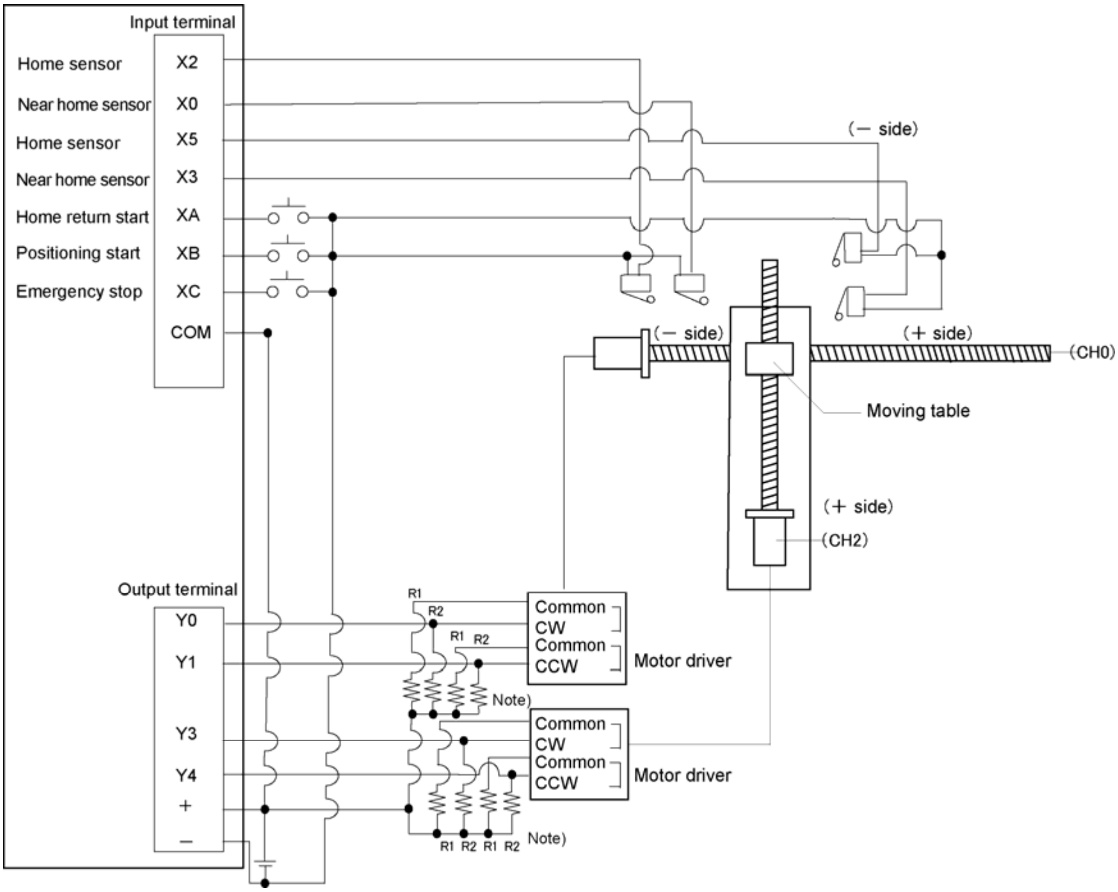
Note:

- 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 2kΩ(1/2 W) to R1, and connect a resistor of 2kΩ(1/2 W) – 470Ω(2 W) to R2.

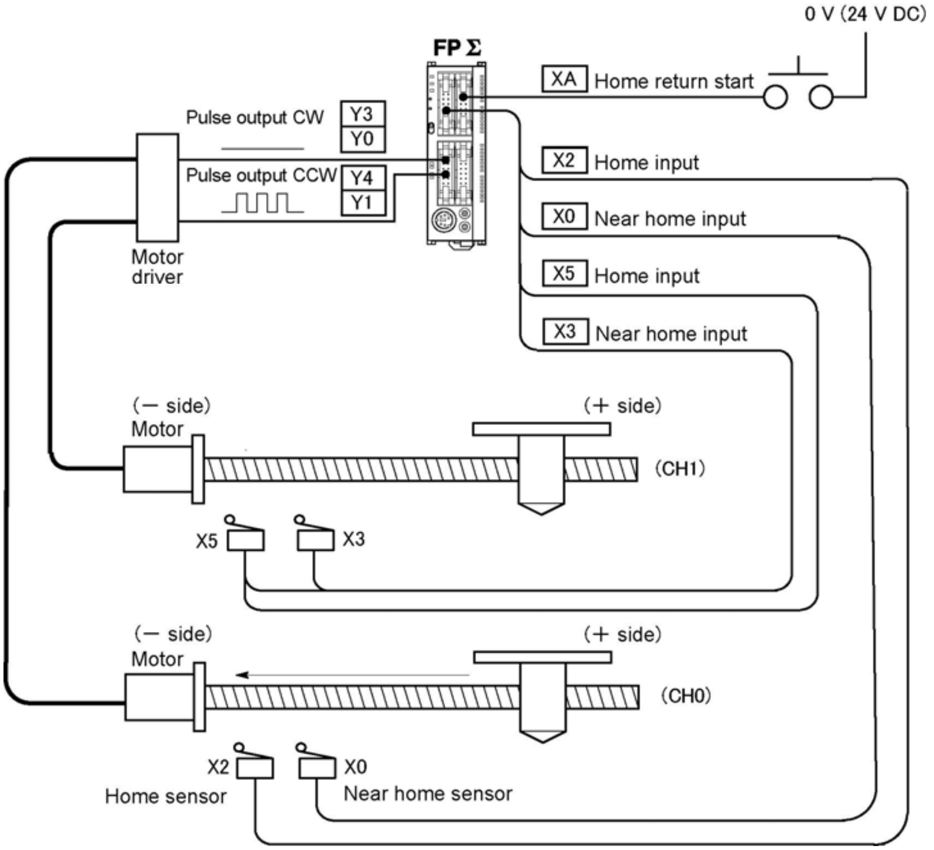
Home return operation (Minus direction)

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.

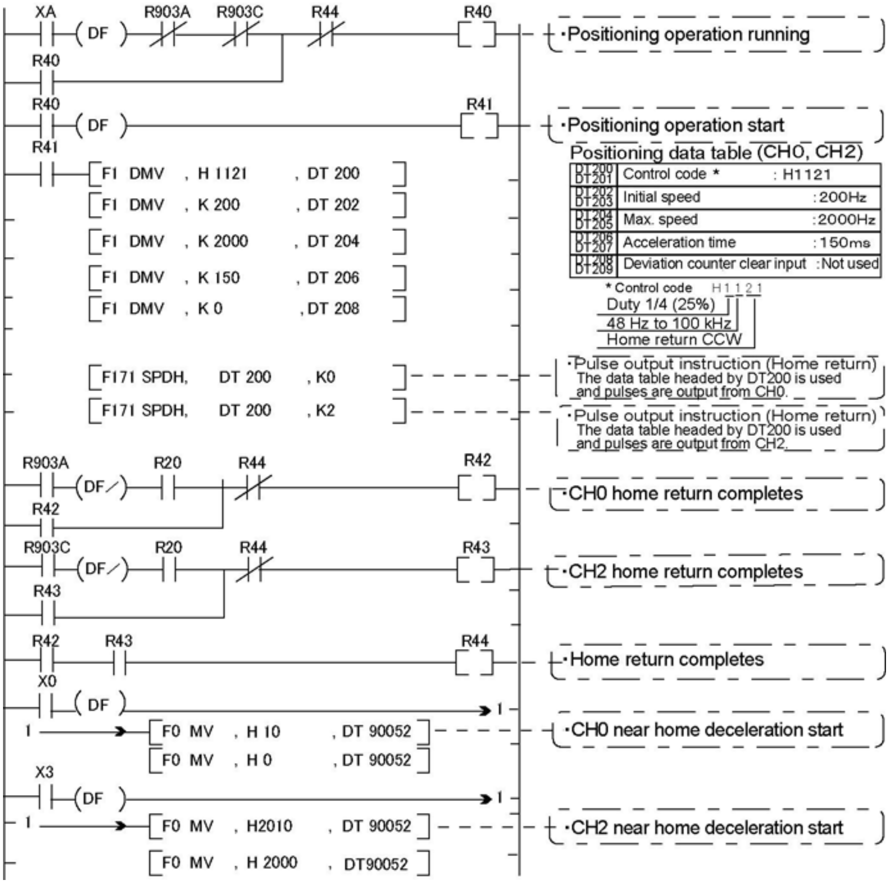
In CH0, when X3 turns on, deceleration begins, and when X2 turns on, home return is completed. After the return to home is completed, the elapsed value areas DT90044 and DT90045 are cleared to 0.

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.

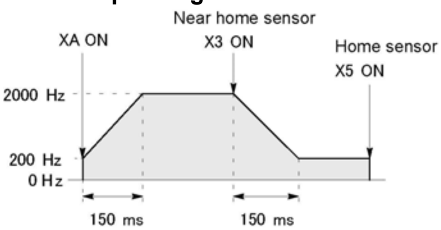


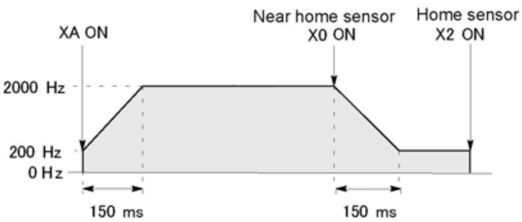
Program



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.

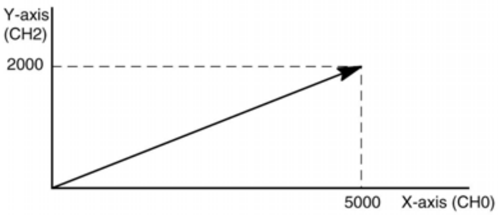
```
R11
-| |-(DF )-[F1 DMV, H1000, DT500  ]
          [F1 DMV, K500,  DT502  ]
          [F1 DMV, K5000, DT504  ]
          [F1 DMV, K300,  DT506  ]
          [F1 DMV, K5000, DT508  ]
          [F1 DMV, K2000, DT510  ]
          [F175 SPSH, DT500, K0  ]
```

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

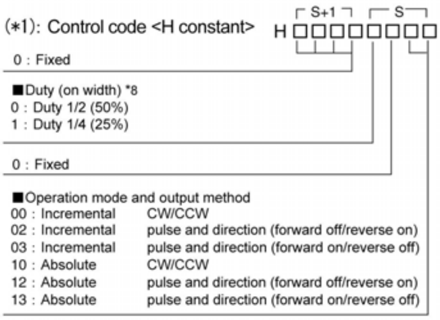
●Positioning data table

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)		*5	
DT516 DT517	Y-axis (CH2) component speed (Initial speed)		*5	
DT518 DT519	Y-axis (CH2) component speed (Max. speed)		*5	
DT520	X-axis (CH0) frequency range		*6	
DT521	Y-axis (CH2) frequency range		*6	
DT522	X-axis (CH0) number of acceleration/deceleration steps		*7	
DT523	Y-axis (CH2) number of acceleration/deceleration steps		*7	

●Positioning path



(*1): Control code <H constant>



(*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 no 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 become1.5 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,
a) In incremental mode, set the target value for the axis which will be not be operated.
b) 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
a) 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.
b) If 9800 Hz < maximum speed ≦ 100000 Hz,
If initial speed < 48 Hz, initial speed is corrected to 48 Hz, and range 0 is selected.
If 48 Hz ≦ initial speed < 191 Hz, range 1 is selected.
If initial speed ≧ 191 Hz, range 2 is selected.

(∗7): Number of acceleration/deceleration steps
The system automatically calculates the number of acceleration/ decelaration steps in the range 0 to 60 steps.
- If the oepration 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) × 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

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

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

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

Note) 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.

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

Δx : CH of which distance betwen the target value and the current value is short.
Δy : CH of which distance betwen 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 coditions 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 (θ 60°, Xs=5000, Ys=8660) using circula interpolation control, and when the pass position (θ -20°, Xp=9396, Yp=-3420) has been passed, pulse output stops at the target position (θ -30°, Xe=8660, Ye=-5000).
When the program runs, the data table and positioning path are as shown below.

●Positioning data table

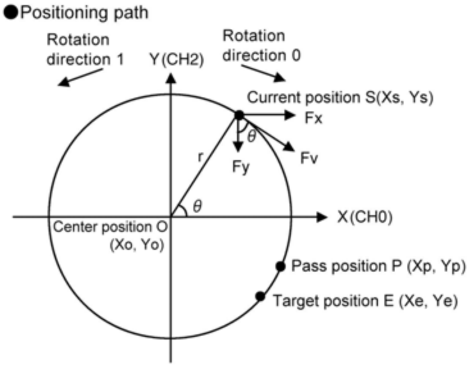
<Pass position setting method>

DT600 DT601	Control code	: H 10	*1	Setting area
DT602 DT603	Composite speed	: 500 Hz	*2	
DT604 DT605	Target value (X-axis CH0)	: 8660 pulses	*3	Designated with user program
DT606 DT607	Target value (Y-axis CH2)	: - 5000 pulses	*3	
DT608 DT609	Pass value (X-axis CH0)	: 9396 pulses	*3	
DT610 DT611	Pass value (Y-axis CH2)	: - 3420 pulses	*3	
DT612 DT613	Radius	: 10000 pulses		Operation result stoage 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	*3	
DT608 DT609	X-axis (CH0) center position	: 0 pulse	*3	
DT610 DT611	Y-axis (CH2) center position	: 0 pulse	*3	
DT612 DT613	Radius	: 10000 pulse		Operation result stoage 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)

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

(∗1): Control code <H constant> H□□□□□□□□ (S+1: upper four digits, S: lower four digits)

0 : Fixed

■Operation continuation mode (∗ 4)
0 : Stop
1 : Continue

■Rotation direction (∗ 5)
0 : From ch2, CW-axis to ch0, CW-axis
1 : From ch0, CW-axis to ch2, CW-axis

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

■Operation mode and output method

00 :	Incremental	CW/CCW
02 :	Incremental	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 (Frequency) <K constant>

100 Hz to 20 kHz [K100 to K20000]

Use the following formula to calculate composite speed.

$$Fv\,[\mathrm{Hz}] \leqq \frac{\text{Radius "r" [Pulse]} \times 10}{\text{Scan time [ms]}}$$

(∗3): Target position, pass position and center position

K-8388608 to K8388607

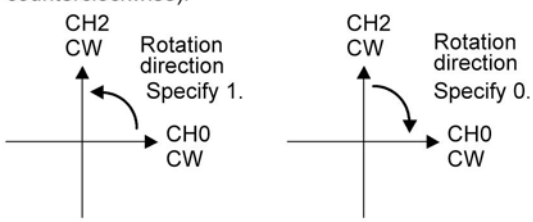
(∗4): Operation continuation mode

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

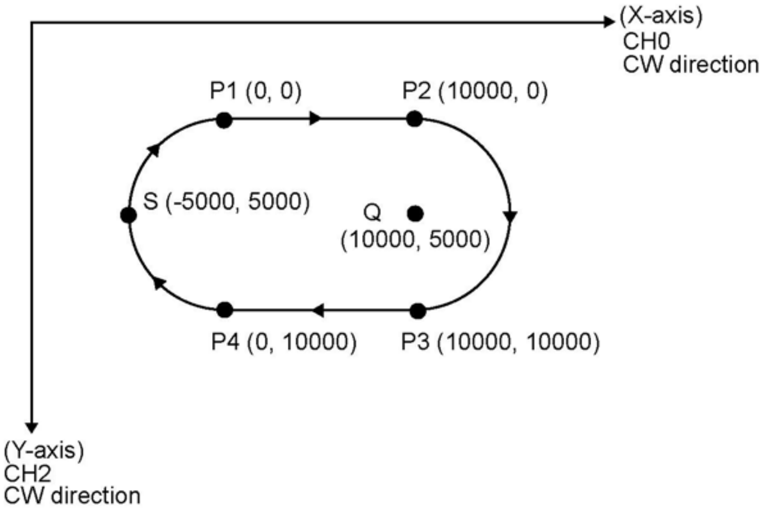
Pass position setting: Specify the pass and target positions for the current position.

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 postion 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/de-celeration 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-coodinate of the pass position when moving from P4 to P1.
	DT50 to DT51	Pass position (Y-axis)	Specify the Y-coodinate 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-coodinate of the center position when executing the circular interpolation of P2 to P3.
	DT70 to DT71	Center position (Y-axis)	Specify the Y-coodinate 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
─┤├──[ F1 DMV , H 1010        , DT 0                     ]  Absolute
Always ON       Control code    Data table
     [ F1 DMV , K 2000        , DT 2                     ]  Composite speed
                                Composite speed (initial)     setting (base)
     [ F1 DMV , DT 2          , DT 4                     ]  Composite speed setting
                Composite speed Composite speed (maximum)     (for linear)
     [ F1 DMV , K 0           , DT 6                     ]  Acceleration/deceleration time
                                Acceleration/deceleration time
R9010
─┤├──[ F1 DMV , H 1010        , DT 40                    ]  Pass position setting
Always ON       Control code    Control code
     [ F1 DMV , DT 2          , DT 42                    ]  Composite speed
                Composite speed Composite speed
     [ F1 DMV , K 0           , DT 44                    ]
                P1 (X axis)     Target position ch0           Target position setting
     [ F1 DMV , K 0           , DT 46                    ]
                P1 (Y axis)     Target position ch2
     [ F1 DMV , K -5000       , DT 48                    ]
                S (X axis)      Pass position ch0             Pass position setting
     [ F1 DMV , K 5000        , DT 50                    ]
                S (Y axis)      Pass position ch2
R9010
─┤├──[ F1 DMV , H 1110        , DT 60                    ]  Center setting
Always ON       Control code    Control code
     [ F1 DMV , DT 2          , DT 62                    ]  Composite speed
                Composite speed Composite speed
     [ F1 DMV , K 10000       , DT 64                    ]
                P3 (X axis)     Target speed ch0              Target position setting
     [ F1 DMV , K 10000       , DT 66                    ]
                P3 (Y axis)     Target speed ch2
     [ F1 DMV , K 10000       , DT 68                    ]
                Q (X axis)      Cetner position ch0           Center position setting
     [ F1 DMV , K 5000        , DT 70                    ]
                Q (Y axis)      Cetner position ch2
```

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

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

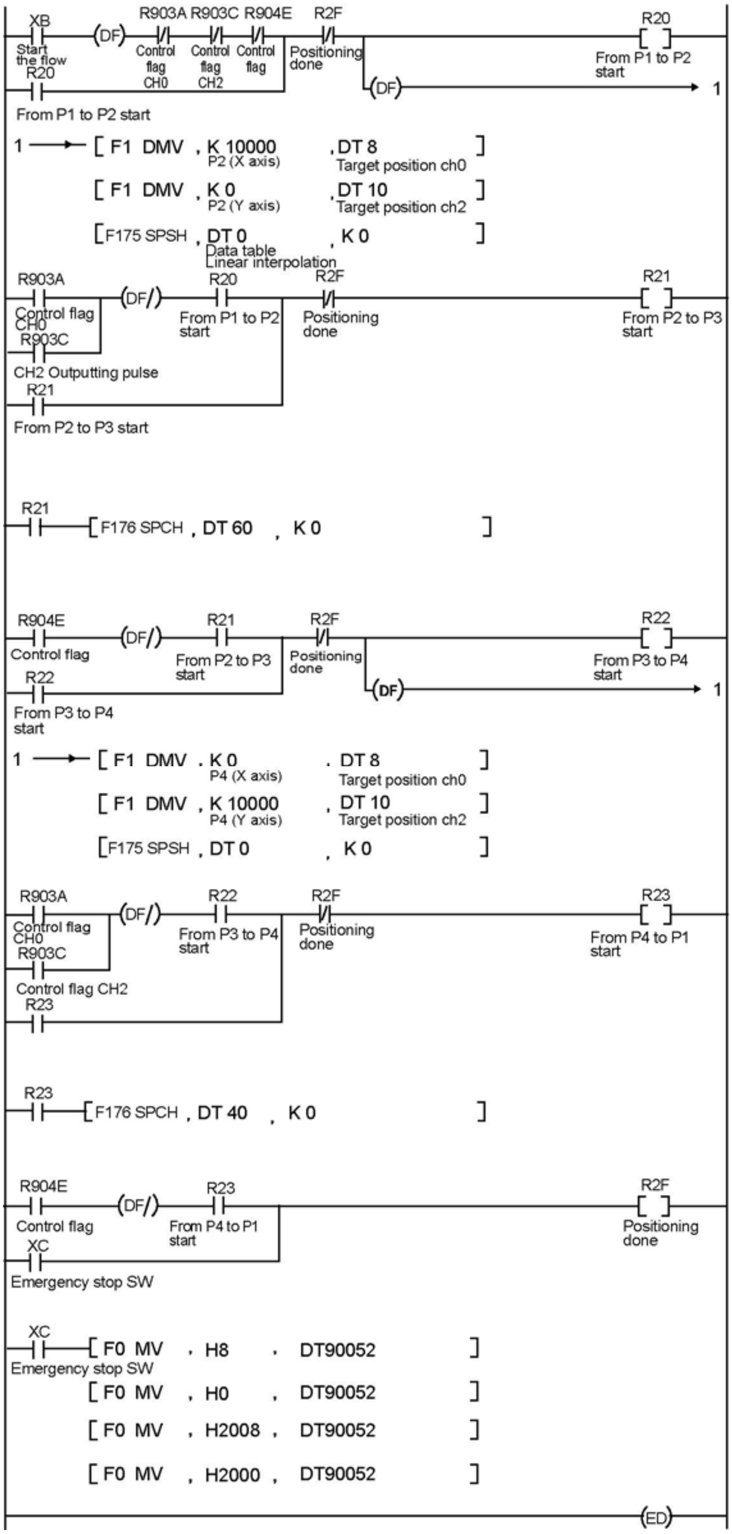
Positioning data table (From P4 to P1)

- 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)



Positioning (from P1 to P2)

- In case of R903A, R903C and R904E are OFF, if XB turns ON, positioning is started.

Positioning (from P2 to P3)

- When R903A and R903C turns OFF, circular interpolation positioning is started.

Positioning (from P3 to P4)

- When R904E turns OFF, positioning is started.

Positioning (from P4 to P1)

- When R903A and R903C turns OFF, circular interpolation positioning is started.

Positioning done

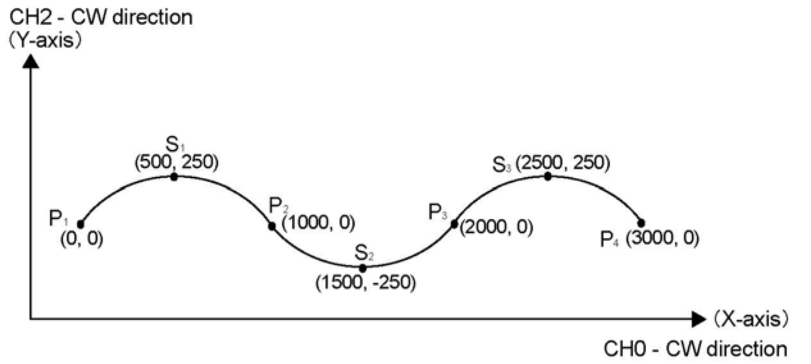
- R2F is controlled by R904E which are able to confirm whether the positioning was done or not.

Forced stop program

- If XC turns on, the output of the pulse is stopped.

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

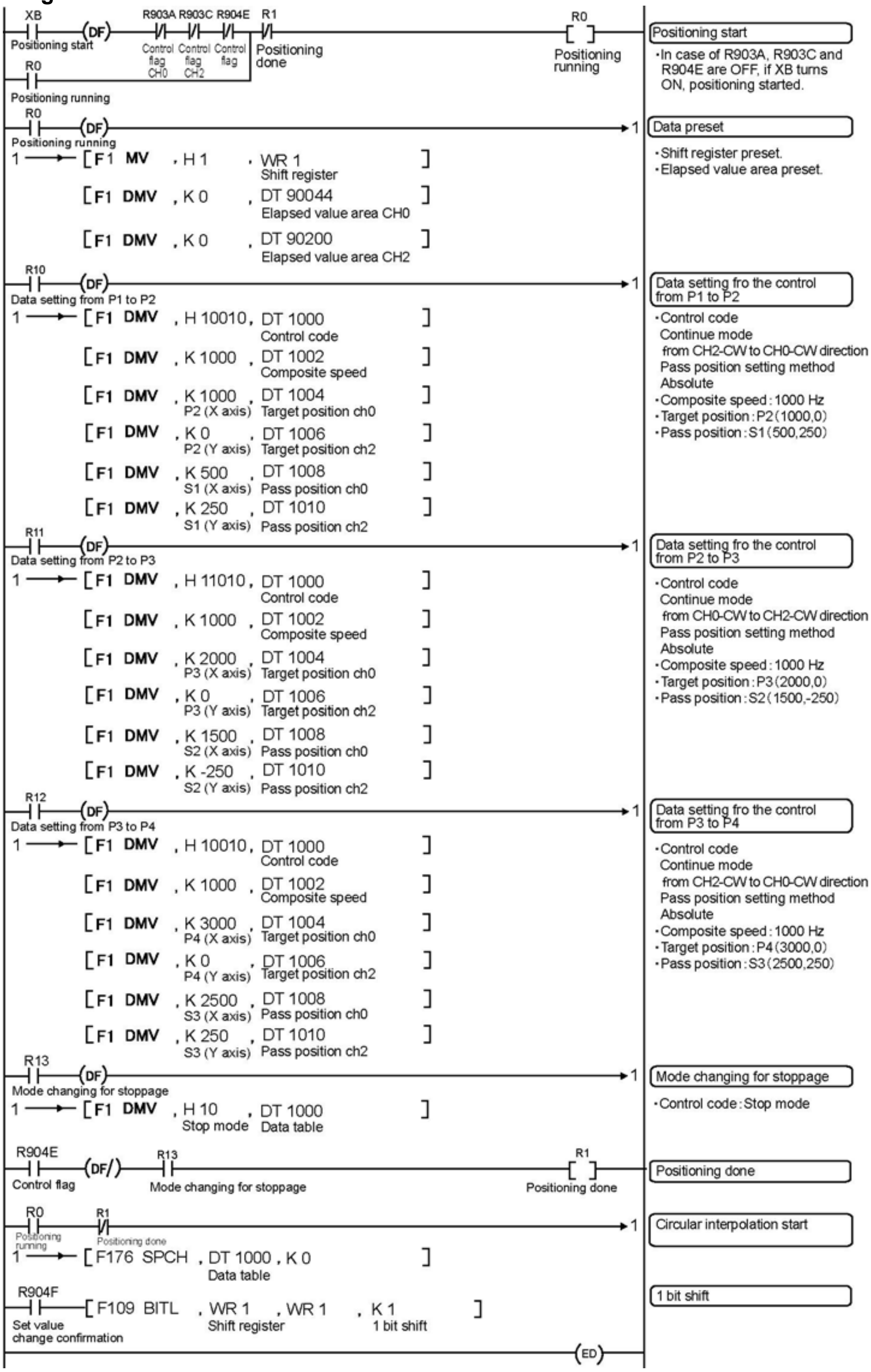
I/O No.	Description	I/O No.	Description
XB	Positioning start	**R903A**	Control flag (CH0)
R0	Positioning running	**R903C**	Control flag (CH2)
R1	Positioning done	**R904E**	Circular interpolation control flag
R10	Data setting for the control from P1 to P2	**R904F**	Set value change confirmation flag
R11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



XB
DF
Positioning start
R903A R903C R904E R1
Control flag CH0
Control flag CH2
Control flag
Positioning done
R0
Positioning running
Positioning start
・In case of R903A, R903C and R904E are OFF, if XB turns ON, positioning started.
R0
Positioning running
Data preset
[F1 MV , H 1 , WR 1] Shift register
[F1 DMV , K 0 , DT 90044] Elapsed value area CH0
[F1 DMV , K 0 , DT 90200] Elapsed value area CH2
・Shift register preset.
・Elapsed value area preset.
R10
Data setting from P1 to P2
Data setting fro the control from P1 to P2
[F1 DMV , H 10010 , DT 1000] Control code
[F1 DMV , K 1000 , DT 1002] Composite speed
[F1 DMV , K 1000 , DT 1004] P2 (X axis) Target position ch0
[F1 DMV , K 0 , DT 1006] P2 (Y axis) Target position ch2
[F1 DMV , K 500 , DT 1008] S1 (X axis) Pass position ch0
[F1 DMV , K 250 , DT 1010] S1 (Y axis) Pass position ch2
・Control code
Continue mode
from CH2-CW to CH0-CW direction
Pass position setting method
Absolute
・Composite speed : 1000 Hz
・Target position : P2 (1000,0)
・Pass position : S1 (500,250)
R11
Data setting from P2 to P3
Data setting fro the control from P2 to P3
[F1 DMV , H 11010 , DT 1000] Control code
[F1 DMV , K 1000 , DT 1002] Composite speed
[F1 DMV , K 2000 , DT 1004] P3 (X axis) Target position ch0
[F1 DMV , K 0 , DT 1006] P3 (Y axis) Target position ch2
[F1 DMV , K 1500 , DT 1008] S2 (X axis) Pass position ch0
[F1 DMV , K -250 , DT 1010] S2 (Y axis) Pass position ch2
・Control code
Continue mode
from CH0-CW to CH2-CW direction
Pass position setting method
Absolute
・Composite speed : 1000 Hz
・Target position : P3 (2000,0)
・Pass position : S2 (1500,-250)
R12
Data setting from P3 to P4
Data setting fro the control from P3 to P4
[F1 DMV , H 10010 , DT 1000] Control code
[F1 DMV , K 1000 , DT 1002] Composite speed
[F1 DMV , K 3000 , DT 1004] P4 (X axis) Target position ch0
[F1 DMV , K 0 , DT 1006] P4 (Y axis) Target position ch2
[F1 DMV , K 2500 , DT 1008] S3 (X axis) Pass position ch0
[F1 DMV , K 250 , DT 1010] S3 (Y axis) Pass position ch2
・Control code
Continue mode
from CH2-CW to CH0-CW direction
Pass position setting method
Absolute
・Composite speed : 1000 Hz
・Target position : P4 (3000,0)
・Pass position : S3 (2500,250)
R13
Mode changing for stoppage
Mode changing for stoppage
[F1 DMV , H 10 , DT 1000] Stop mode Data table
・Control code : Stop mode
R904E
Control flag
DF/
R13
Mode changing for stoppage
R1
Positioning done
Positioning done
R0
Positioning running
R1
Positioning done
Circular interpolation start
[F176 SPCH , DT 1000 , K 0] Data table
R904F
Set value change confirmation
[F109 BITL , WR 1 , WR 1 , K 1] Shift register 1 bit shift
1 bit shift
ED

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

```
X6
-| |----[F0 MV, K1, DT100        ]

        [F0 MV, K500, DT101      ]

        [F173 PWMH, DT100, K0    ]
```

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.

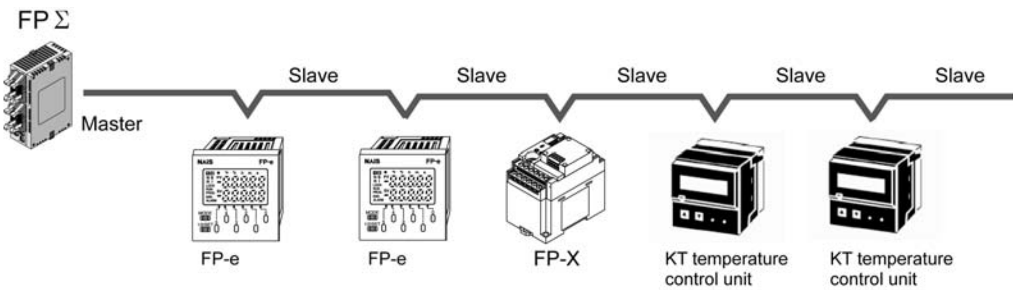
1. Only the slave function is available for the FPΣ 12k type.
2. Both the master and slave functions are available for the FPΣ 32k type, however, the master function is not available for the TOOL port.

MEWTOCOL master function (32k type only)

- This function is to carry out the communication on the master side (side 0that 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.

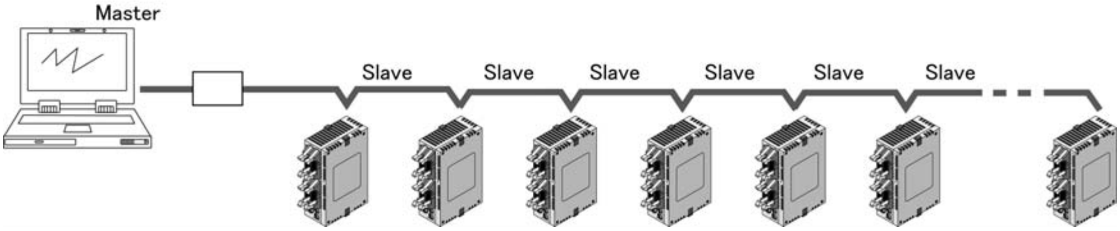
The 1:1 or 1:N communication is available between our devices equipped with the computer link function and the MEWTOCOL-COM.
[Our devices (e.g.)] : PLC, IPD, temperature control unit, message runner, eco-power meter

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 unti is used as a slave unit.



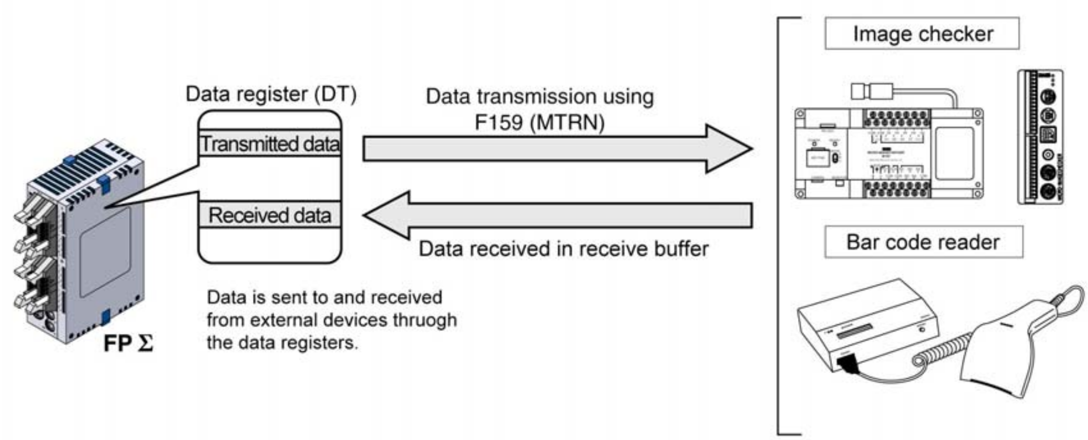
MEWTOCOL slave function

- 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

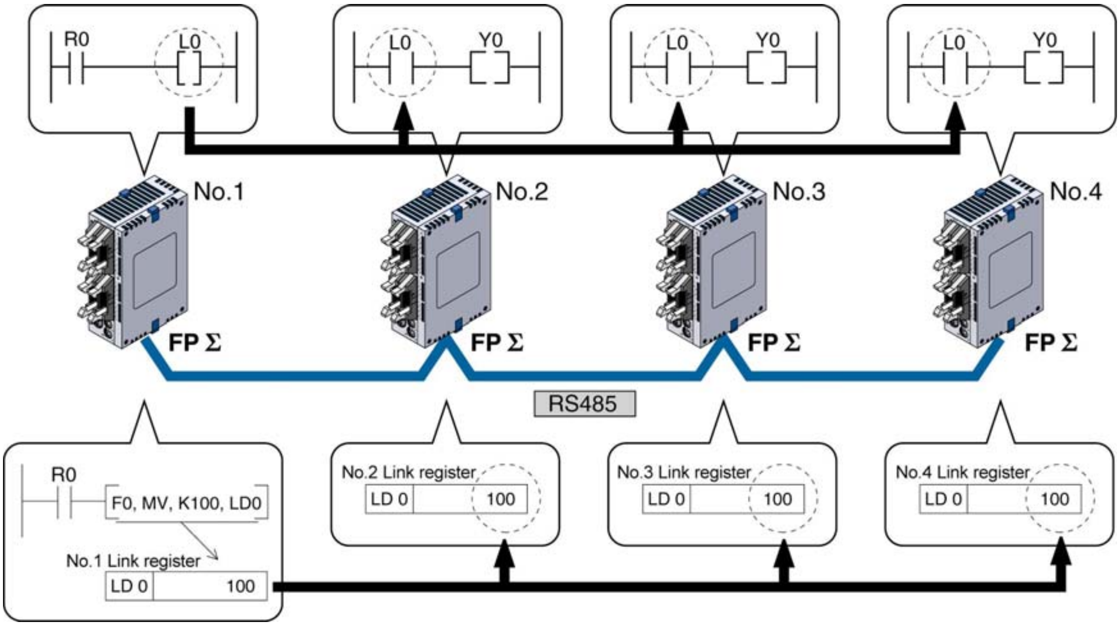
- In a PC(PLC) link, data is shared with all PLCs connected via MEWNET using dedicated internal relays called link relays (L) and data registers called link registers (LD).
- If the link relay contact for one PLC goes on, the same link relay also goes on in each of the other PLCs connected to the network.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

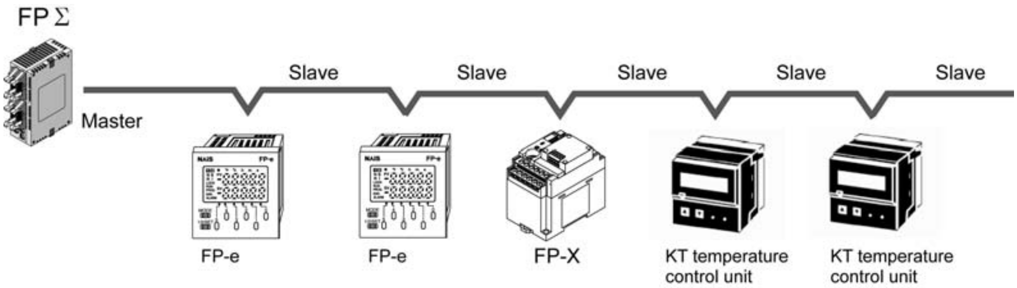
- The MODBUS RTU protocol enables the communication between the FPΣ and other devices (including our FP-e, Programmable display GT series and KT temperature control unit).
- Enables to have conversations if the master unit sends instructions (command messages) to slave units and the slave units respond (response messages) according to the instructions.
- Enabels 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 ASCI mode and RTU (binary) mode in the MODBUS protocol, however, the FPΣ is supported with the RTU (binary) mode only.

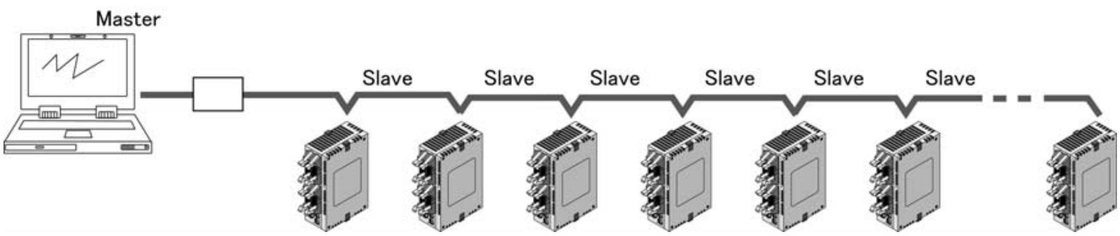
Master function

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 unti is used as a slave unit.



7.1.2 Types of Communication Cassette

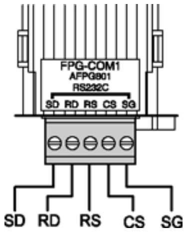
There are four types of communication cassettes, each having a particular field of application:

Reference: <7.2 Communication Specifications>

1-channel RS232C type (Product No. AFPG801)

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.

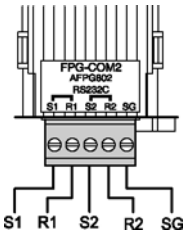
	1:1 communication	1:N communication
Computer link	Available	Not available
General-purpose serial communication	Available	Not available
PC(PLC) link	Available Note)	
MODBUS RTU	Available	Not available

Note) Number of units is two.

2-channel RS232C type (Product No. AFPG802)

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

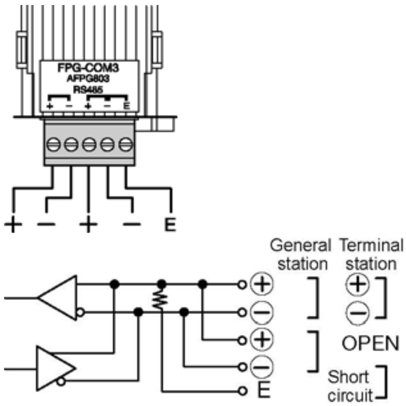
	1:1 communication	1:N communication
Computer link	Available	Not available
General-purpose serial communication	Available	Not available
PC(PLC) link	Available Note)	
MODBUS RTU	Available	Not available

Note) Number of units is two.

1-channel RS485 type (Product No. AFPG803)

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	――	

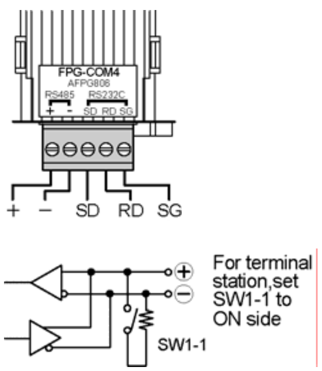
	1:1 communication	1:N communication
Computer link	Not available	Available
General-purpose serial communication	Not available	Available
PC(PLC) link	Available	
MODBUS RTU	Not available	Available

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. AFPG806)

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

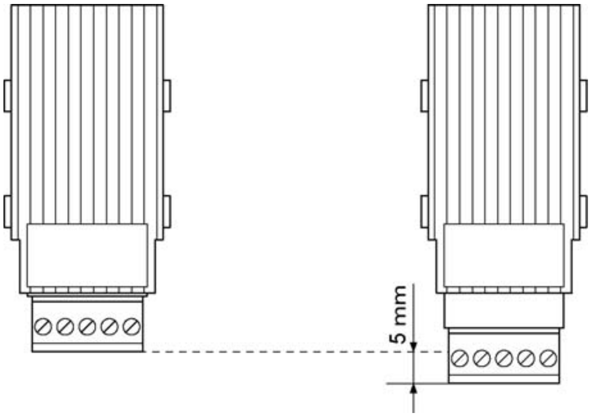
The indication of the control unit is for 2-channel RS232C type. For the other types, refer to the following.

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



AFPG801
AFPG802
AFPG803

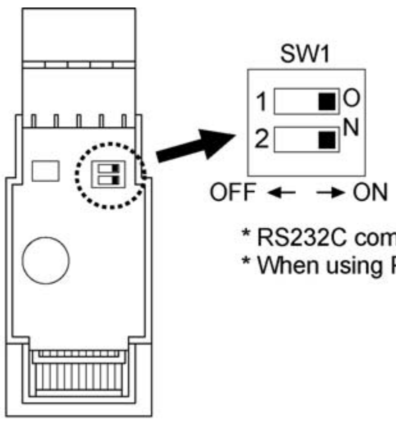
AFPG806
Note) This is longer by 5mm.

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 communicatoin (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 AFPG806 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	OFF ON	General station (intial value)	OFF ON	Terminal station
SW1-2 Baud rate	OFF ON	19200 bps	OFF 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 communi-cation	**1:N communi-cation**	**1:1 communi-cation**	**1:N communi-cation**		**1:1 communi-cation**	**1:N communi-cation**
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
Commu-nication method	Half-duplex communi-cation	Two-wire, half-duplex communi-cation	Half-duplex communi-cation	Two-wire, half-duplex communi-cation	Token bus (Floating master)	Half-duplex communi-cation	Two-wire, half-duplex communi-cation

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).

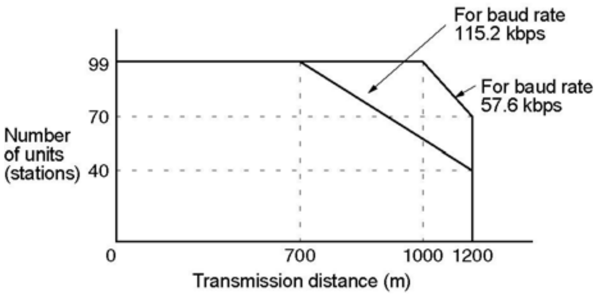
Note2) The number of units of the PC(PLC) link with RS232C is two.

Communication specifications

Item		**Specifications**	
Interface		RS232C (non-isolated)	RS485 (isolated) Note1) 2)
Communication mode		1:1 communicaion	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 ommunication	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 AFPG803 effective.

The termination resistance of the AFPG806 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 AFPG806 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 AFPG806 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

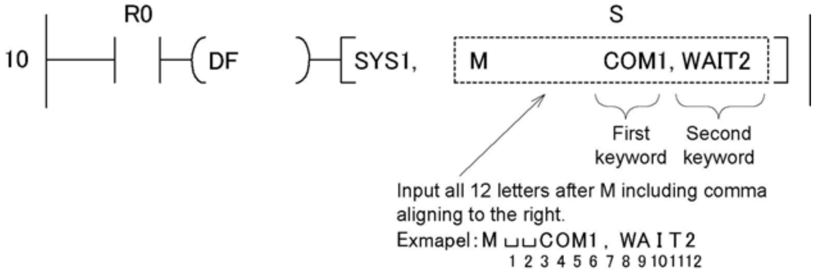
FPG-COM3 (AFPG803), FPG-COM4 (AFPG806)

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
|
```

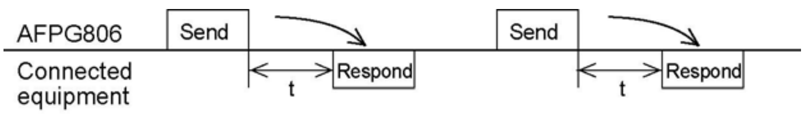
Example:



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.



t : In case of 19200 bps, 1 ms or more
In case of 115200 bps, 200μs or more

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 AFPG806)

- 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

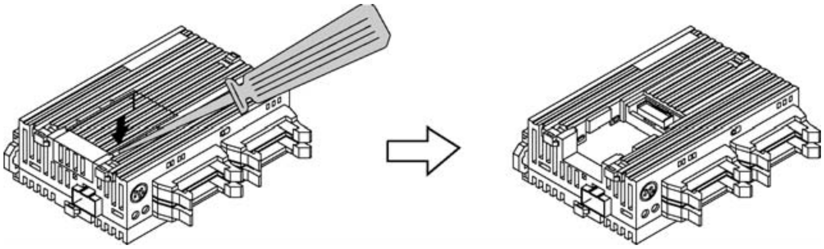
- Confirm the time after receiving data until a transmission starts with makers.
- KT temperature controller and inverters (VF-7E and VF-8X) can be used without any adjustment, as the time taken up to a response is more than 1 ms.
- GT series indicator cannot be used.
- With GV series indicator, set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

7.3 Installation and Wiring

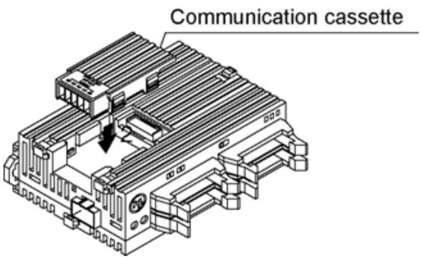
7.3.1 Installation of Communication Cassette

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

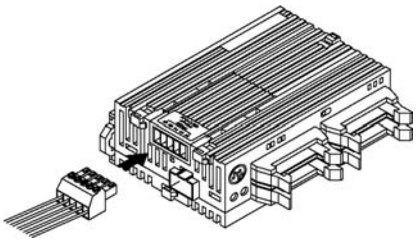
2. Remove cover using screwdriver.



3. Install communication cassette.



4. Plug in communication connector.

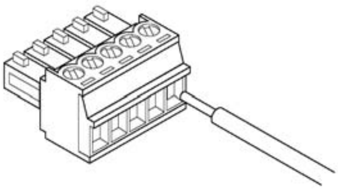


7.3.2 Wiring

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

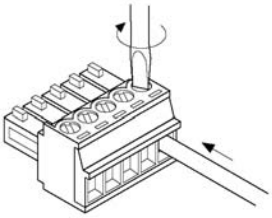
Screwdriver for terminal block

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

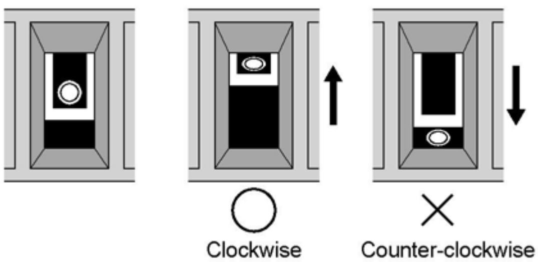
1. Remove 7 mm of the wire's insulation.

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

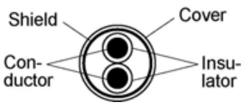
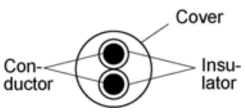
- When removing the wire's insulation, be careful not to scratch the core wire.
- Do not twist the wires to connect them.
- Do not solder the wires to connect them. The solder may break due to vibration.
- After wiring, make sure stress is not applied to the wire.
- In the terminal block socket construction, 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 mm^2.



7.3.3 Cables

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

Appropriate electrical cables (twisted cables)

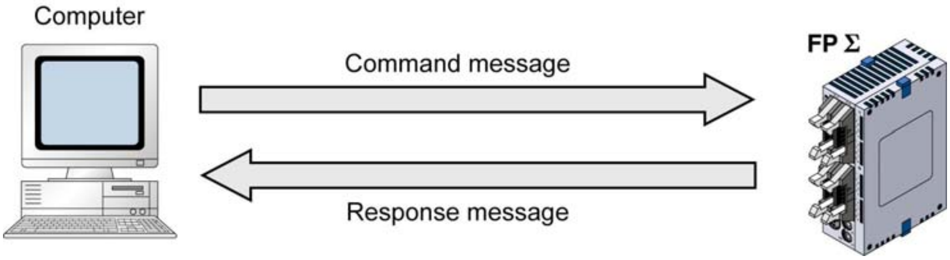
<table>
<tr><th rowspan="2">Type</th><th rowspan="2">Cross-sectional view</th><th colspan="2">Conductor</th><th colspan="2">Insulator</th><th rowspan="2">Cable diam.</th><th rowspan="2">Sample appropriate cable</th></tr>
<tr><th>Size</th><th>Resist-ance (at 20°C)</th><th>Material</th><th>Thick-ness</th></tr>
<tr><td rowspan="2">Shielded twisted pair</td><td rowspan="2"></td><td>1.25 mm^2 (AWG16) or greater</td><td>Max. 16.8 Ω/km</td><td>Polye-thylene</td><td>Max. 0.5 mm</td><td>Approx. 8.5 mm</td><td>Belden 9860 Hitachi Cable, Ltd. KPEV-S1.25 mm^2 x 1P</td></tr>
<tr><td>0.5 mm^2 (AWG20) or greater</td><td>Max. 33.4 Ω/km</td><td>Polye-thylene</td><td>Max. 0.5 mm</td><td>Approx. 7.8 mm</td><td>Belden 9207 Hitachi Cable, Ltd. KPEV-S0.5 mm^2 x 1P</td></tr>
<tr><td>VCTF</td><td></td><td>0.75 mm^2 (AWG18) or greater</td><td>Max. 25.1 Ω/km</td><td>Polychlo-rinated biphenyl</td><td>Max. 0.6 mm</td><td>Approx. 6.6 mm</td><td>VCTF-0.75 mm^2 x 2C(JIS)</td></tr>
</table>

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 mm^2.

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.

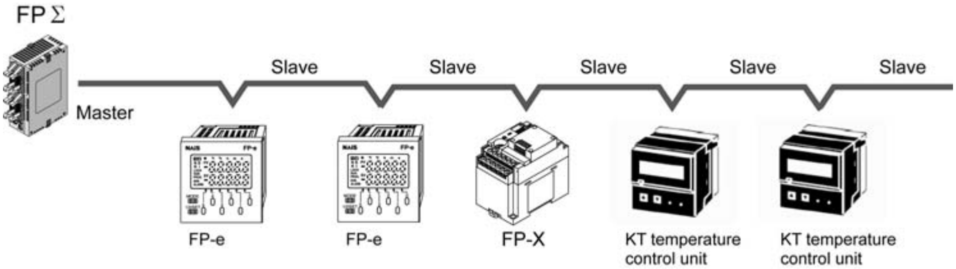
3. Only the slave function is available for the FPΣ 12k type.
4. Both the master and slave functions are available for the FPΣ 32k type, however, the master function is not available for the TOOL port.

MEWTOCOL master function (32k type only)

- This function is to carry out the communication on the master side (side 0that 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.

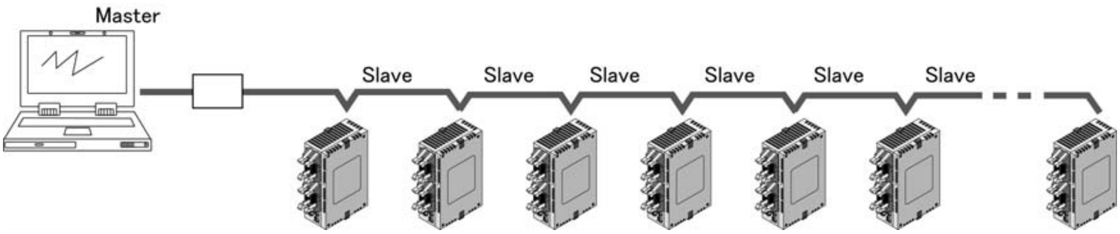
The 1:1 or 1:N communication is available between our devices equipped with the computer link function and the MEWTOCOL-COM.
[Our devices (e.g.)] : PLC, IPD, temperature control unit, message runner, eco-power meter

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 unti 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.



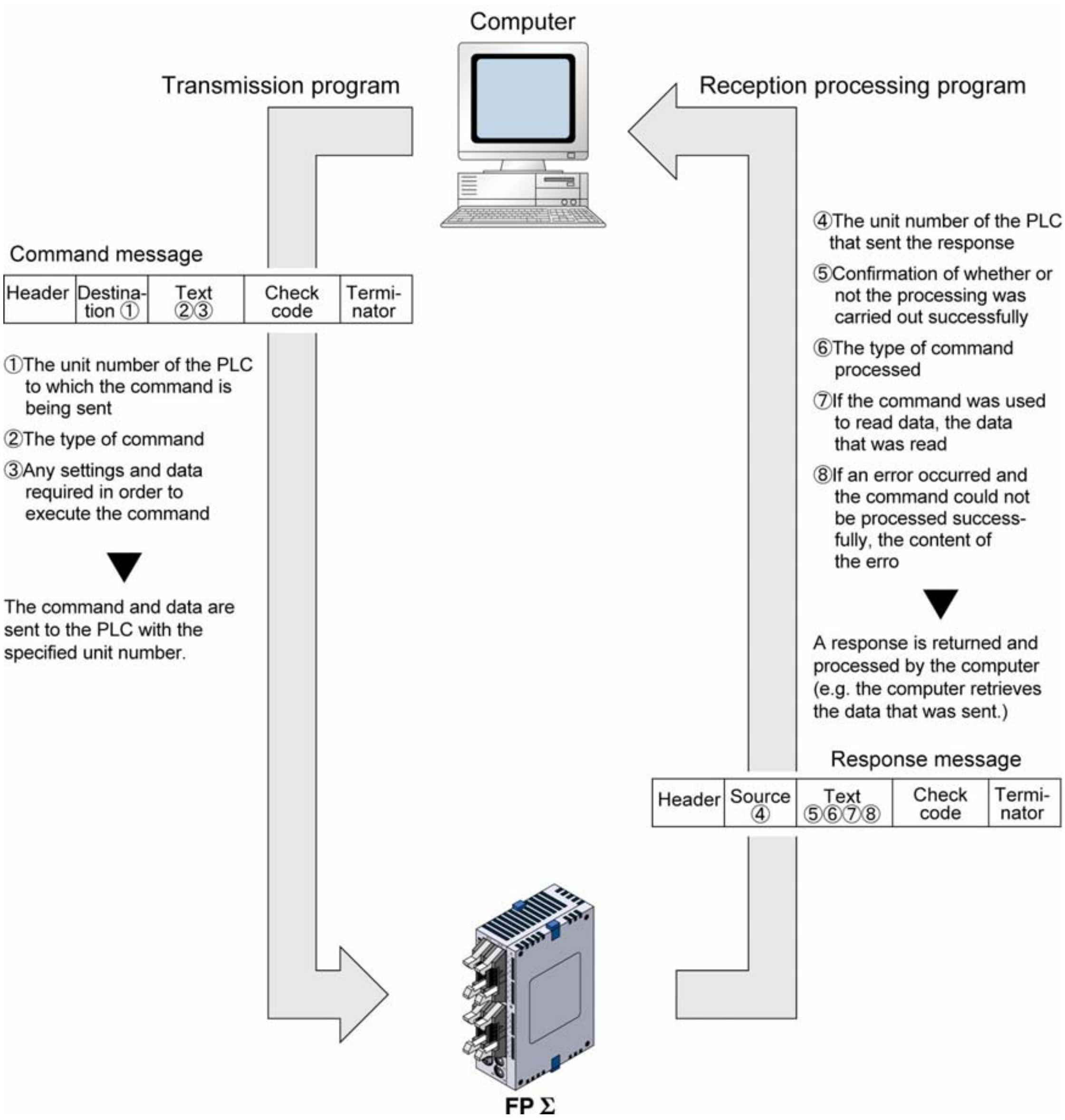
Outline of operation when using computer link (MEWTOCOL slave)

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

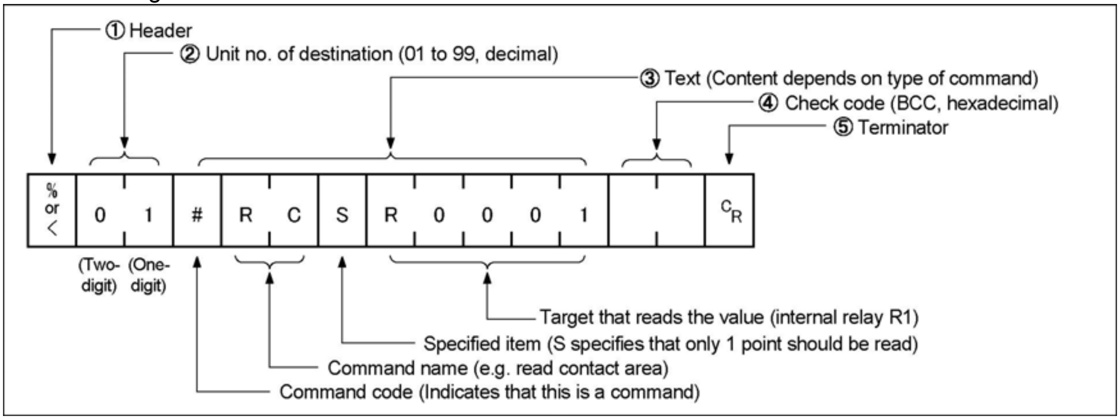
- Communication is carried out in a conversational format, based on the MEWTOCOL-COM communication procedures.
- Data is sent in ASCII format.
- The computer has the first right of transmission. The right of transmission shifts back and forth between the computer and the PLC each time a message is sent.



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)

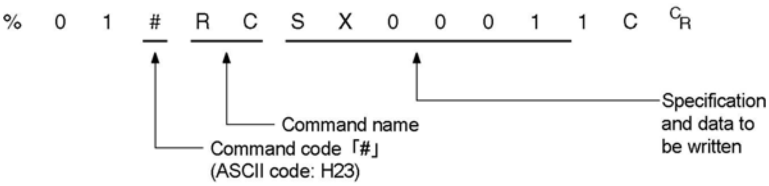
Commands must always have a "%" (ASCII code: H25) or a "<" (ASCII code: H3C) at the beginning of a message.

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.

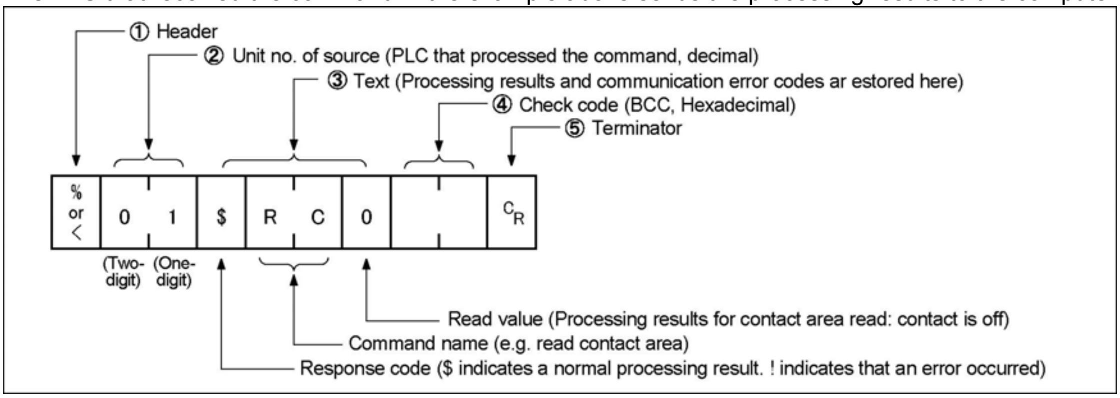
Key Point:

- 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)

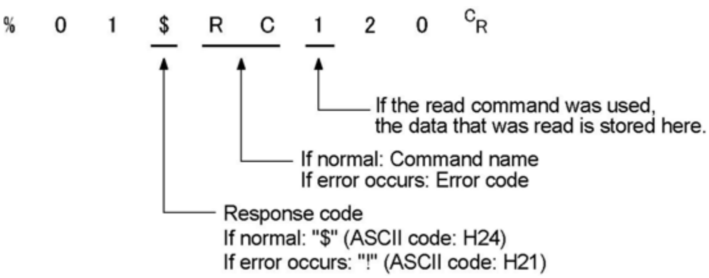
A “%” (ASCII code: H25) or “<” (ASCII code: H3C) must be at the beginning of a message. The response must start with the same header that was at the beginning of the command.

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.



4. Check code

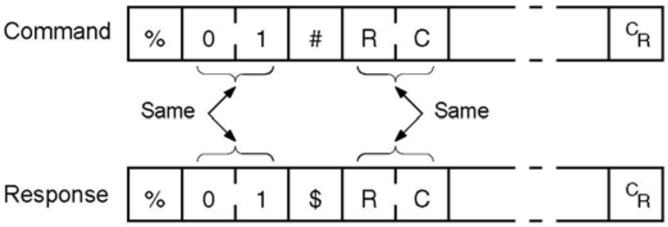
BCC (block check code) for error detection using horizontal parity. The BCC starts from the header and checks each character in sequence, using the exclusive OR operation, and replaces the final result with character text.

5. Terminator (end code)

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

Note:

- If no response is returned, the communication format may not be correct, or the command may not have arrived at the PLC, or the PLC may not be functioning. Check to make sure all of the communication specifications (e.g. baud rate, data length, and parity) match between the computer and the PLC.
- If the response contains an "!" instead of a "$", the command was not processed successfully. The response will contain a communication error code. Check the meaning of the error code.
- Unit number and command name are always identical in a command and its corresponding response (see below). This makes the correspondence between a command and a response clear.



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.

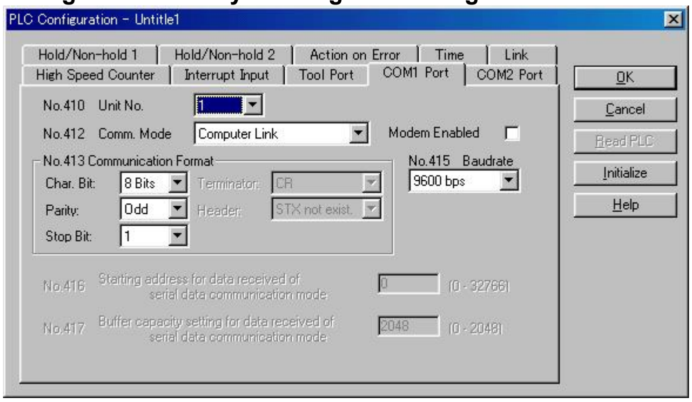
Setting communication parameters

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 funciton. (FPΣ 32k type only)

Dialog box of PLC system register setting



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 FPΣ 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.

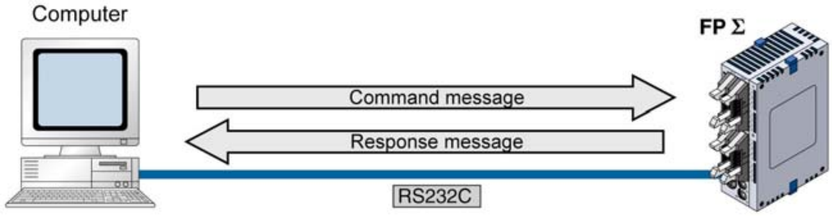
Programming

- 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

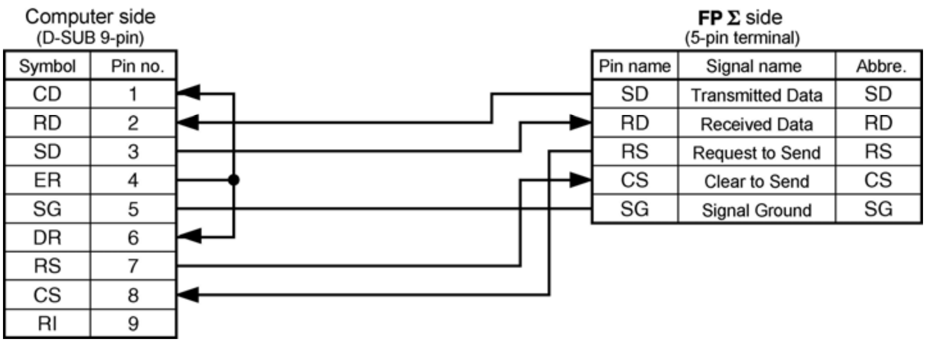
Connection to the computer <1:1 communication>

Overview

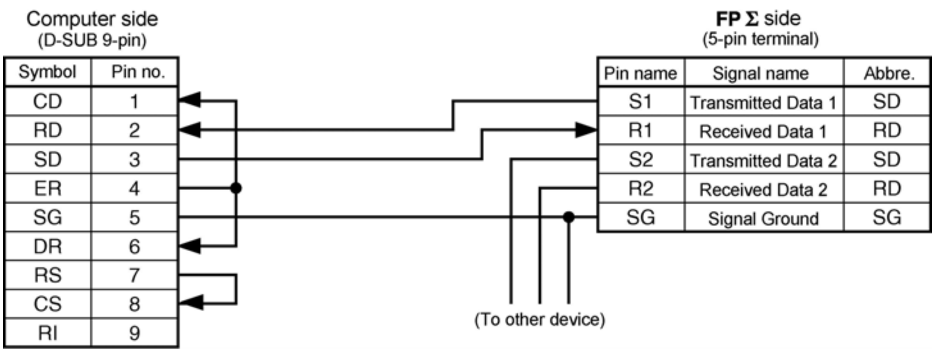
For a 1:1 computer link between the FPΣ and a computer, an RS232C cable is needed. Communication is performed via commands from the computer and responses from the PLC.



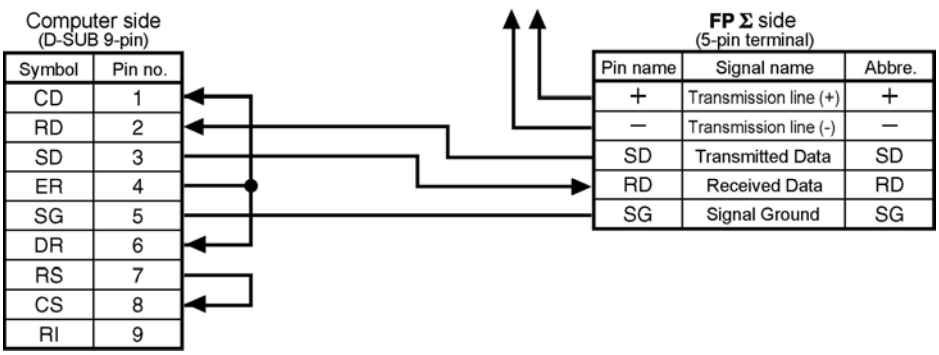
<Using AFPG801 (1-channel RS232C type communication cassette>



<Using AFPG802 (2channel RS232C type communication cassette>



<Using AFPG806(Combination of 1-channel RS485 type and 1-channel RS232C type>



1:1 communication with programmable display GT10/GT30

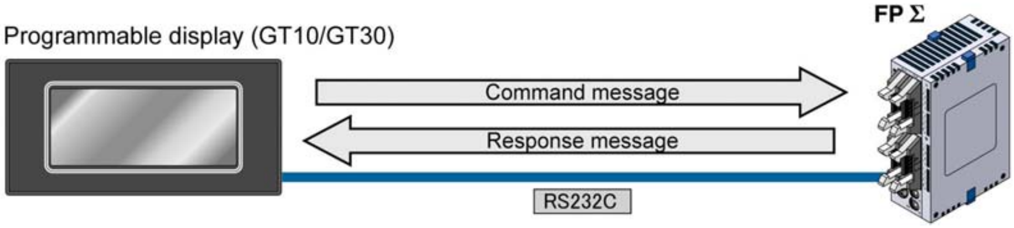
Overview

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.

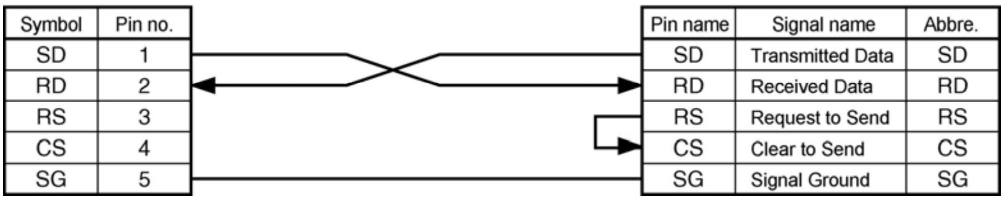
Reference: <GT01 Technical Manual>



<Using AFPG801 (1-channel RS232C type communication cassette>

GT10/GT30 side (5-pin terminal)

FP Σ side (5-pin terminal)



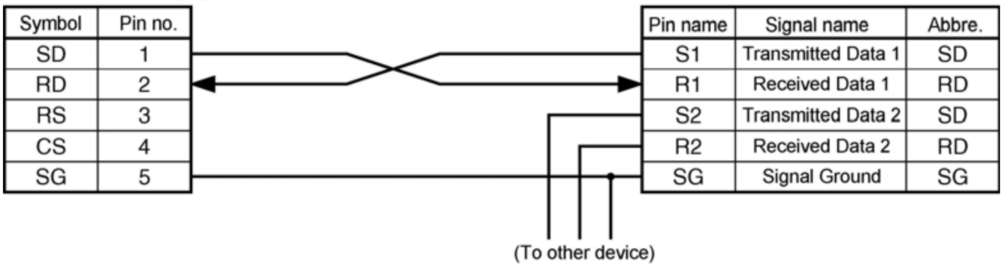
Symbol	Pin no.
SD	1
RD	2
RS	3
CS	4
SG	5

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 AFPG802 (2-channel RS232C type communication cassette>

GT10/GT30 side (5-pin terminal)

FP Σ side (5-pin terminal)



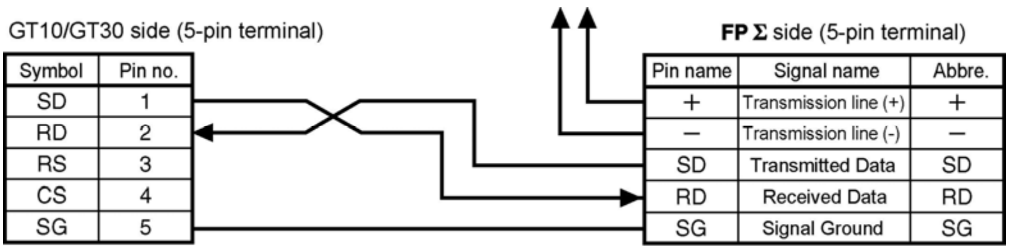
Symbol	Pin no.
SD	1
RD	2
RS	3
CS	4
SG	5

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

<Using AFPG806(Combination of 1-channel RS485 type and 1-channel RS232C type>

GT10/GT30 side (5-pin terminal)

FP Σ side (5-pin terminal)



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

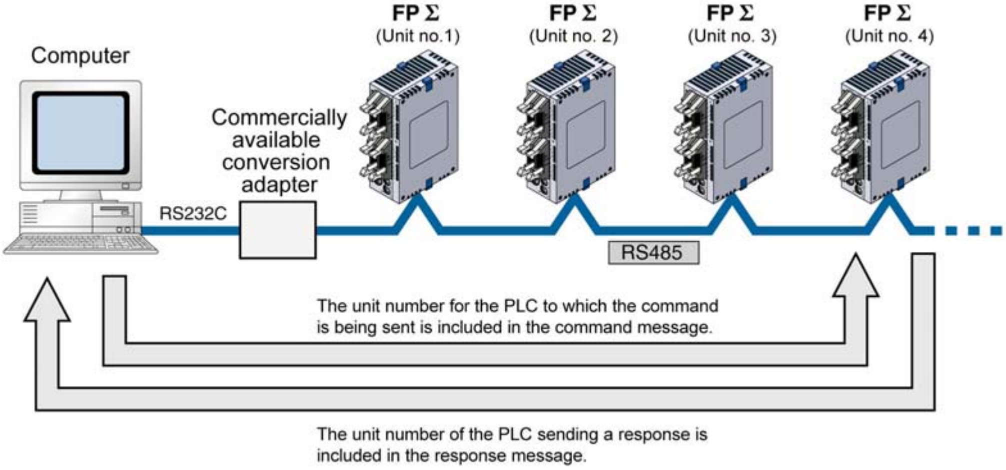
Pin name	Signal name	Abbre.
+	Transmission line (+)	+
−	Transmission line (-)	−
SD	Transmitted Data	SD
RD	Received Data	RD
SG	Signal Ground	SG

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 AFPG806 (COM4), start the transmission of the data to FPΣ after the time mentioned blow 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 AFPG806 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.

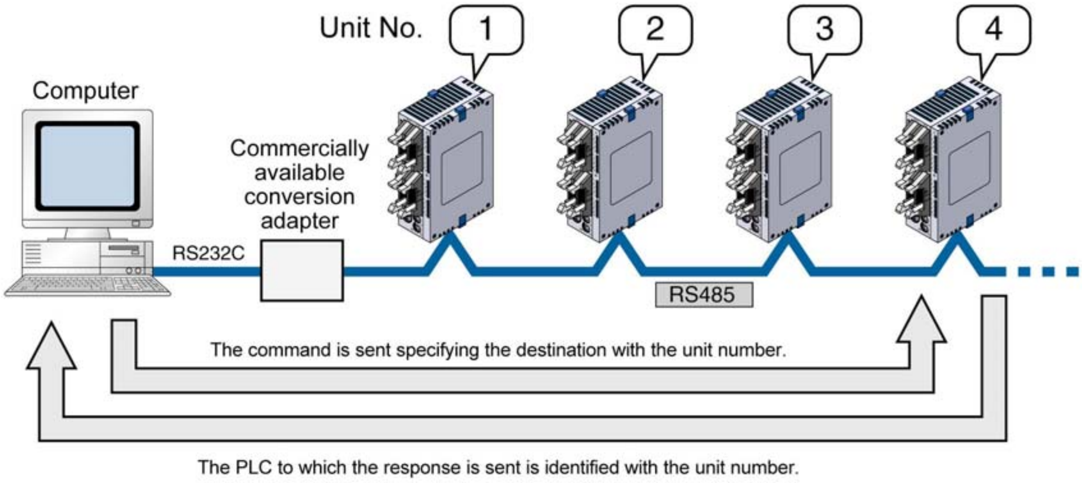
Reference: <7.1.4 Setting of AFPG806 Switch>

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 AFPG803 effective.
The termination resistance of the AFPG806 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.

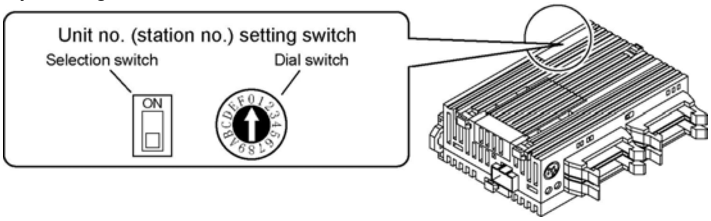


Table of switch settings and related unit numbers

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

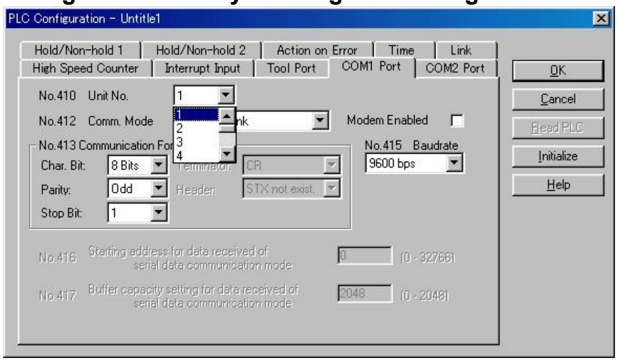
- A unit number between 1 and 31 can be set.
- Set the unit number setting switch to “0” to make the system register valid.
- The same unit number is given to the COM1 port and COM2 port when using the unit number setting switch. (Use the system register setting to set the unit number individually for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

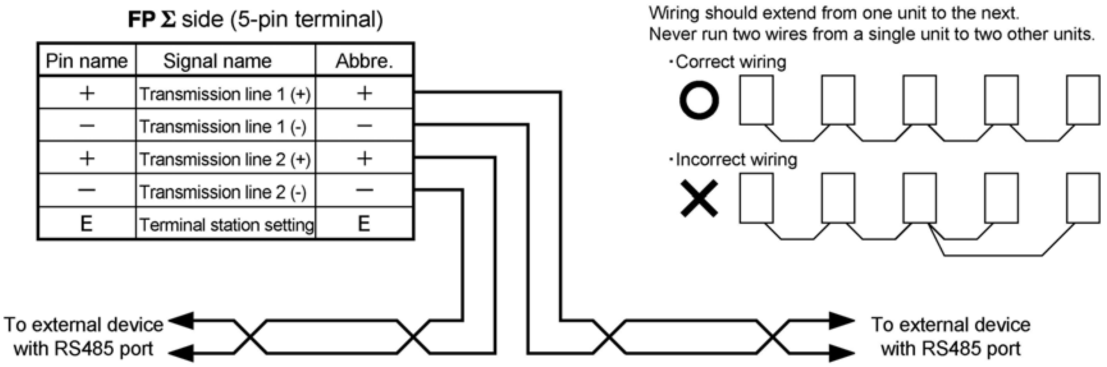
Click on ▼, and select a unit number from 1 to 99.

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

Connection with external devices
AFPG803
Connection diagram

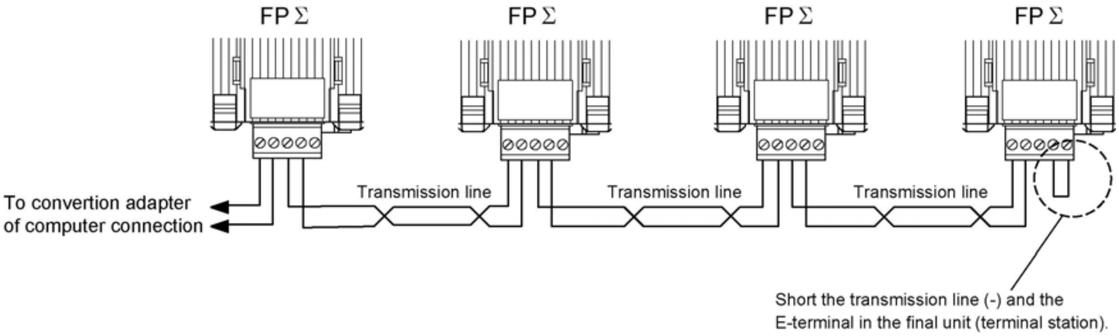
FP Σ side (5-pin terminal)

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



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.

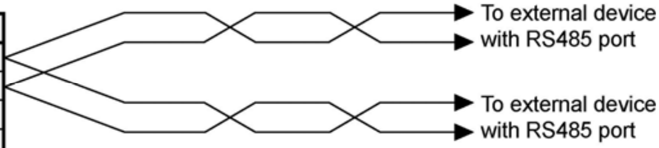


AFPG806

Connection diagram

FP Σ side (5-pin terminal)

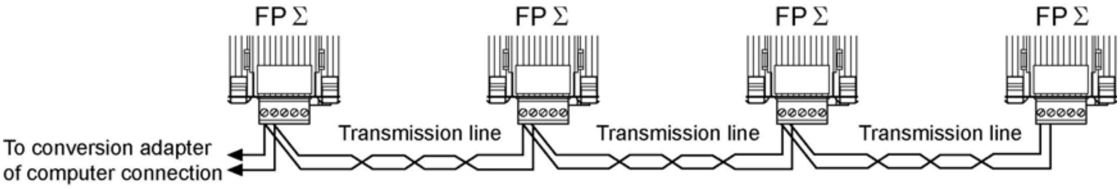
Pin name	Signal name	Abbre.
+	Transmission line 1 (+)	+
−	Transmission line 1 (-)	−
SD	Transmitted Data	SD
RD	Received Data	RD
SG	Signal Ground	SG



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 mm^2.

Setting of terminal station

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

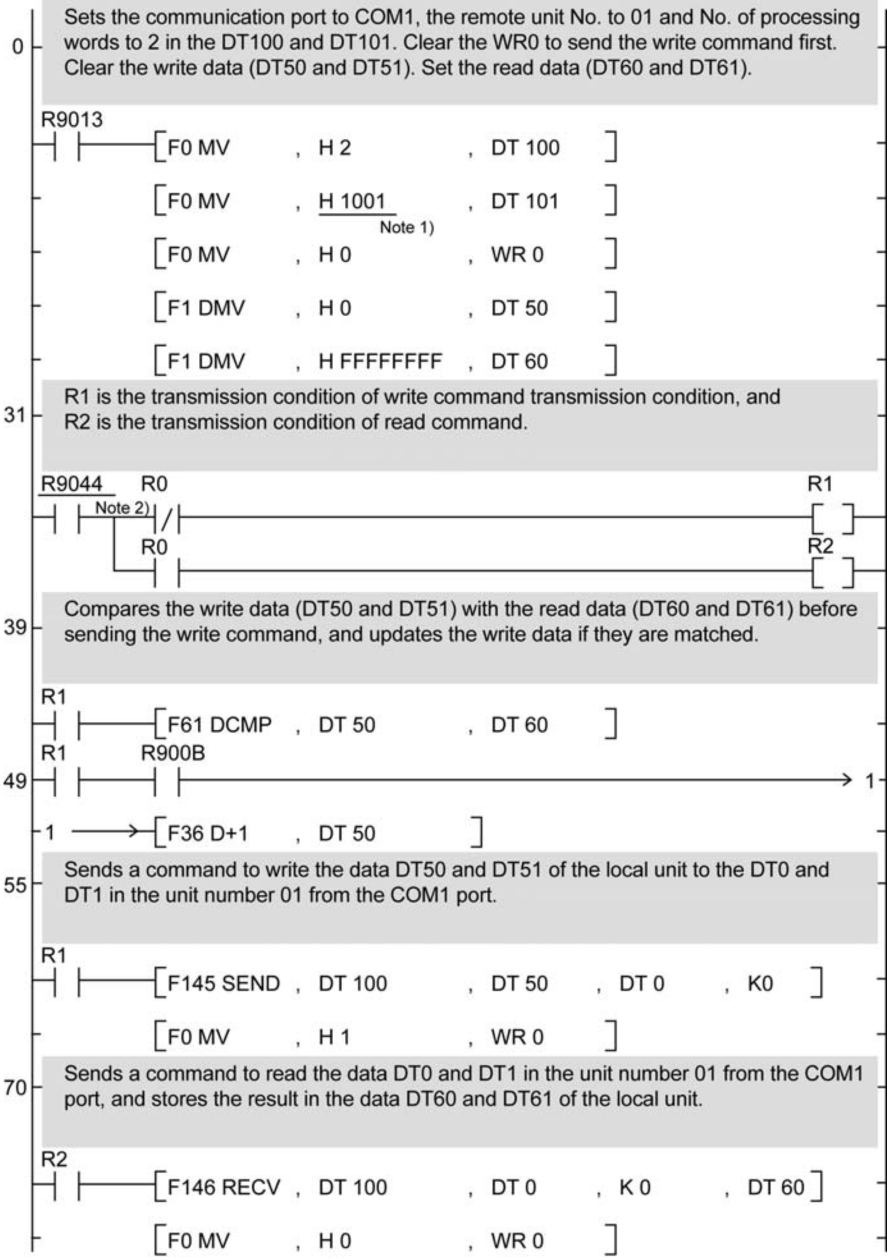


Reference: <7.1.4 Setting of AFPG806 switch>

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.

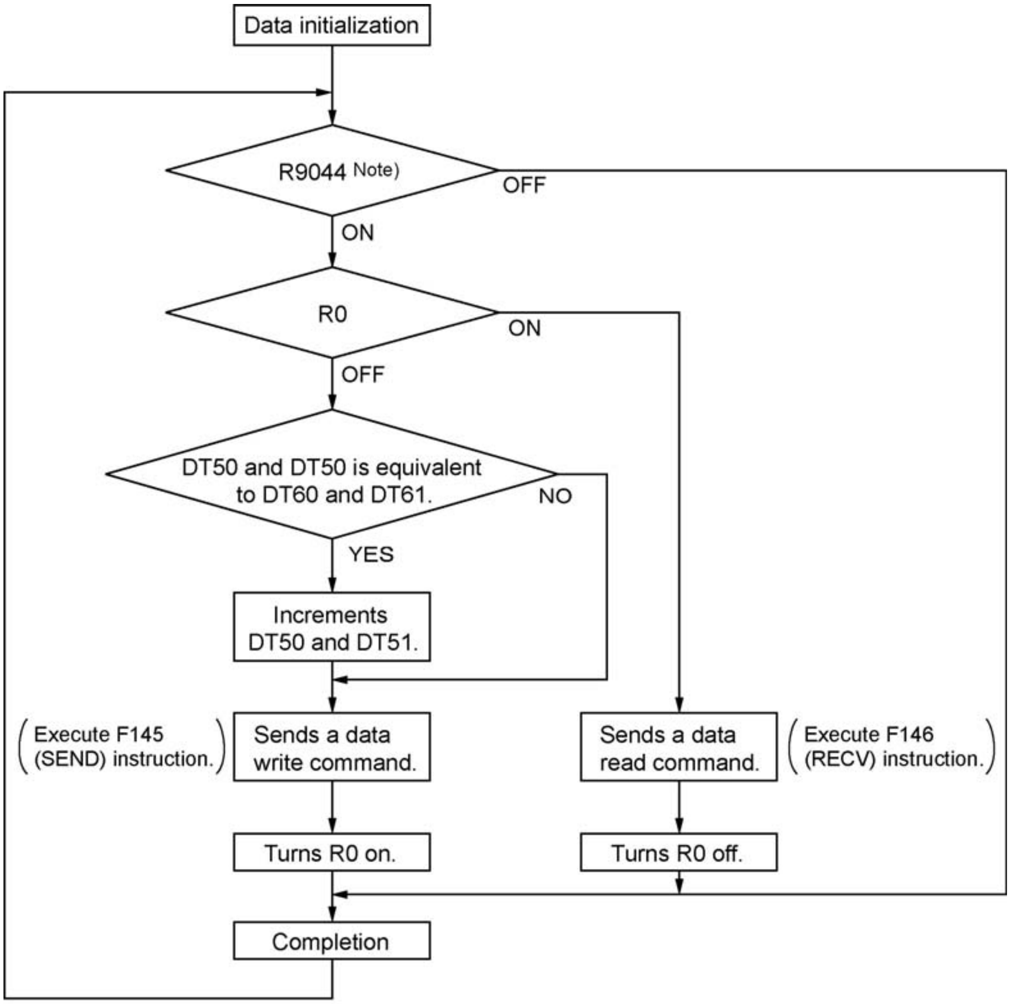
Sample program



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.

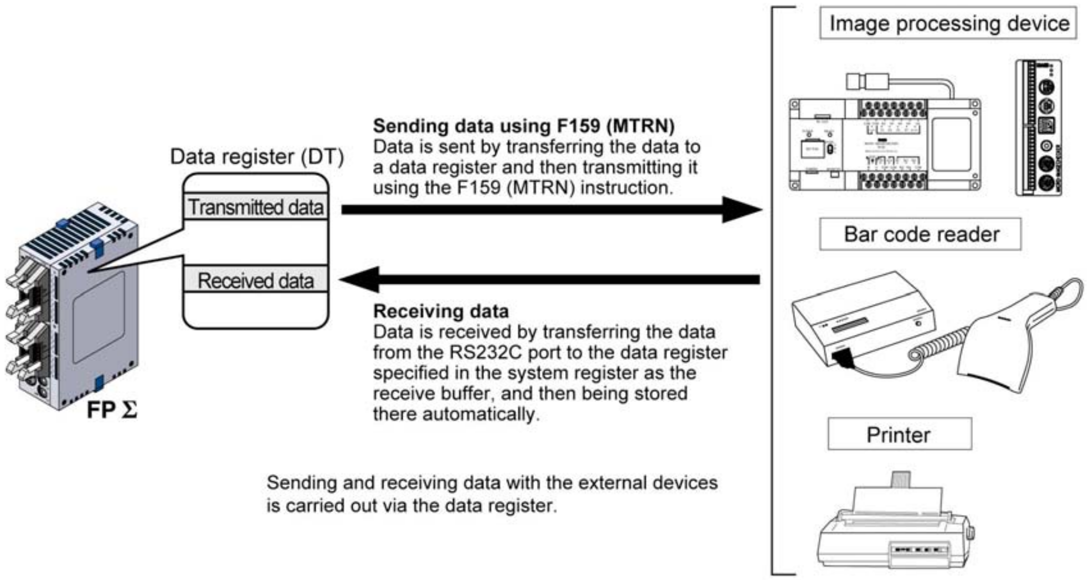
Note) The above COM1 port will be COM2 port for the COM2 port.

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.

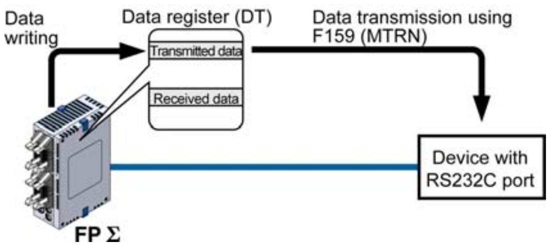


Outline of operation

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

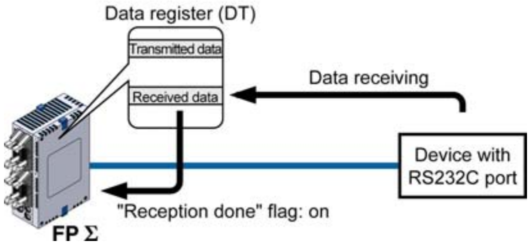
Data to be transmitted from the PLC is stored in the data register used as the send buffer (DT). When F159 (MTRN) is executed, the data is output from the COM port.



- 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.



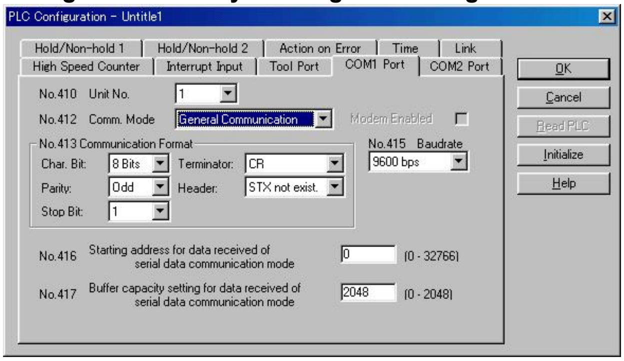
- When data is being received, the “reception done” flag is controlled by the F159 (MTRN) instruction.
- No terminator is included in the stored data.
- The maximum volume of data that can be received is 4096 bytes.

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 FPWIN 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

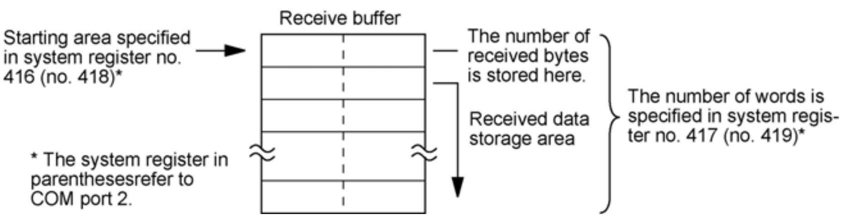
The default setting for the communication speed for the various ports is 9600 bps. Change the value to match the external device connected to the COM port:

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.



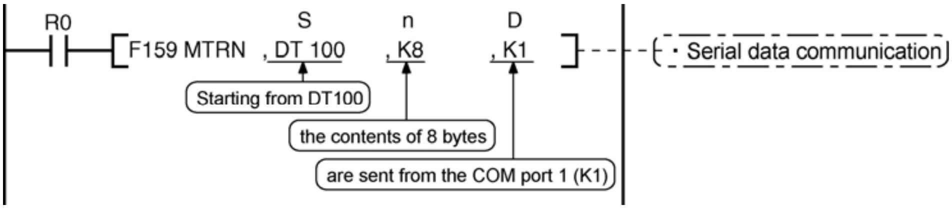
7.5.2 Communication with External Devices

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.

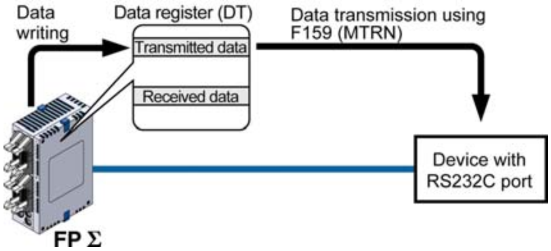
Reception of data

Reception of data is controlled by turning the “reception done” flags R9038/R9048 on and off. The received data is stored in the receive buffe 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	
DT101	H42(B)	H41(A)
DT102	H44(D)	H43(C)
DT103	H46(F)	H45(E)
DT104	H48(H)	H47(G)

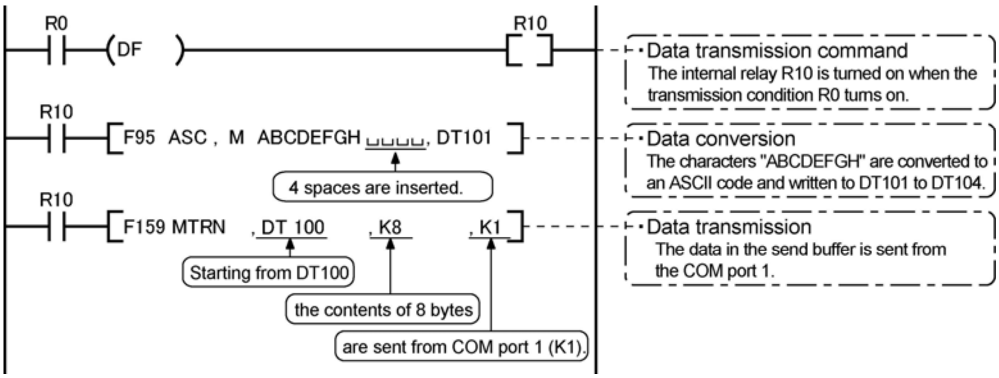
When transmission begins: K8 is set.
0 is set when transmission completed.
(Ver 3.10 or later)
When transmission ends: K0

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.

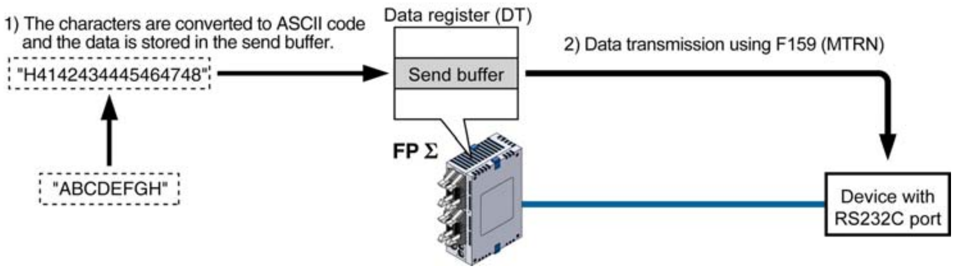


The program described above is executed in the following sequence.

1) "ABCDEFGH" is converted to an ASCII code and stored in a data register.

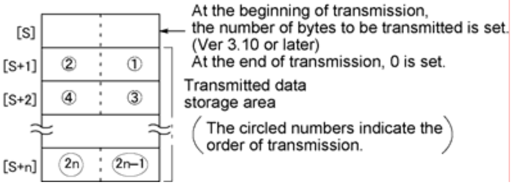
2) The data is sent from COM1 port using the F159 (MTRN) instruction.

Explanatory diagram



Explanation of data table

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



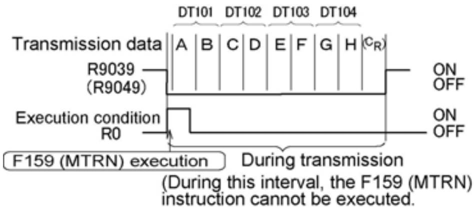
- Use an F0 (MV) or F95 (ASC) instruction to write the data to be transmitted to the transmission data storage area specified in S.

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.



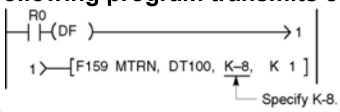
3. When all of the specified quantity of data has been transmitted, the S value is cleared to 0 and the “transmission done” flag R9039/R9049 turns on.

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:

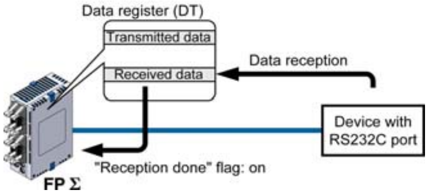
The following program transmits 8 bytes of data without adding the terminator.



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.

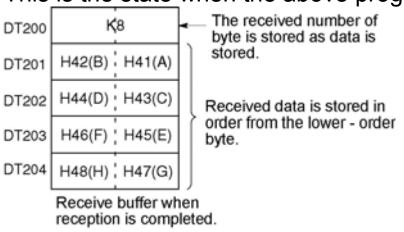
Receiving data from external devices



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)

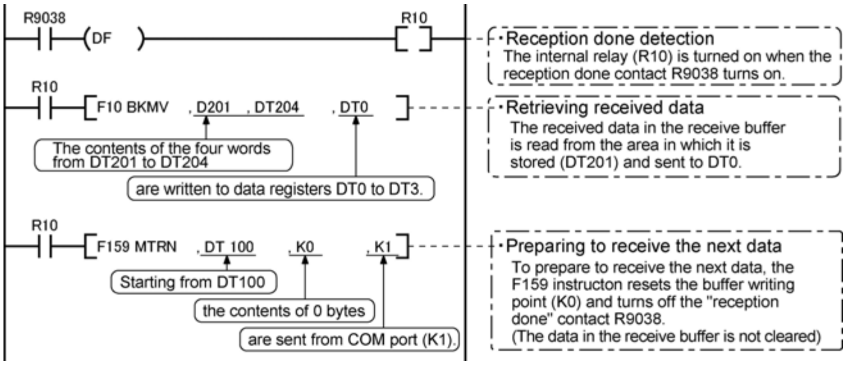
This is the state when the above program is executed.



- 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.



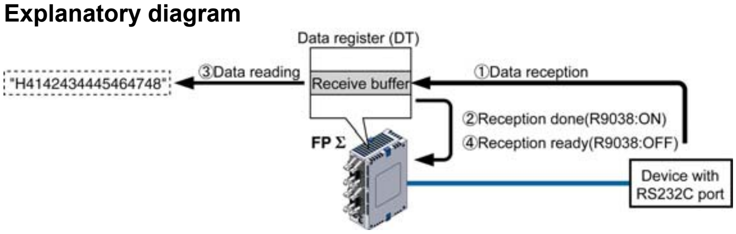
The program described above is executed in the following sequence.

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:

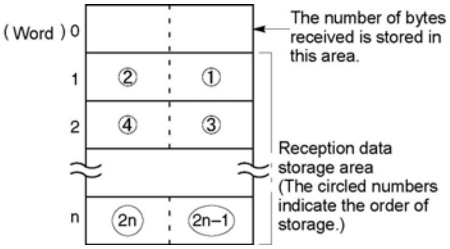
- Be aware that the “reception done” flag R9038 or R9048 changes even while a scan is in progress (e.g., if the “reception done” flag is used multiple times as an input condition, there is a possibility of different statuses existing within the same scan.) To prevent multiple read access to the special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

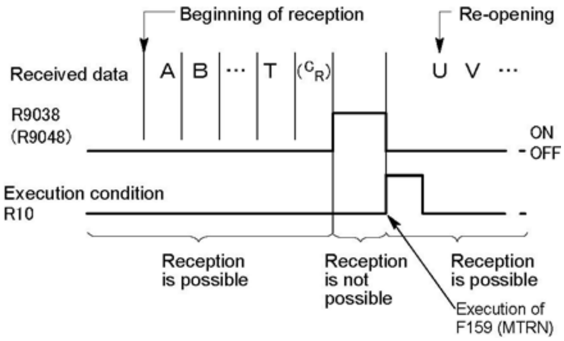


- Specify the data registers in system register 416 to 419.
- The number of bytes of data received is stored in the starting address of the receive buffer. The initial value is 0.
- Received data is stored in the received data storage area in order from the lower -order byte.

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.

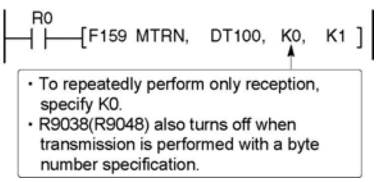


2. When the terminator (end code) is received, the “reception done” flag R9038 (R9048) turns on. Reception of any further data is prohibited.
3. When an F159 (MTRN) instruction is executed, the “reception done” flag R9038 (R9048) turns off, the number of received bytes is cleared, and subsequent data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

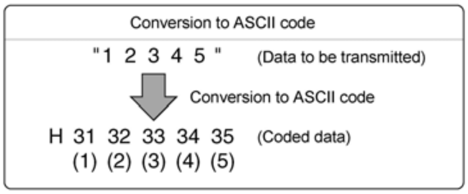
Sending data:

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

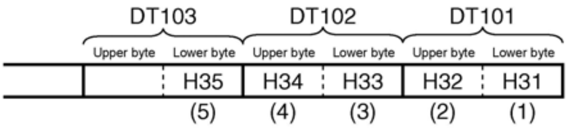
Example:

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.



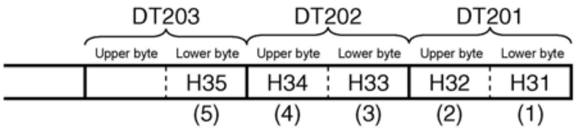
Receiving data:

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

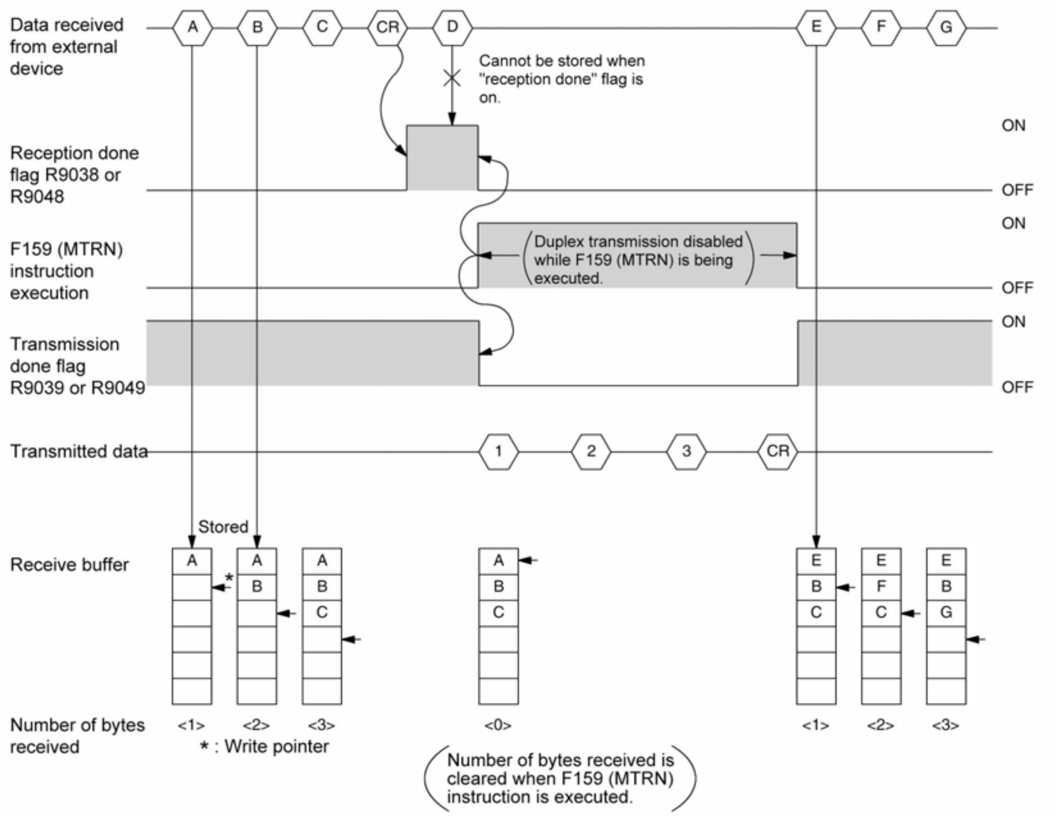
Example:

The data "12345$^{\mathrm{C}}_{\mathrm{R}}$" 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.

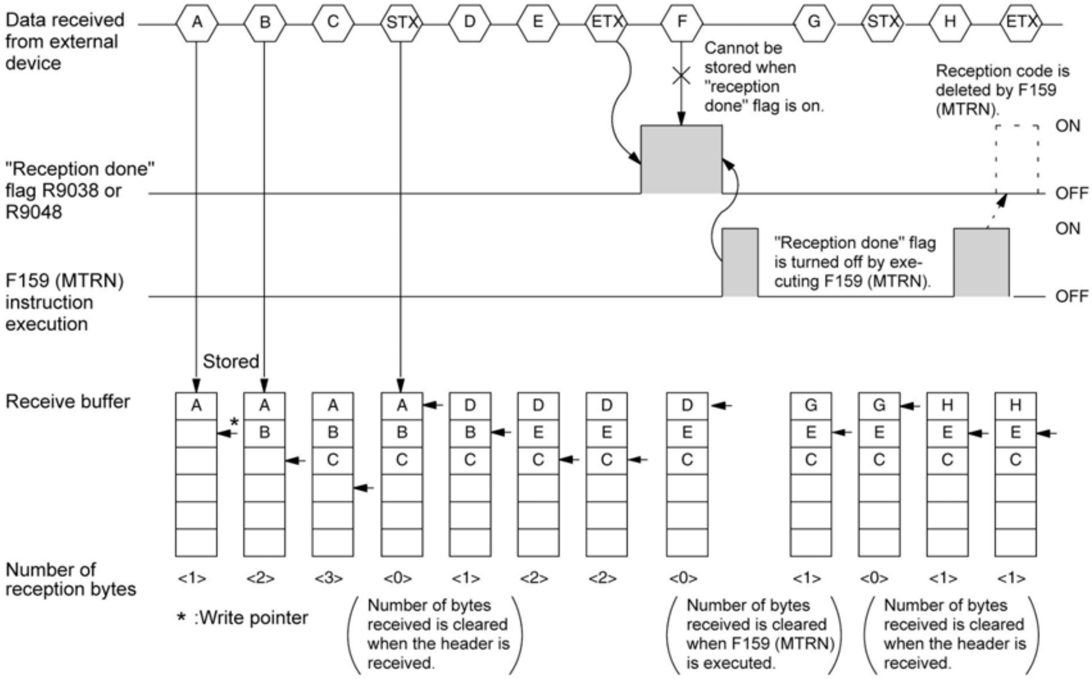
Note:
- Be aware that the “reception done” flag R9038 or R9048 changes even while a scan is in progress (e.g., if the “reception done” flag is used multiple times as an input condition, there is a possibility of different statuses existing within the same scan.) To prevent multiple read access to the 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:

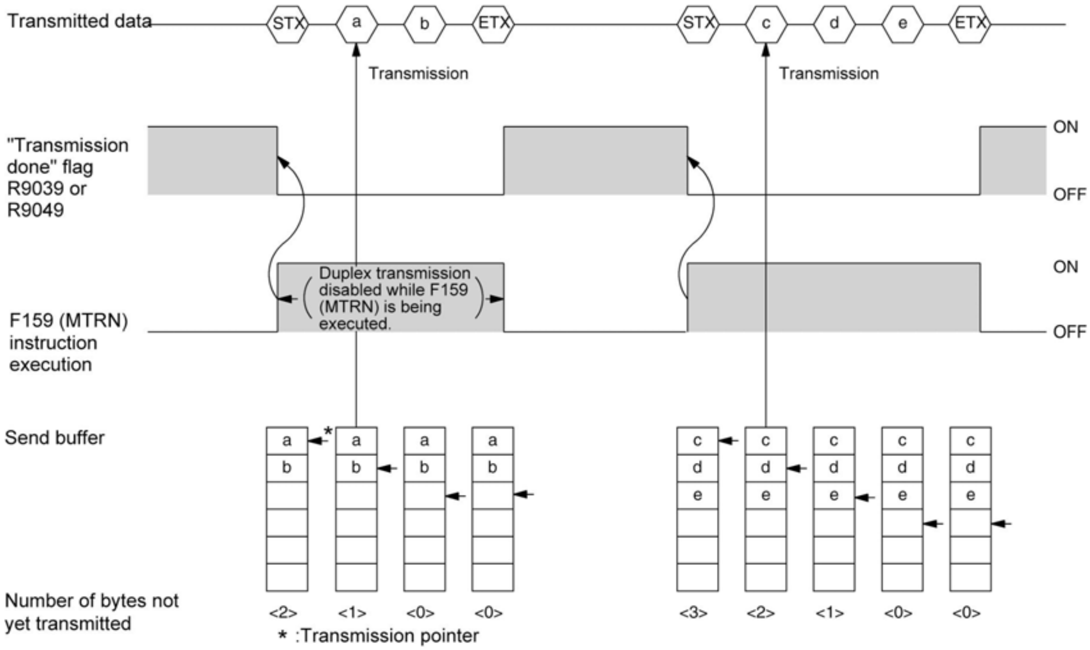
The “reception done” flag, the “transmission done” flag, and the F159 (MTRN) instruction are related as follows:



- 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:



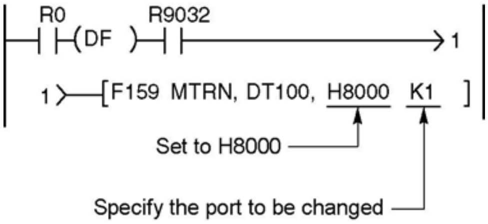
- Header (STX) and terminator (ETX) are automatically added to the data being transmitted. The data is transmitted to an external device.
- When the F159 (MTRN) instruction is executed, the “transmission done” flag R9039 or R9049 goes off.
- Duplex transmission is disabled while F159 (MTRN) is being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

Key Point:

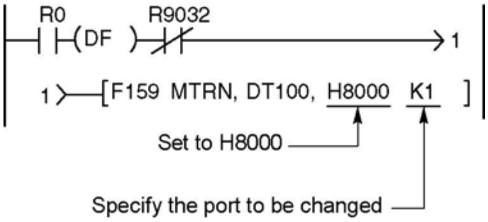
- The contact numbers in parentheses refer to COM2 port.

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)

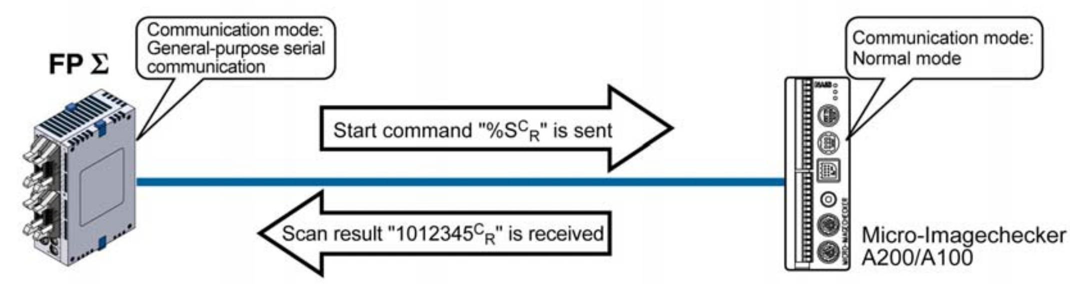
Note:

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 "%$S^C{}_R$" has been sent from the FPΣ side, the scan result is returned from the Micro-Imagechecker as the response.

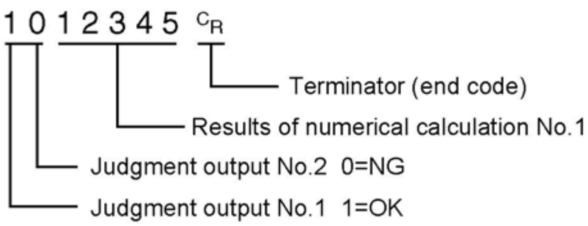
Communication format settings for Micro-Imagechecker

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.

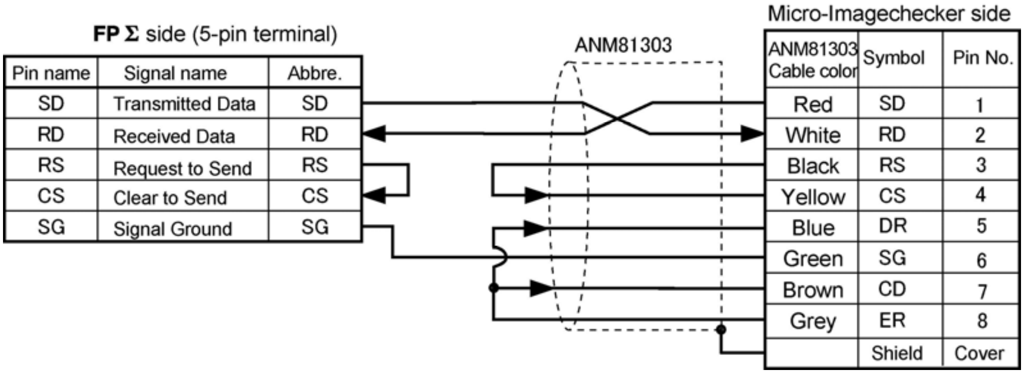
No.	Name	Set Value
No. 51	Communication mode	Normal mode
No. 52	Serial settings	Baud rate: ………… 9600 bps Bit length: ………….. 8 bits Stop bit: …………….. 1 bit Parity : ……………….. None/Odd Flow control: ……….. None
No. 53	Serial output settings	Output digit: ………… 5 column Invalid Digit: ………. Repl. 0 Read End: …..………. None Process End: ………. None Numerical calculation: Output Judgment: ………… Output

Key Point:

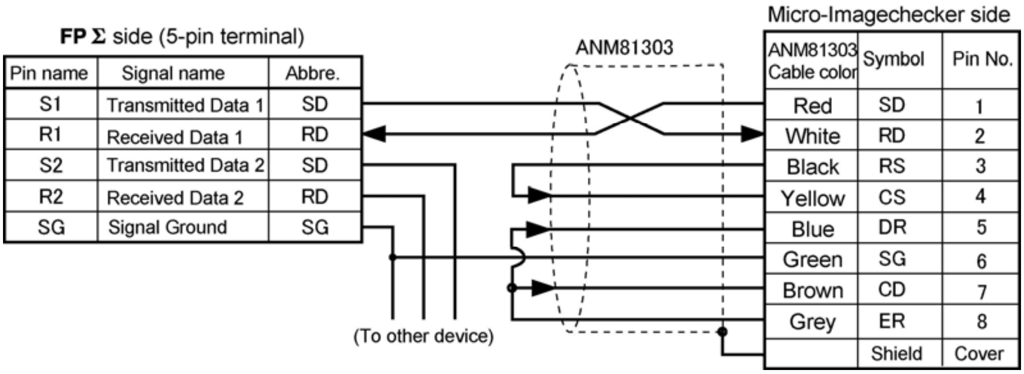
- If "Del" is specified for the invalid processing parameter, zero suppression processing will be carried out on the output data, and the output format will be changed. Always make sure "Repl. 0" is specified.
- When outputting data to an external device, numerical calculation is required, so "Out" should be specified for the "Numerical calculation" parameter.
- With the above settings, the following data will be output from the Micro-Imagechecker.



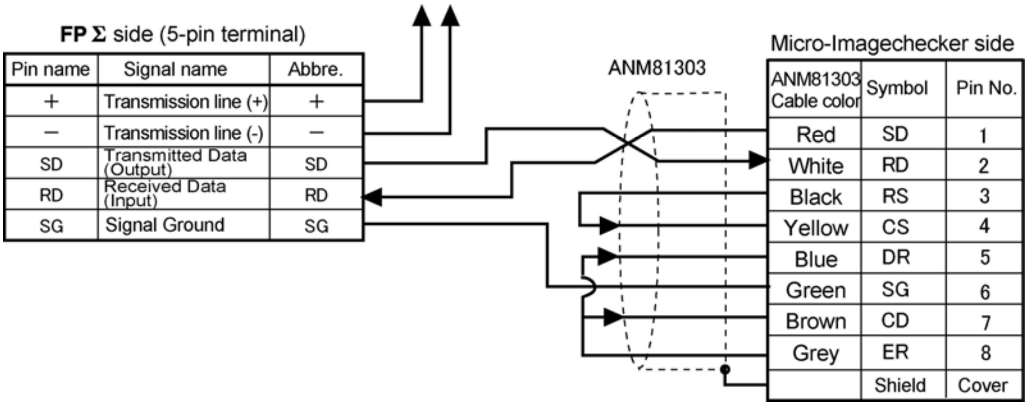
Connection to Micro-Imagechecker A200/A100
<Using AFPG801, 1-channel RS232C type communication cassette>



<Using AFPG802, 2-channel RS232C type communication cassette>

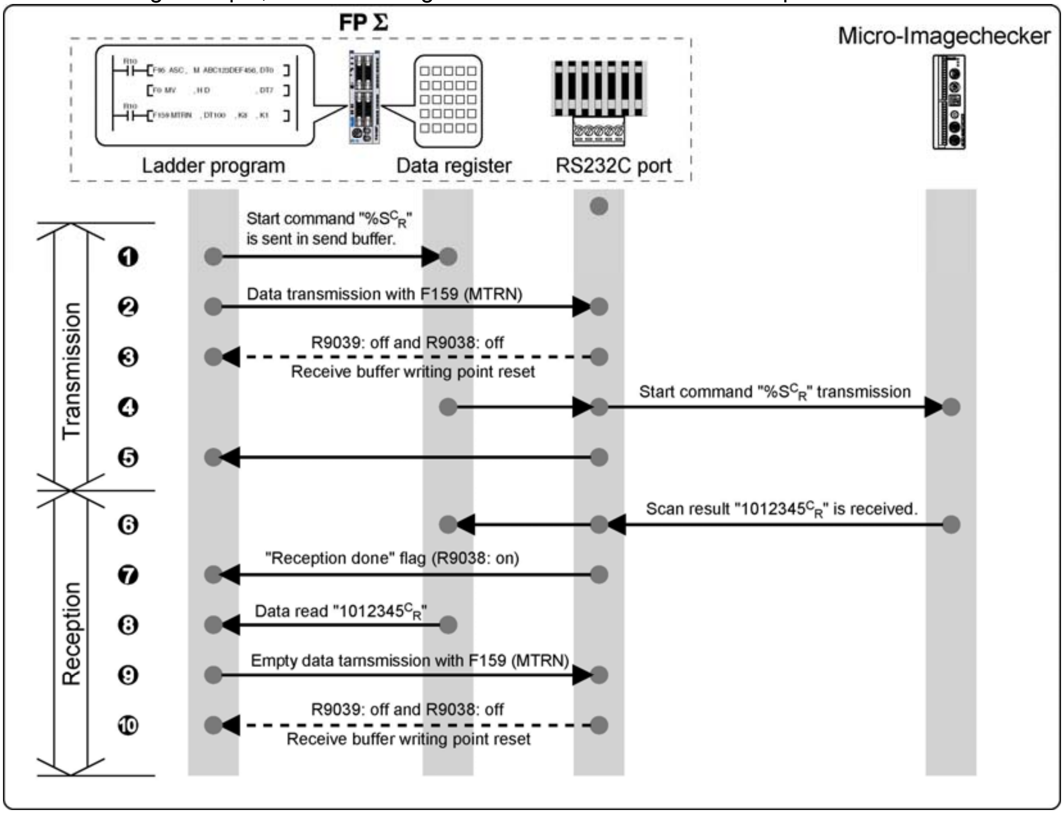


<Using AFPG806, 1-channel RS485 type and 1-channel RS232C type in combination>



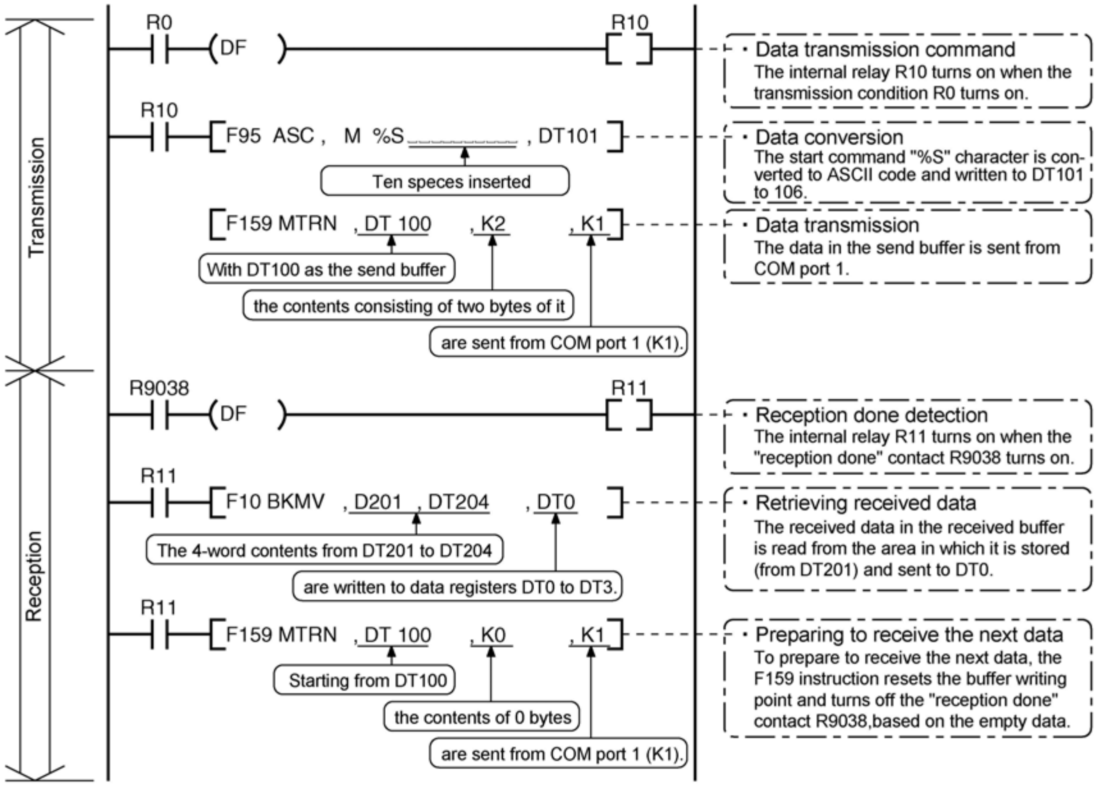
Procedure of communication

In the following example, the Micro-Imagechecker is connected to COM1 port.



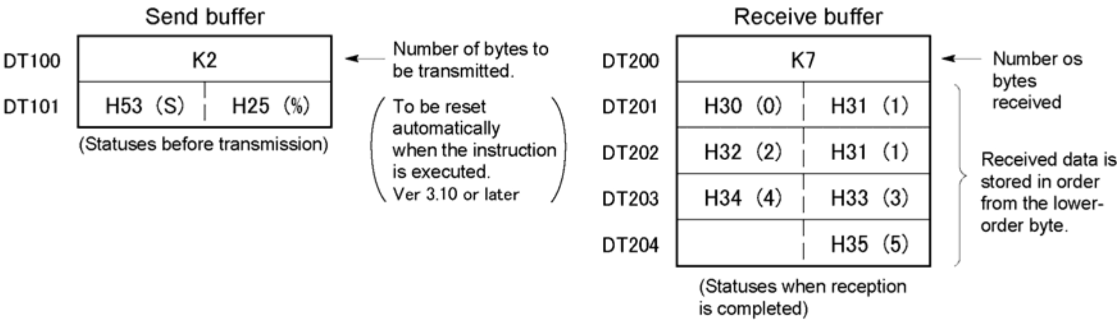
Sample program

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.



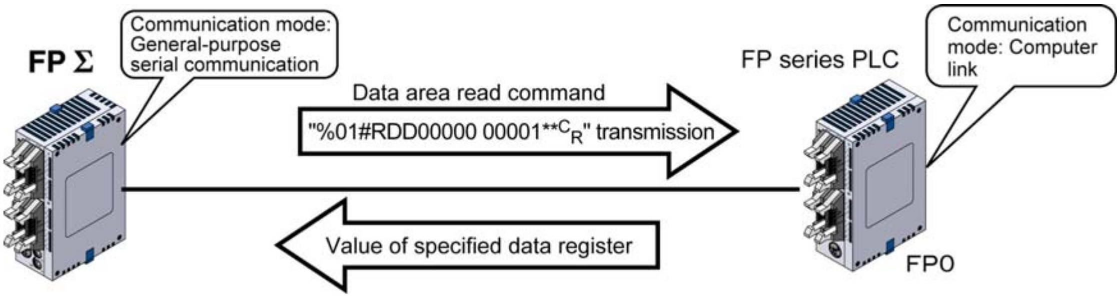
1:1 communication with FP Series PLC

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)

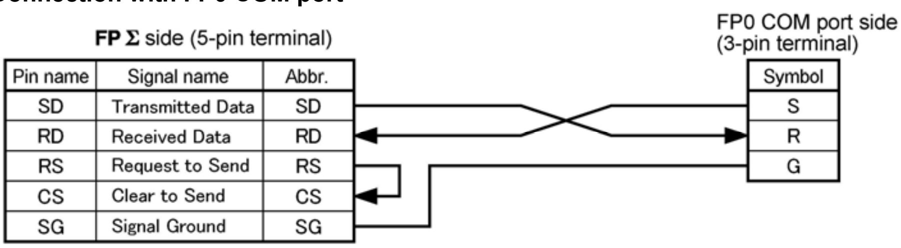
No.	Name	Set Value
No. 412	COM1 port selection of communication mode	Computer link
No. 413 *	Communication format for COM port	Data length: …… 8 bits Parity check: ….. Odd Stop bit: ………… 1 bit Terminator: …….. CR Header: ………… No STX
No. 414 *	Baud rate setting for COM port	19200 bps

* These settings should be the same as the settings of the connected FPΣ.

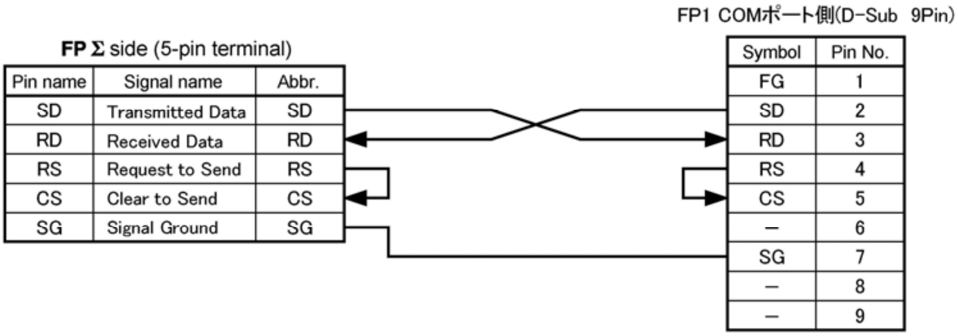
Connection to FP series PLCs (FP0, FP1)

<Using AFPG801, 1-channel RS232C type communication cassette>

- Connection with FP0 COM port

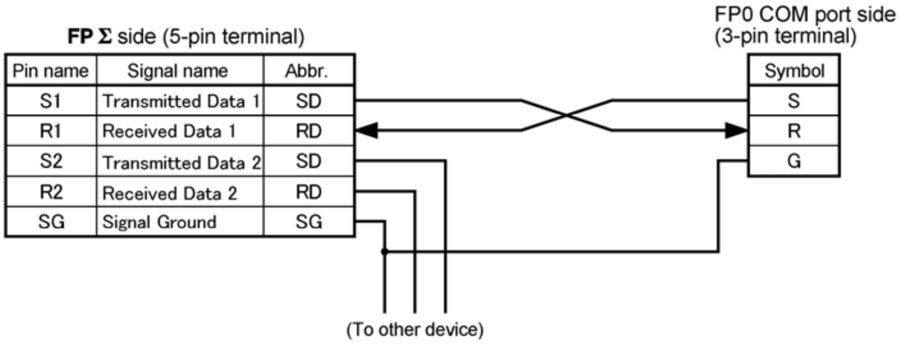


- Connection with FP1 COM port

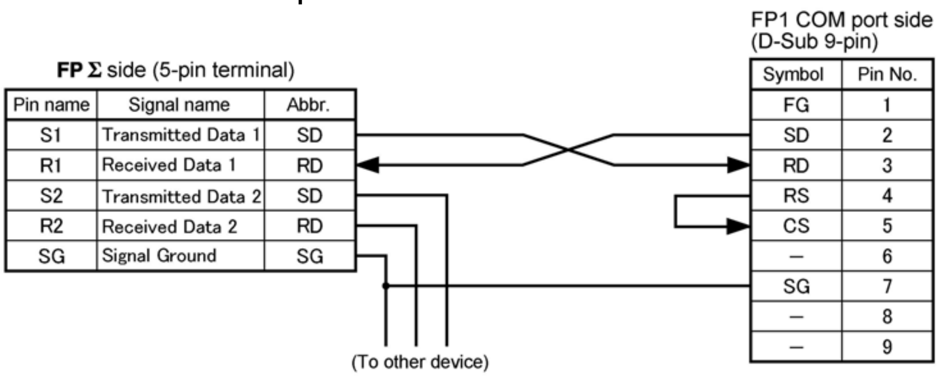


<Using AFPG802, 2-channel RS232C type communication cassette>

- Connection with FP0 COM port

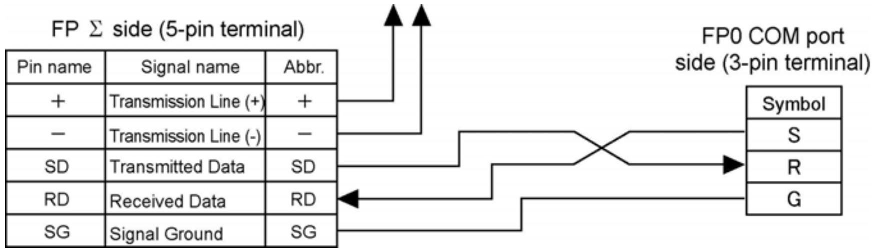


- Connection with FP1 COM port

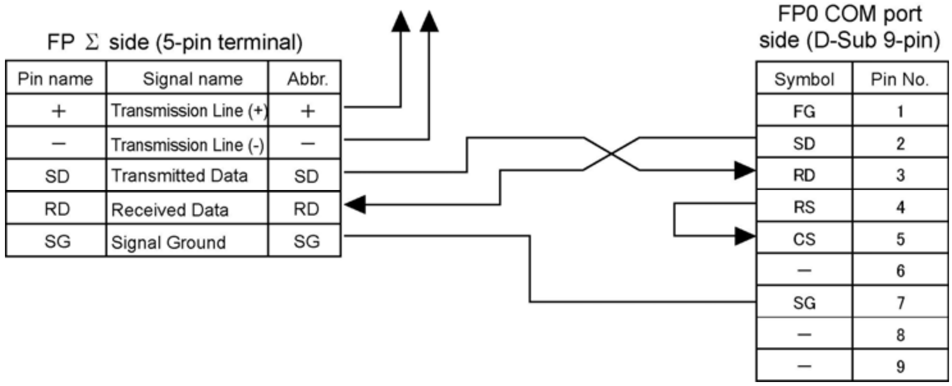


<Using AFPG806, 1-channel RS485 type and 1-channel RS232C type in combination>

- Connection with FP0 COM port

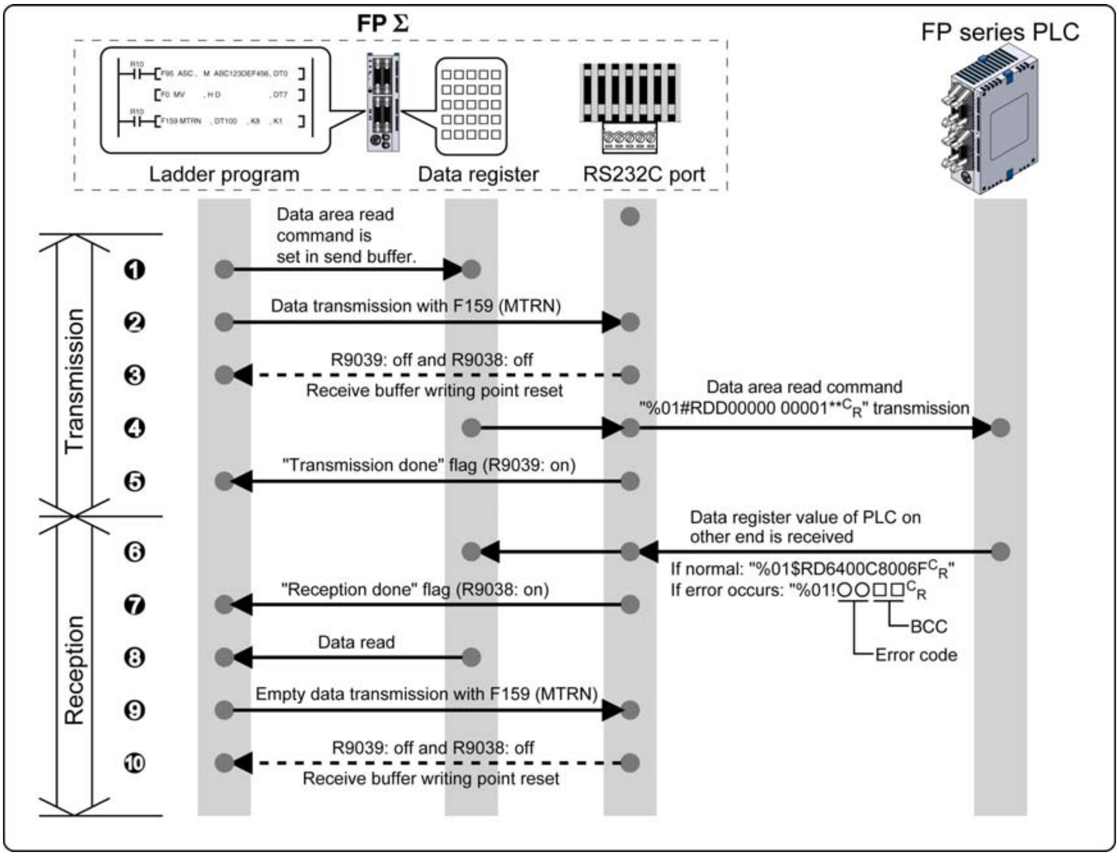


- Connection with FP1 COM port



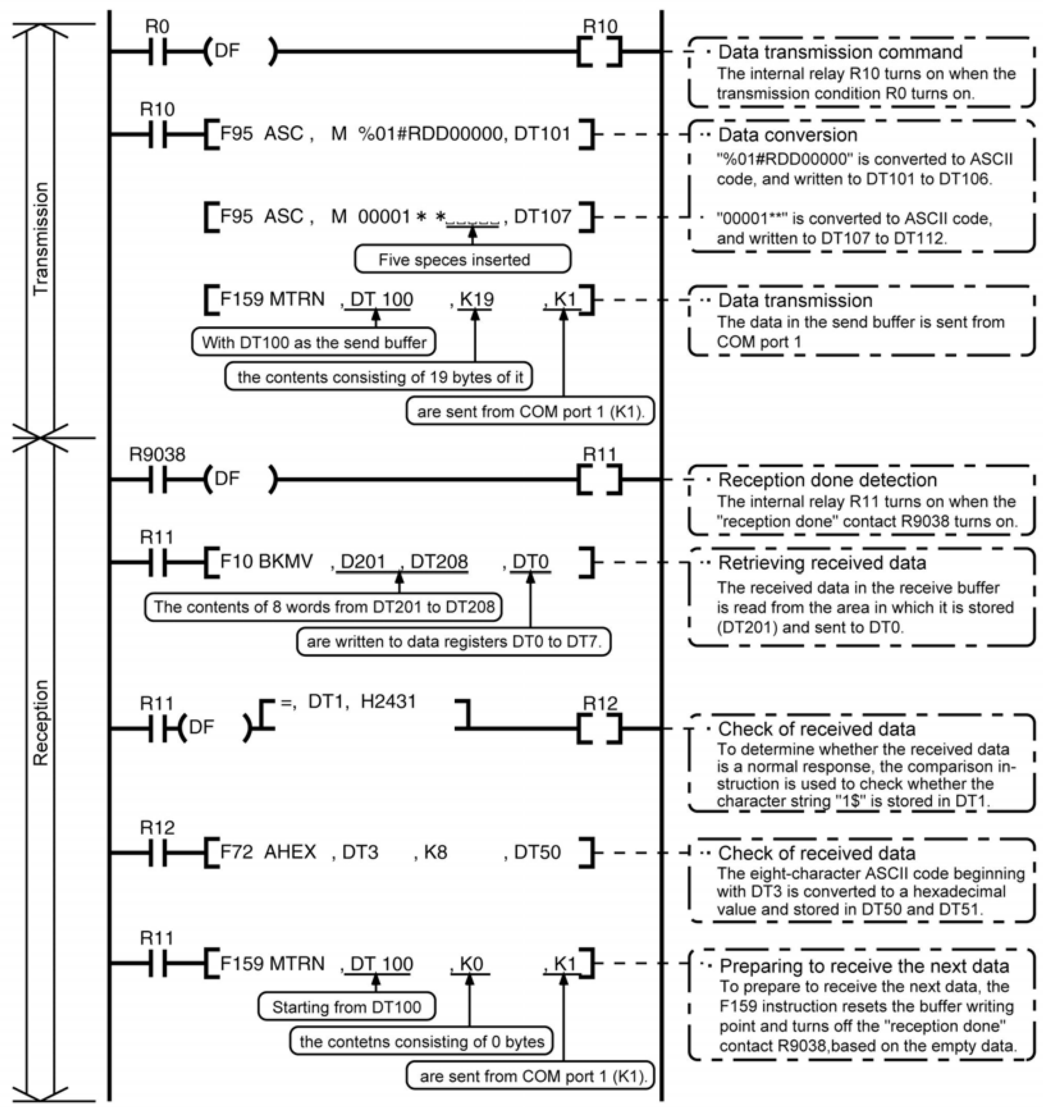
Procedure of communication

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

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

(Statuses before transmission)

DT100: Number of bytes to be transmitted.
(Set automatically when the instru-ction is executed. Ver 3.10 or later)

Receive buffer

DT200	K16	
DT201	H30 (0)	H25 (%)
DT202	H24 ($)	H31 (1)
DT203	H44 (D)	H52 (R)
DT204	H34 (4)	H36 (6)
DT205	H30 (0)	H30 (0)
DT206	H38 (8)	H43 (C)
DT207	H30 (0)	H30 (0)
DT208	H46 (F)	H36 (6)

(Statuses when reception is completed)

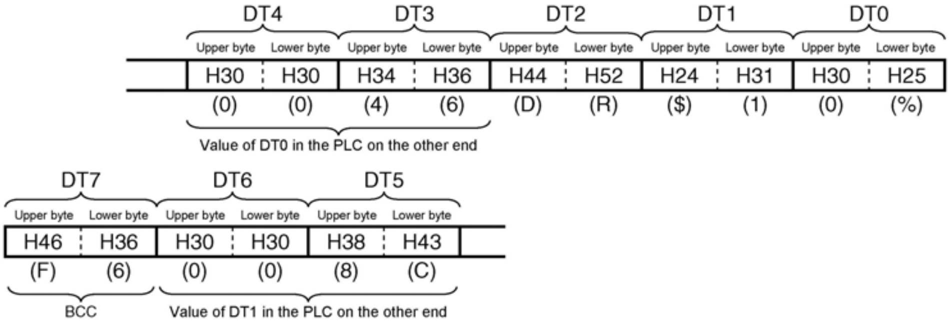
DT200: Number of bytes received

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

Key Point:

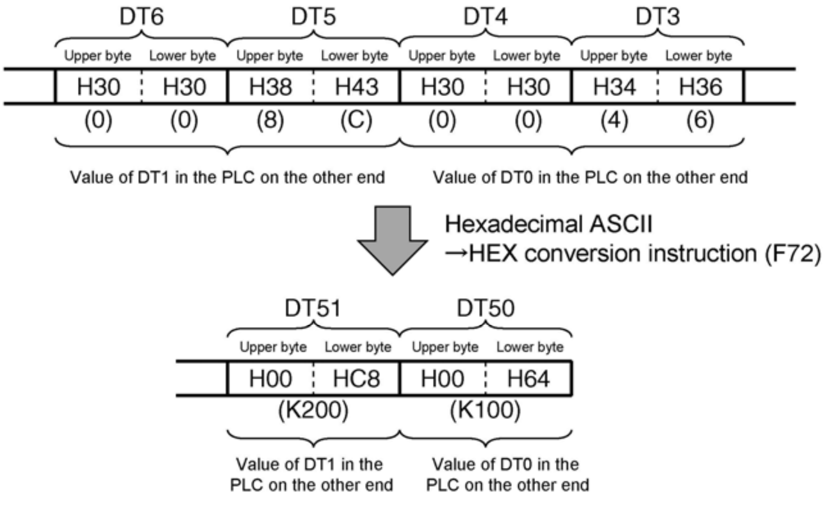
Contents of the response:

If K100 is stored in DT0 and K200 is stored in DT1 of the FP series PLC on the other end, "%01$RD6400C8006F$^{C}{}_{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 (AHEX) (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

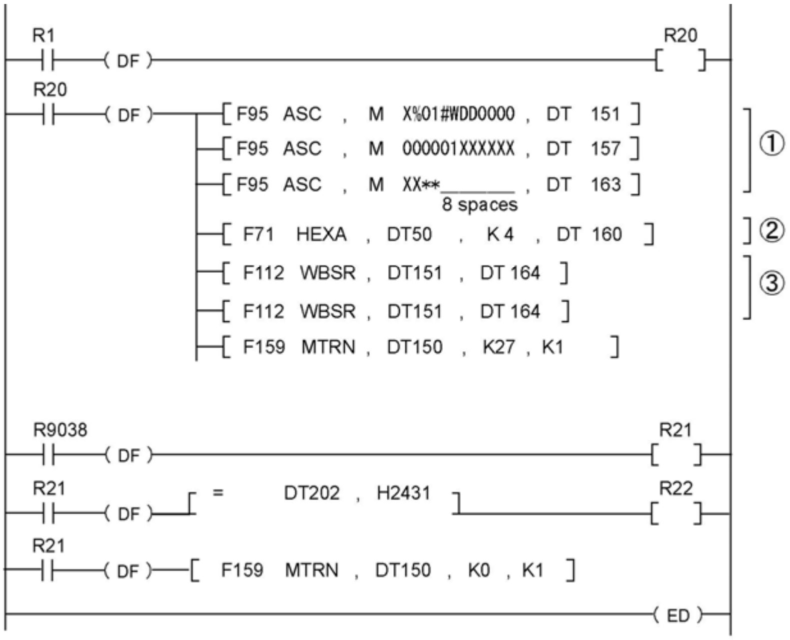


If an error occurs, "%01!○○□□$^{C}{}_{R}$" is returned as the response (○○ is the error code and □□ is the BCC).

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	*	*

② ASCII code is inserted for the value of DT50 (DT160–DT161)

ASCII code is inserted for the value of DT51 (DT162–DT163)

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

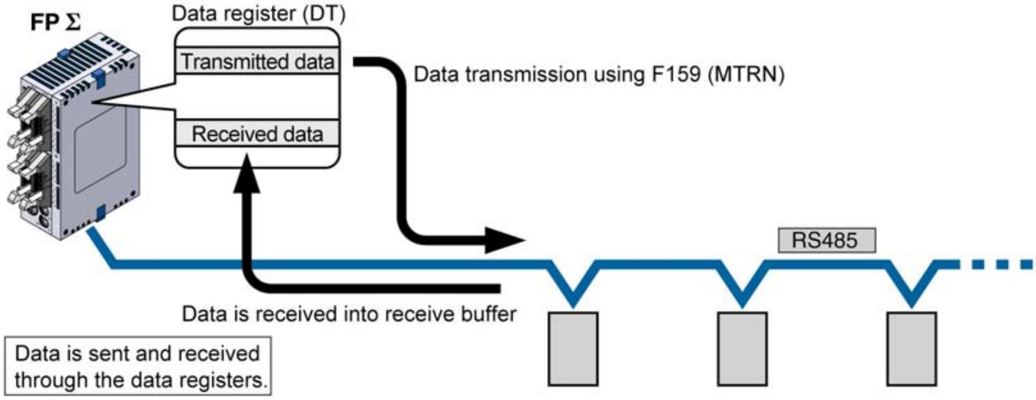
Normal response %01$WD□□ C_R
└ BCC

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>

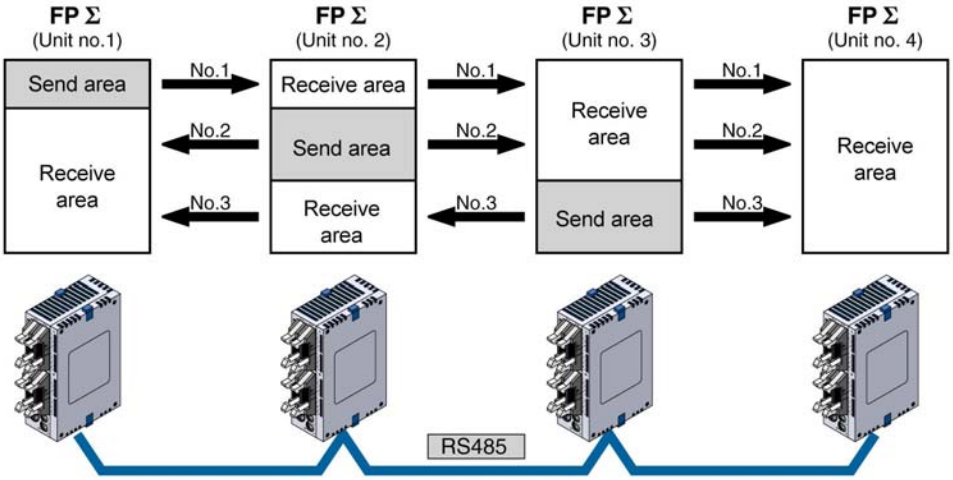
Note3) Connect the "–" terminal and the "E" terminal with a lead wire to make the termination resistance of the AFPG803 effective.
The termination resistance of the AFPG806 is specified by the dip switch located in the communication cassette.

7.6 Communication Function 3: PC(PLC) link

7.6.1 PC(PLC) link

Overview

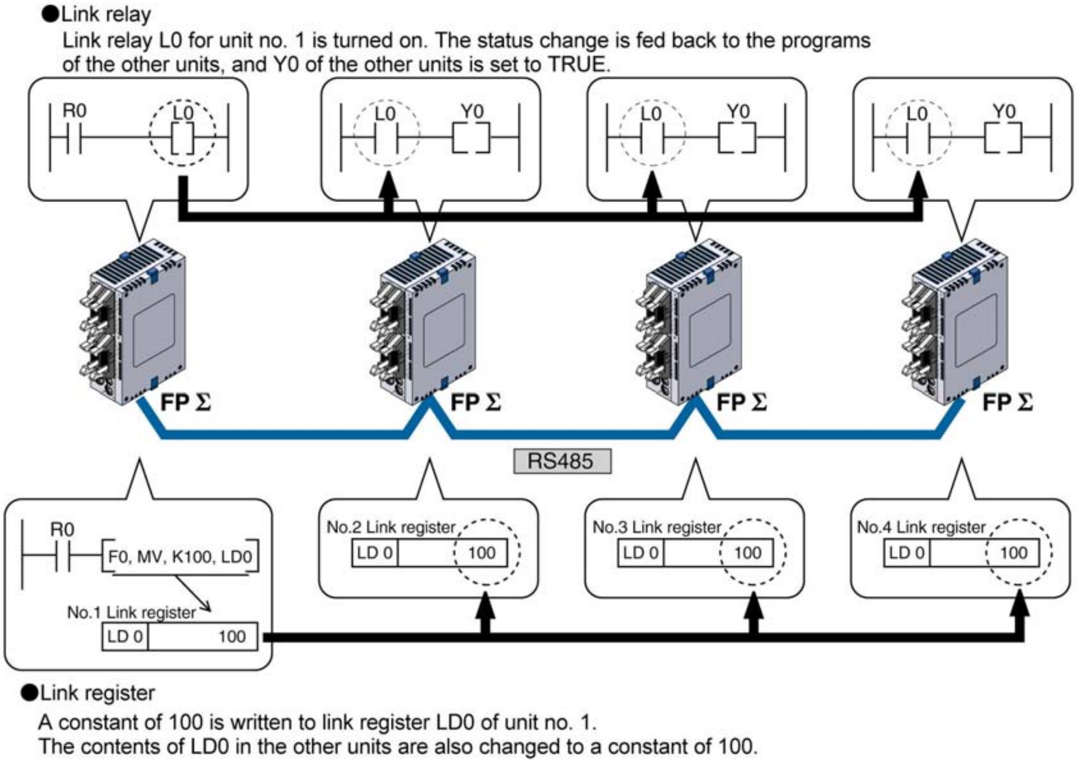
- The PC(PLC) link is an economic way of linking PLCs, using a twisted-pair cable.
- Data is shared between the PLCs using link relays (L) and link registers (LD).
- The statuses of the link relays and link registers of one PLC are automatically fed back to the other PLCs on the same network.
- PC(PLC) 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.

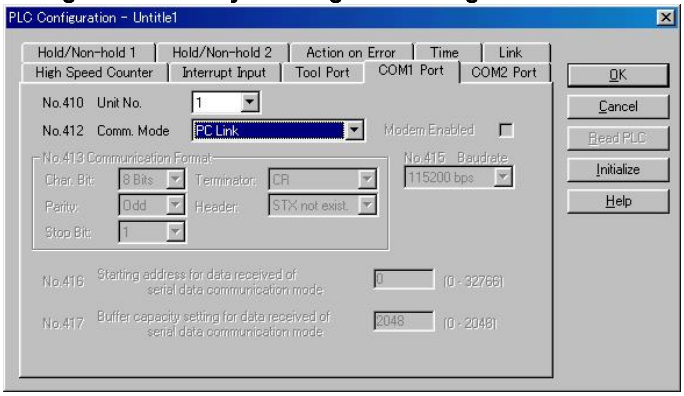


7.6.2 Setting Communication Parameters

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



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 AFPG803 effective.
The termination resistance of the AFPG806 is specified by the dip switch located in the communication cassette.

Note2) 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.

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.

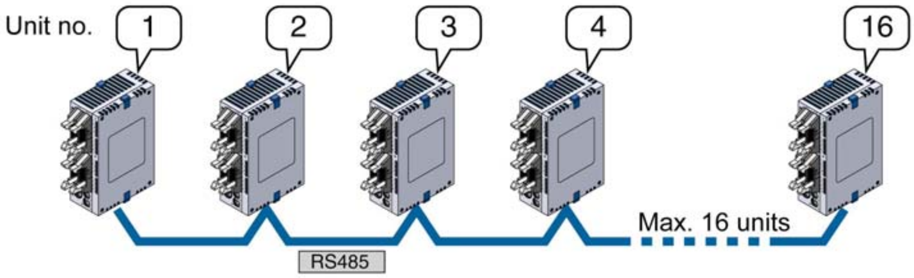
The unit number is specified either by using **the unit number setting switch**, **SYS1 instruction** or **the system register**.

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.

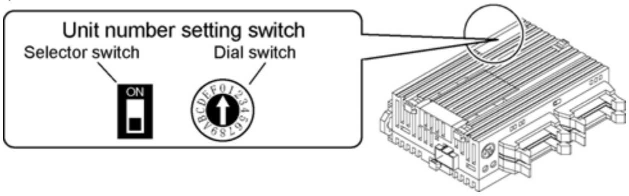


Table of switch settings and related unit numbers

Unit No.			Unit No.		
※	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		

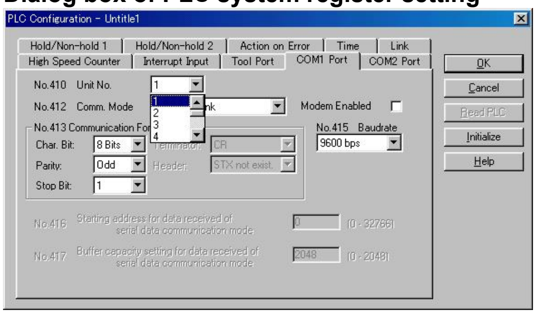
- The numbers in a range of 1 to 16 can be set using the unit number setting switch. With the RS232C, set it to 1 or 2.
- Set the unit number setting switch to 0 to make the system register setting valid. (Individual settings are possible using the system register setting.)

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 FPWIN 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:

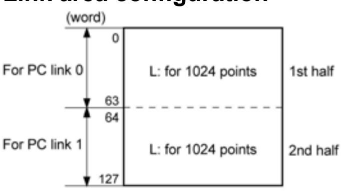
The PC(PLC) link 1 is available for the FPΣ 32k type only.
Set the system register 46 to “Reverse” to use the PC(PLC) link 1.

System registers

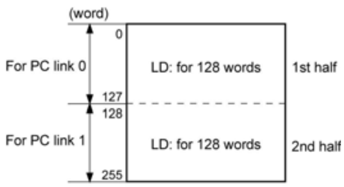
No.		Name	Default value	Set value
For PC (PLC) link 0	40	Range of link relays used for PC(PLC) link	0	0 to 64 words
	41	Range of link data registers used for PC(PLC) link	0	0 to 128 words
	42	Starting number for link relay transmission	0	0 to 63
	43	Link relay transmission size	0	0 to 64 words
	44	Starting number for link data register tranmission	0	0 to 127
	45	Link data register transmission size	0	0 to 128 words
	46	PC(PLC) link switch flag	Normal	Normal: 1st half Reverse: 2nd half
	47	Maximum unit number setting for MEWNET-W0 PC(PLC) link	16	1 to 16 [Note1)]
For PC (PLC) link 1	46	PC(PLC) link switch flag	Normal	Normal: 1st half Reverse: 2nd half
	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 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 tranmission	128	128 to 255
	55	Link data register transmission size	0	0 to 128 words
	57	Maximum unit number setting for MEWNET-W0 PC(PLC) link	0	0 to 16 [Note1)]

Note1) The same maximum unit number should be specified for all the PLCs connected in the PC(PLC) link.

Link area configuration



For link relay



For link register

- 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 ben 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:

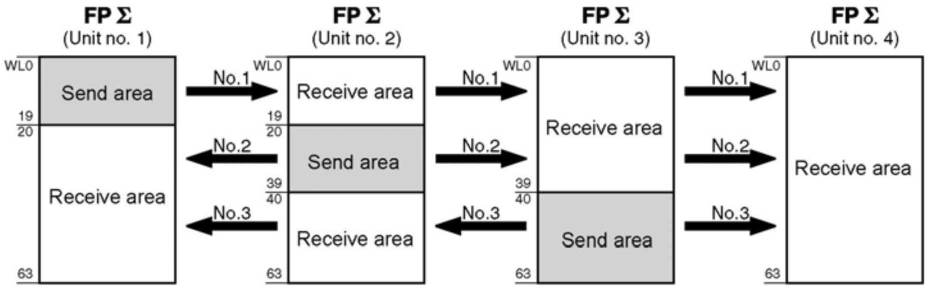
The PC link 1 can be used to connect with the second PC link W0 of the FP2 Multi Communication Unit (MCU). At that time, the link relay number and link register number for the PC link can be the same values as the FP2 (from WL64, from LD128).

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

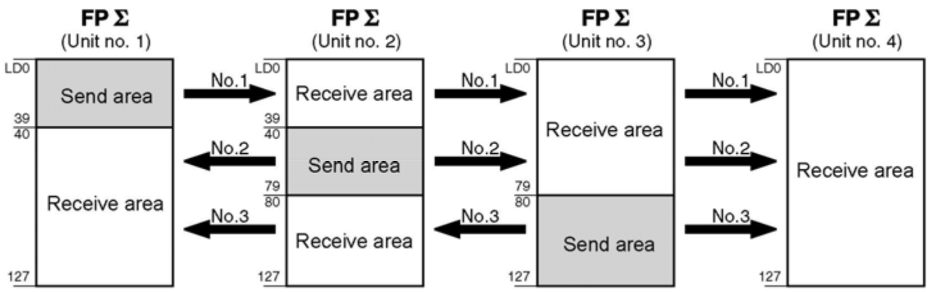


System registers

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

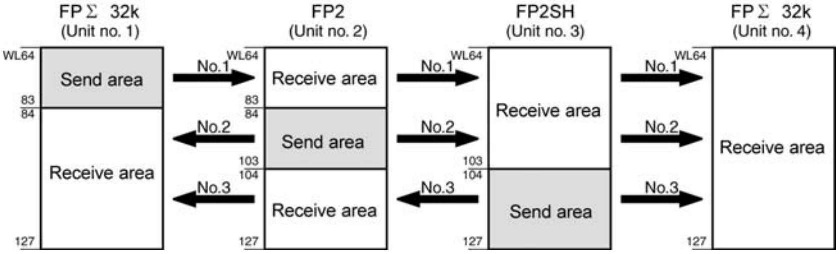
No.	Name	Set value of various control units			
		No. 1	No. 2	No. 3	No. 4
No. 41	Range of link registers used for PC(PLC) link	128	128	128	128
No. 44	Start address of link register send area	0	40	80	0
No. 45	Size of link register send area	40	40	48	0

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

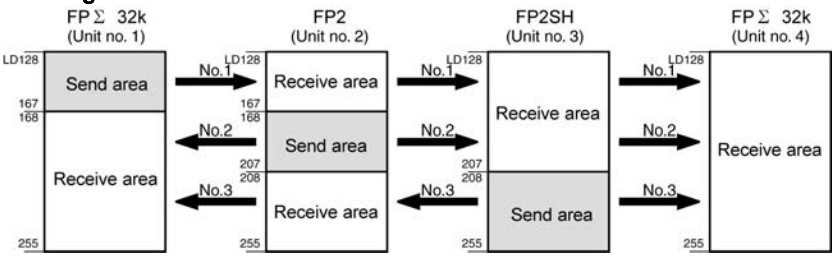


System registers

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).

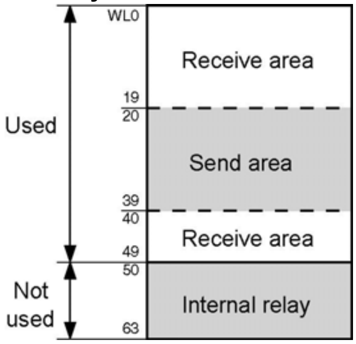
Reference:

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.

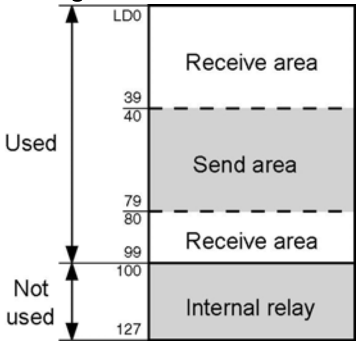
Link relay allocation



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.

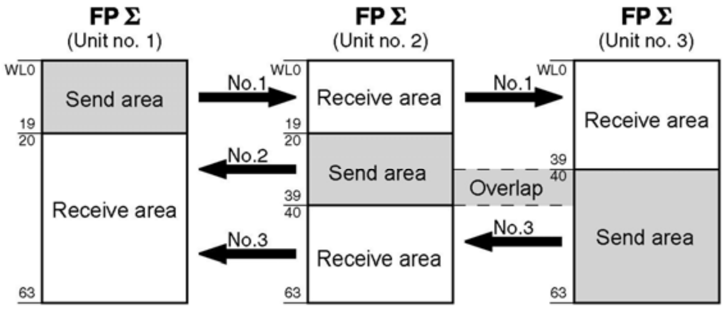
Note: Precautions for link area allocation

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



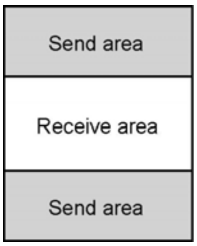
System registers

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.

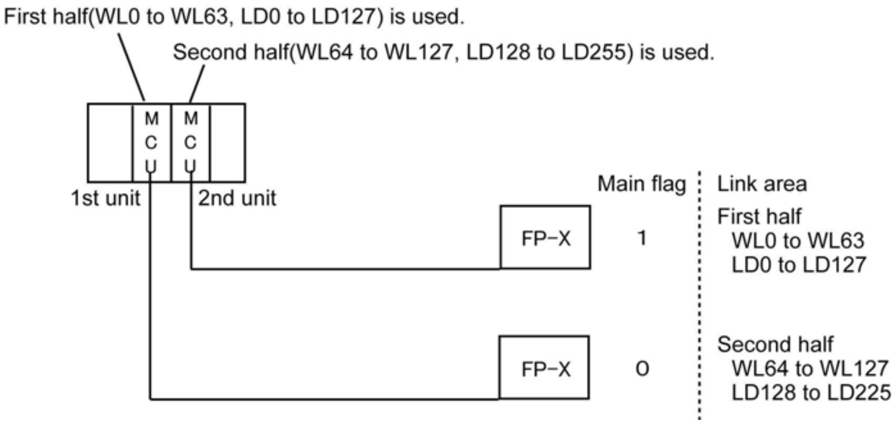
Note:

- 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 loink relays and registers are 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															

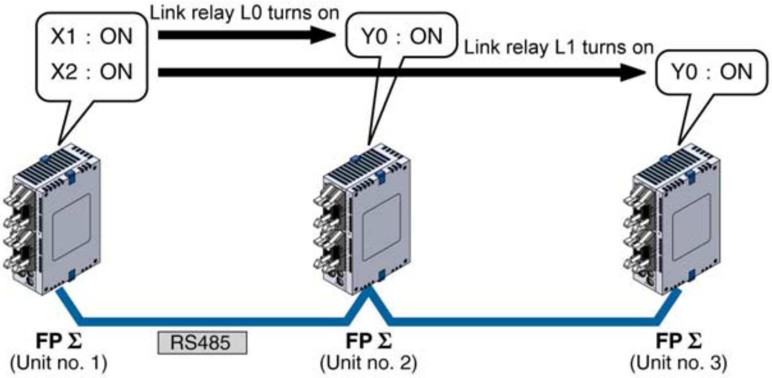
Key Point: Monitoring the PC(PLC) link status
In FPWIN GR, the PC(PLC) link status items, such as the transmission cycle time and the number of times that errors have occurred, can be monitored by selecting the PC(PLC) link switch on the FPWIN GR Status Monitor screen.

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 use. 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

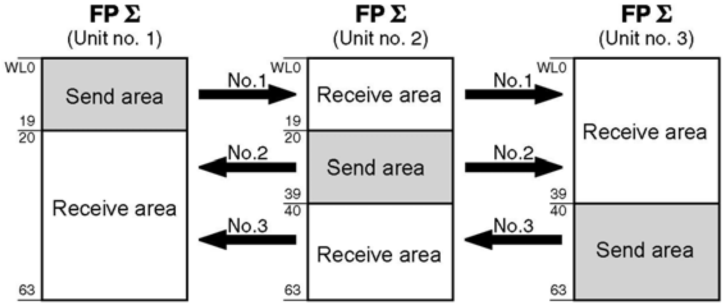
No.	Name	Set value
No. 410	COM1 port unit no.	3
No. 412	COM1 port selection of communication mode	PC(PLC) link

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

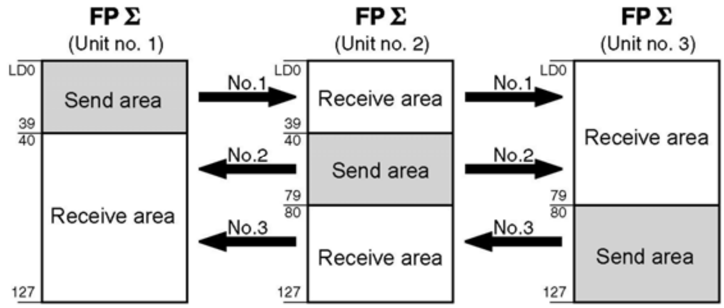
- Link relay allocation



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

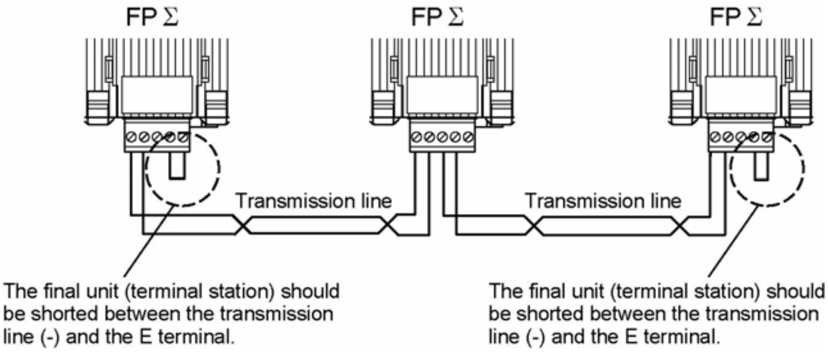
No.	Name	Set value of various control units		
		No. 1	No. 2	No. 3
No. 41	Range of link registers used for PC(PLC) link	128	128	128
No. 44	Start address of link register send area	0	40	80
No. 45	Size of link register send area	40	40	48

Setting the largest unit number

No.	Name	Set value
No. 47	Largest unit number setting for PC(PLC) link	3

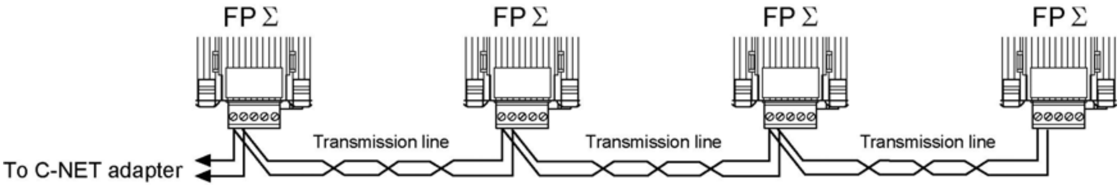
Connection diagram

<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 mm^2.
The terminal station is specified with the dip switch located in the communication cassette.

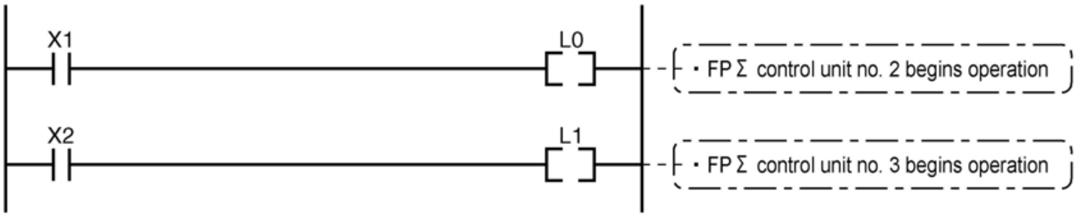


Reference: <7.1.4 Setting of AFPG806 Switch>.

Sample program

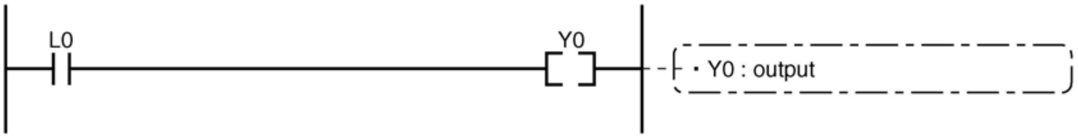
- Unit no. 1

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



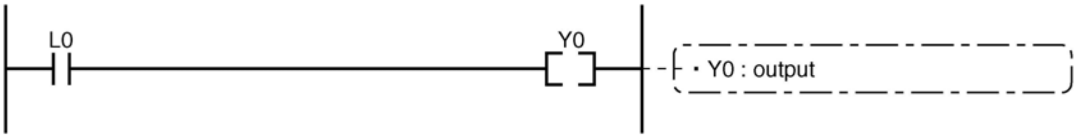
- Unit no. 2

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.

$$T\ max. = \underbrace{Ts1 + Ts2 + \cdot\cdot\cdot\cdot\cdot\cdot + Tsn}_{①\ Ts\ \text{(transmission time per station)}} + \underbrace{Tlt}_{②\ Tlt\ \text{(link table sending time)}} + \underbrace{Tso}_{③\ Tso\ \text{(master station scan time)}} + \underbrace{Tlk}_{④\ Tlk\ \text{(link addition processing time)}}$$

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

← Ts (transmission time per station)
Ts = scan time + Tpc (PC(PLC) link sending time)
Tpc = Ttx (sending time per byte) x Pcm (PC(PLC) link sending size)
Ttx = 1/(baud rate x 1000) x 11 ms …. Approx. 0.096 ms at 115.2 kbps
Pcm = 23 + (number of relay words + number of register words) x 4

↑ Tlt (link table sending time)
Tlt = Ttx (sending time per byte) x Ltm (link table sending size)

Ttx = 1/(baud rate x 1000) x 11 ms …. Approx. 0.096 ms at 115.2 kbps
Ltm = 13 + 2 x n (n = number of stations being added)

→ Tso (master station scan time)
This should be confirmed using the programming tool.

↓ Tlk (link addition processing time) …. If no stations are being added, Tlk = 0.
Tlk = Tlc (link addition command sending time) + Twt (addition waiting time) + Tls (sending time for command to stop transmission if link error occurs) + Tso (master station scan time)

Tlc = 10 x Ttx (sending time per byte)
Ttx = 1/(baud rate x 1000) x 11 ms …. Approx. 0.096 ms at 115.2 kbps
Twt = Initial value 400 ms (can be changed using SYS1 system register instruction)
Tls = 7 x Ttx (sending time per byte)
Ttx = 1/(baud rate x 1000) x 11 ms …. Approx. 0.096 ms at 115. 2 kbps
Tso = 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) x 4 = 71 bytes Tpc = Ttx x Pcm = 0.096 x 71 ≒ 6.82 ms
Each Ts = 1 + 6.82 = 7.82 ms Tlt = 0.096 x (13 + 2 x 16) = 4.32 ms
Given the above conditions, the maximum value for the transmission time (T) of one cycle will be:
T max. = 7.82 x 16 + 4.32 + 1 = 130.44 ms

Calculation example 2
When 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) x 4 = 71 bytes Tpc = Ttx x Pcm = 0.096 x 71 ≒ 6.82 ms
Each Ts = 5 + 6.82 = 11.82 ms Tlt = 0.096 x (13 + 2 x 16) = 4.32 ms
Given the above conditions, the maximum value for the transmission time (T) of one cycle will be:
T max. = 11.82 x 16 + 4.32 + 5 = 198.44 ms

Calculation example 3

When 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.

Ttx = 0.096   Each Ts = 5 + 6.82 = 11.82 ms
Tlt = 0.096 x (13 + 2 x 15) ≒ 4.13 ms
Tlk = 0.96 + 400 + 0.67 + 5 ≒407 ms
Note: The default value for the addition waiting time is 400 ms.

Given the above conditions, the maximum value for the transmission time (T) of one cycle will be:
T max. = 11.82 x 15 + 4.13 + 5 + 407 = 593.43 ms

Calculation example 4

When 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.

Ttx = 0.096   Each Pcm = 23 + (8 + 16) x 4 = 119 bytes
Tpc = Ttx x Pcm = 0.096 x 119 ≒ 11.43 ms
Each Ts = 5 + 11.43 = 16.43 ms   Tlt = 0.096 x (13 + 2 x 8) ≒ 2.79 ms

Given the above conditions, the maximum value for the transmission time (T) of one cycle will be:
T max. = 16.43 x 8 + 2.79 + 5 = 139.23 ms

Calculation example 5

When 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.

Ttx = 0.096   Each Pcm = 23 + (32 + 64) x 4 = 407 bytes
Tpc = Ttx x Pcm = 0.096 x 407 ≒ 39.072 ms
Each Ts = 5 + 39.072 = 44.072 ms   Tlt = 0.096 x (13 + 2 x 2) ≒ 1.632 ms

Given the above conditions, the maximum value for the transmission time (T) of one cycle will be:
T max. = 44.072 x 2 + 1.632 + 5 = 94.776 ms

Calculation example 6

When 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.

Ttx = 0.096   Each Pcm = 23 + (1 + 1) x 4 = 31 bytes
Tpc = Ttx x Pcm = 0.096 x 31 ≒ 2.976 ms
Each Ts = 1 + 2.976 = 3.976 ms   Tlt = 0.096 x (13 + 2 x 2) ≒ 1.632 ms

Given the above conditions, the maximum value for the transmission time (T) of one cycle will be:
T max. = 3.976 x 2 + 1.632 + 1 = 10.584 ms

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 thte 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 max. = Ts1 + Ts2 + ・・・・・・ + Tsn + Tlt + Tso + Tlk

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

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

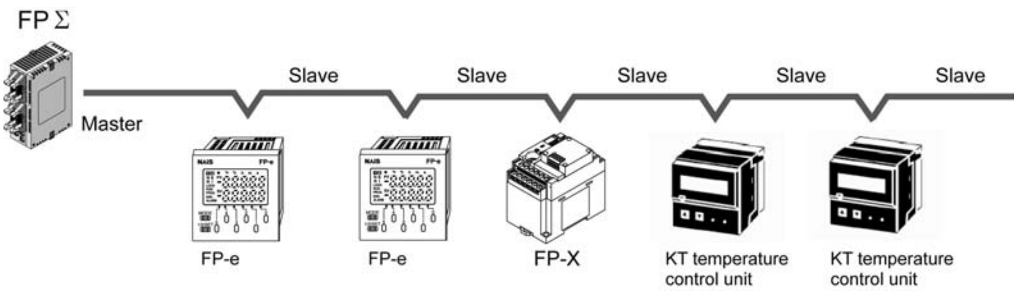
- This function is available for the 32k type only.
- The MODBUS RTU protocol enables the communication between the FPΣ and other devices (including our FP-e, Programmable display GT series and KT temperature control unit).
- Enables to have conversations if the master unit sends instructions (command messages) to slave units and the slave units respond (response messages) according to the instructions.
- Enabels 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.

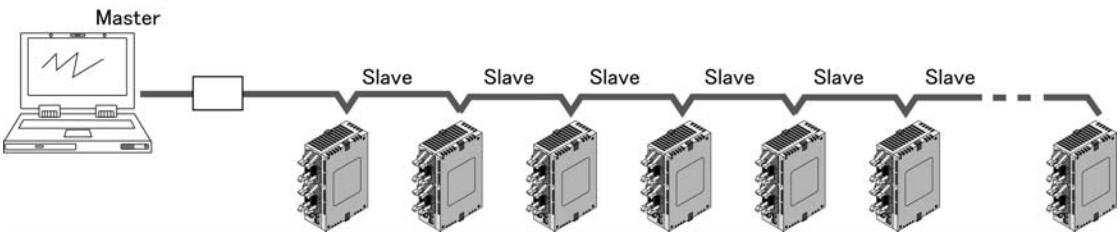
Master function

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 unti 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.

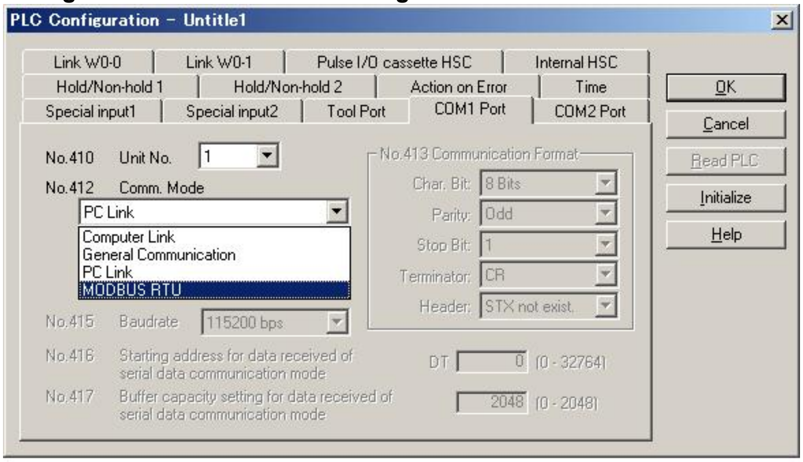
Table for MODBUS reference No. and FPΣ device No.

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 FPWIN 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



For the details on the MODBUS RTU communication function, refer to the exclusive specifications manual.

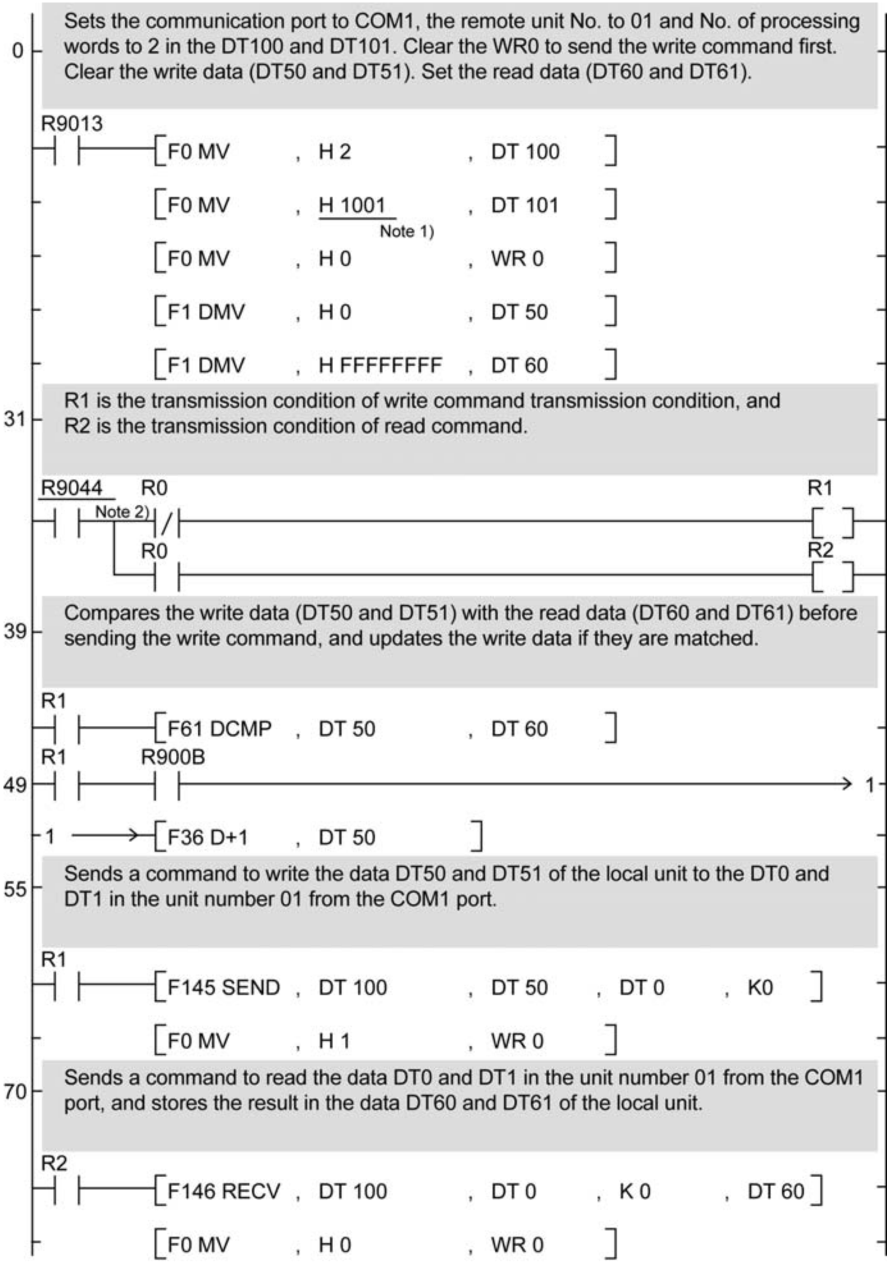
Reference: <MODBUS RTU Specifications>
It can be downloaded from our website.
http://www.mew.co.jp/ac/e/fasys/plc/

For the information on F145 (SEND) and F146 (RECV) instructions

Reference: <Programming Manual ARCT1F353>

Sample program for MODBUS master

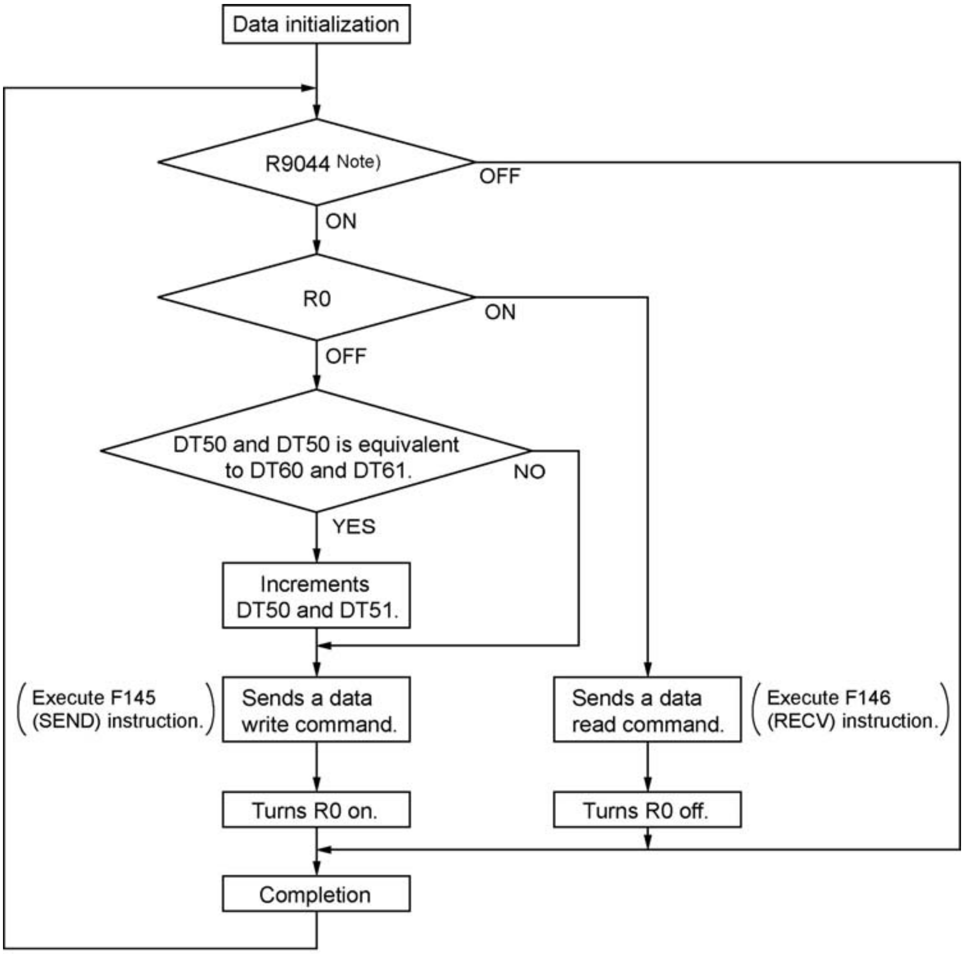
Use the F145 (SEND) “Data send” or F146 (RECV) “Data receive” instruction to use the MODBUS master function.



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 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 “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 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 “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.)

Releaseing the protect of PLC (Programs are retained.)

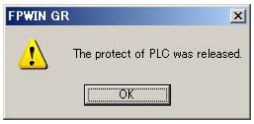
As the dialog box is shown, select as below.

Digit number:
Select “4 digits” or “8 digits”.

Operation Mode:
Select “Unprotect”.

4 digits (or 8 digits) password:
Input a password to be set.

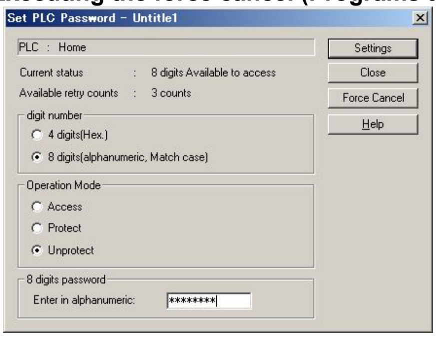
Click “Settings”.



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

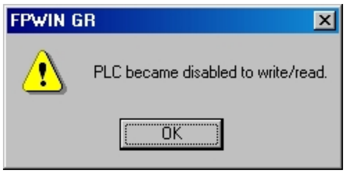
As the dialog box is shown, select as below.

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.

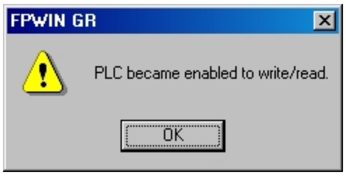
Setting to allow the access to the program by inputting a password

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.)

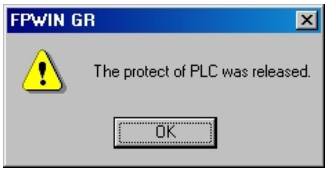
Releaseing the protect of PLC (Programs are retained.)

As the dialog box is shown, select as below.

Operation Mode:
Select “Unprotect”.

4 digits password:
Input a password to be set.

Click “Settings”.



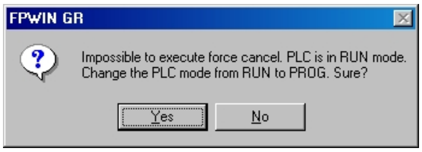
Click [OK].

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 disalbed 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 artibrary 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 exected, 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.

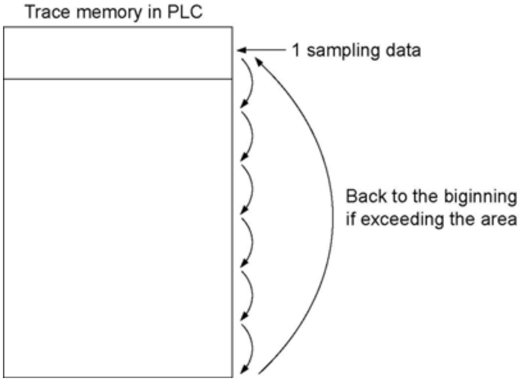
Note: It is not possible to activate the sampling at regular time intervals and the sampling by the F155(SMPL) instruction simultaneously.

How to stop sampling
Methods of the stop trigger (request): Following two methods are available.

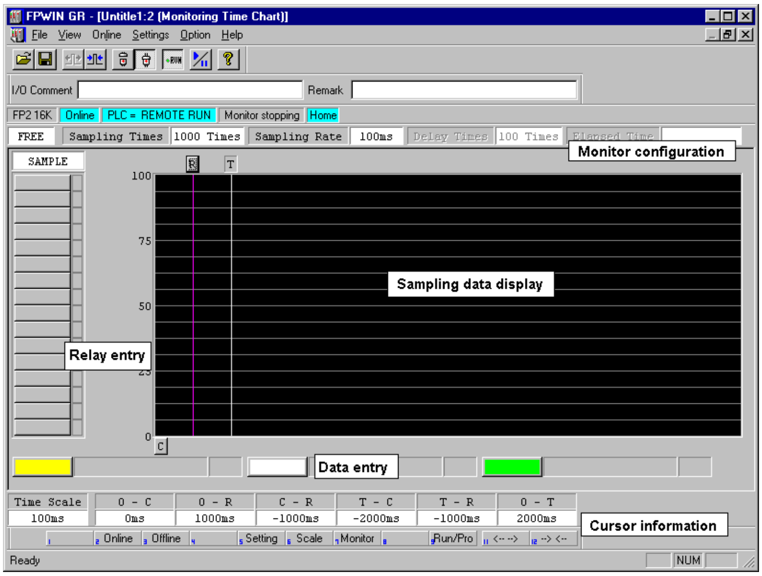
1. Deactivate request by the tool software
2. Deactivate request by the F156(STRG) instruction

If the stop trigger activates, the PLC will continue to take samplings for the specified No. of delay, and then stop the sampling operaton. 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



9.2.3 How to Use Sampling Trace



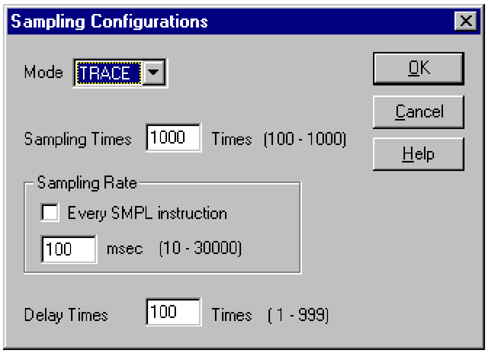
1. Sampling at regular time intervals

(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).

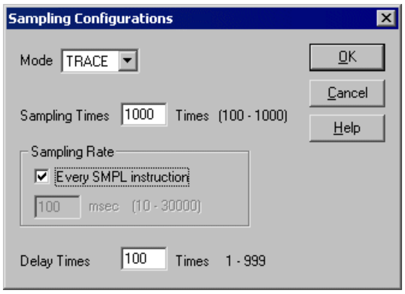


(3) Start monitoring. Start with the button.

2. Sampling by instruction

(1) Register the bit/word device to be monitored by the time chart monitor function of FPWIN GR.

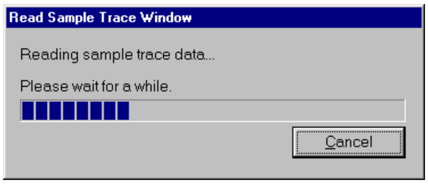
(2) Specify the sampling configurations.
Set the mode of the sampling configurations to “Trace”.
Set the sampling rate (time) to 0.

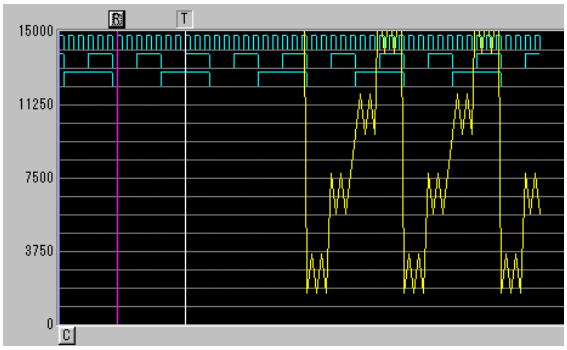


3. Read data by trigger

(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 FPWIN 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

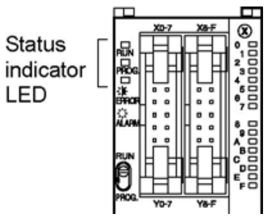
10.1 Self-Diagnostic function

10.1.1 LED Display for Status Condition

Status indicator LEDs on control unit

	LED status			Description	Operation statuss
	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.

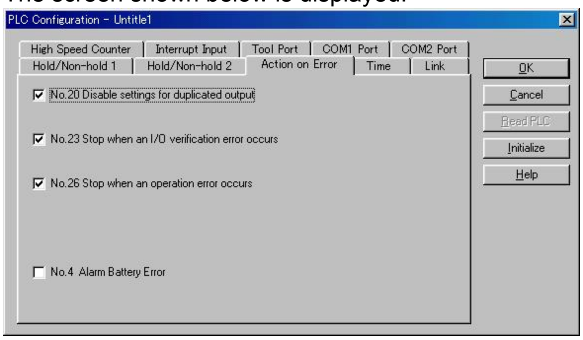


10.1.2 Operation on Error

- 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.

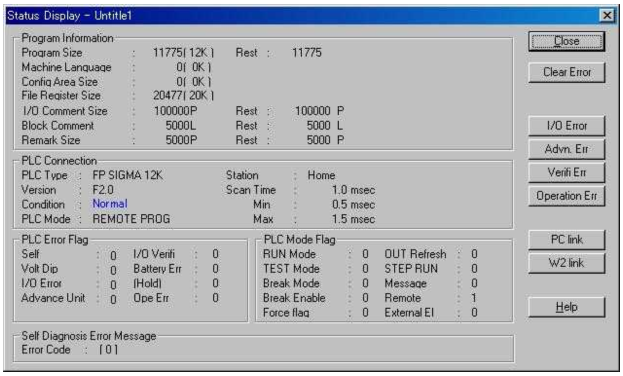
10.2 Troubleshooting

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 FPWIN GR

Click on the "Clear Error" button in the "Status display dialog box". Error code 43 and higher can be cleared.

- In the PROG. mode, the power supply can be turned off and then on again to clear the error, but all of the contents of the operation memory except hold type data arecleared.
- An error can also be cleared by executing a self-diagnostic error set instruction F148 (ERR).

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 pgrogrammed 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 abnoramlity 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 FPWIN GR and turn on the “Access” radio button.
Using FPWIN GR
(1)Select “Set PLC Password” under “Tool” on the menu bar.
(2)The PLC password setting dialog box shown below is displayed. Turn on the radio button next to “Access”, enter a password, and click on the “Settings” button.

Set PLC password dialog box

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 ocurred.

Procedure 1
Check if the ERROR/ALARM LED is flashing.
Reference:
If the ERROR/ALARM LED is flashing, check <10.2.1 If ERROR/ALARM LED is flashing>.

Procedure 2
Execute a total-check function to determine the location of the syntax error.
Using FPWIN 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 communciation 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 enalbed.
- 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.

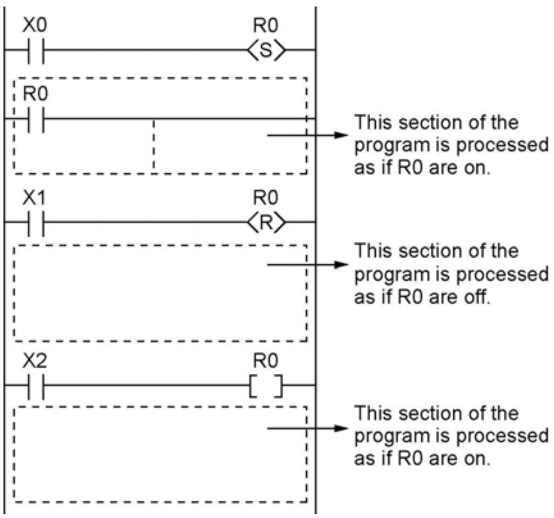
11.1.2 When Output is Repeated with an OT, KP, SET or RST Instruction

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.

<Exmaple>

Processing when SET, RST and OT instructions are used (X0 to X2 are all on).

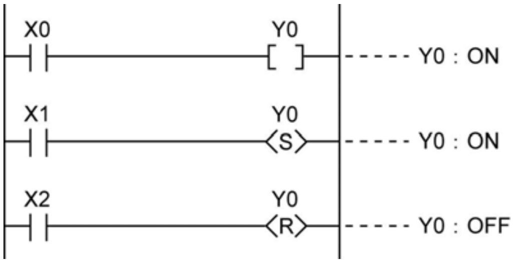


The output is determined by the final operation results

- 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.

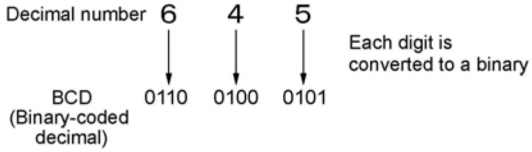
- If you need to output a result while processing is still in progress, use a partial I/O update instruction (F143).

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:

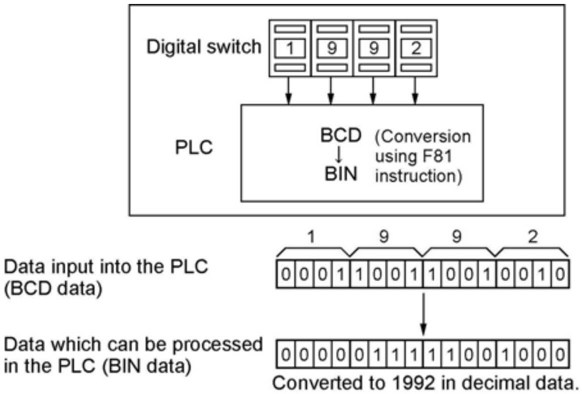


11.2.2 Handling BCD Data in the PLC

- 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.

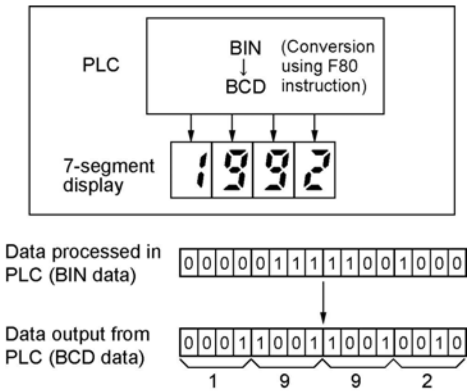
Input from a digital switch

Use the BCD-to-BIN conversion instruction F81.



Output to a 7-segment display (with decoder)

Use the BIN-to-BCD conversion instruction F80.

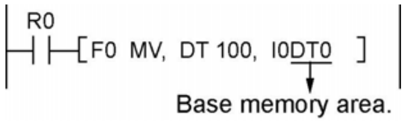


11.3 Handling Index Registers

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.

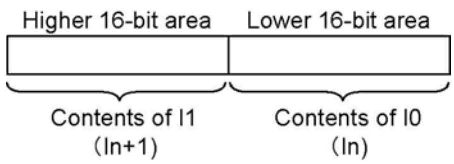


In this example, the number of the destination data register varies depending on the contents of I0 with DT0 acting as a base. For example, when I0 contains K10, the destination will be DT10, and when I0 is K20, the destination will be DT20.

- 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.

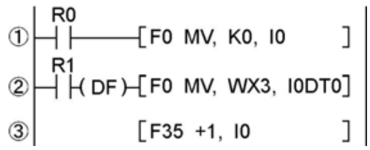
11.3.2 Memory Areas Which can be Modified with Index Registers

- 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

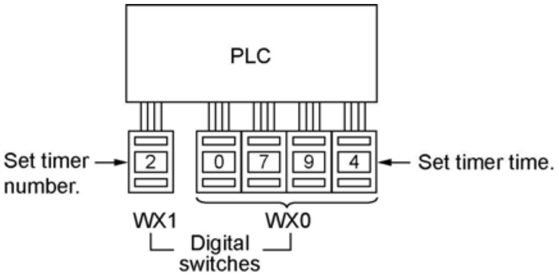
Repeatedly reading in external data
<Example>
Writing the contents of input WX3 to a sequence of data registers beginning from DT0.

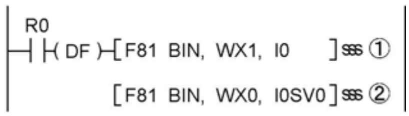


① When R0 turns on, 0 is written to index register I0.
② When the R1 turns on, the contents of input WX3 is transferred to the data register specified by I0DT0.
③ Add 1 to I0. In this case, the contents of I0 will change successively, and the destination data register will be as follows.

Input times of R1	Contents of I0	Destination data register
1st	0	DT0
2nd	1	DT1
3rd	2	DT2
:	:	:

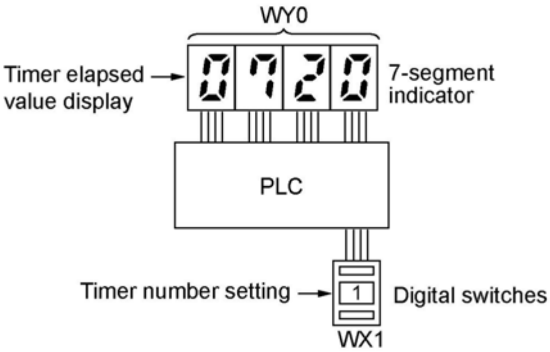
Inputting and outputting data based on a number specified by an input
<Example 1> Setting a timer number specified by a digital switch

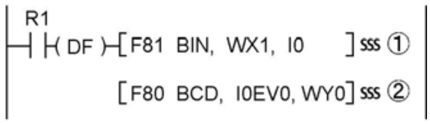




① Convert the BCD timer number data in WX1 to binary and set it in index register I0.
② Convert the BCD timer set value in WX0 to binary and store in the timer set value area SV specified by contents of I0.

<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 aera 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

```
 R0
-| |--[F0 MV, DT0, I0DT0    ]
```

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

```
 R0
-| |--[F81 BIN, DT0, DT100 ]
```

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

```
 R0
-| |--[F80 BCD, DT1, DT101 ]
```

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>

```
 R0
-| |--[F32 %, DT0, DT100, DT200]
```

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

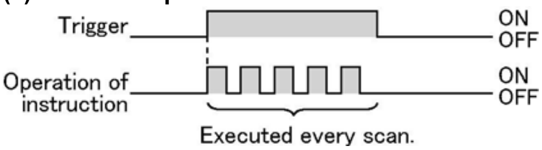
Instructions using the leading edge detection operation

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)

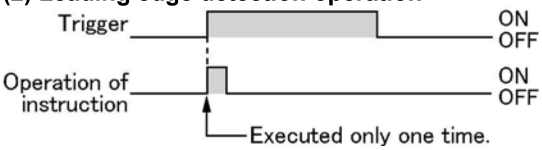
Leading edge detection method

- 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.

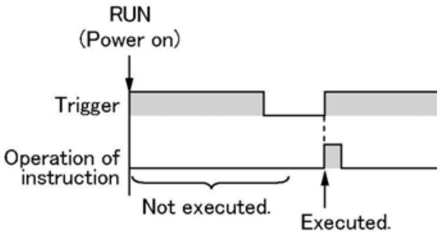
Be careful when using leading edge detection type instructions with control instructions, such as:

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

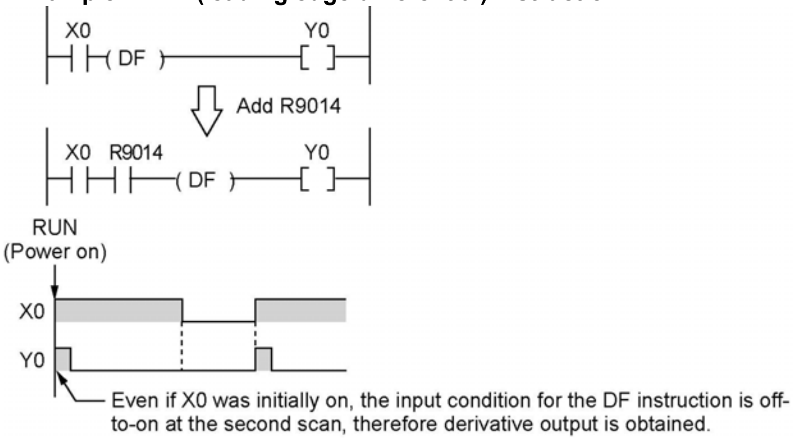
Operation of first scan after RUN begins

- 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.

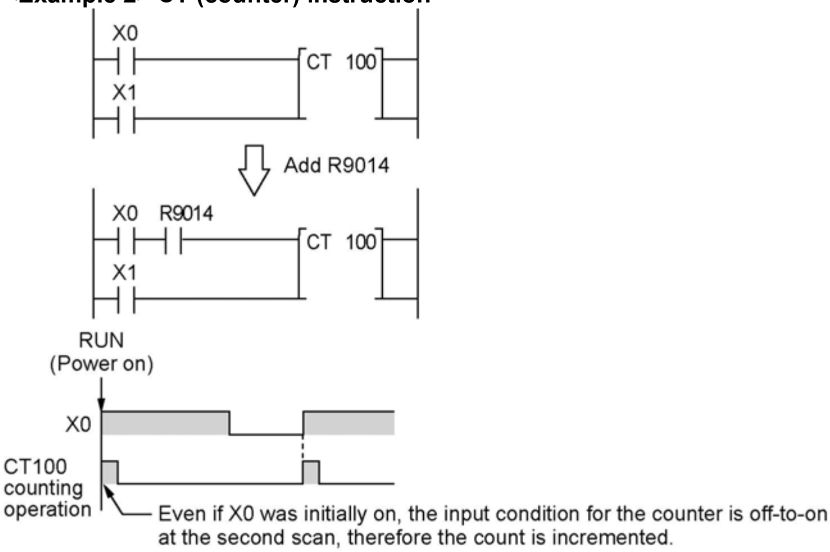


- If you need to execute an instruction when the trigger (execution condition) is on prior to switching to RUN mode, make a program as below using R9014 (initial pulse off relay). (R9014 is a special internal relay which is off during the first scan and turns on at the second scan.)

<Example 1> DF (leading edge differential) instruction



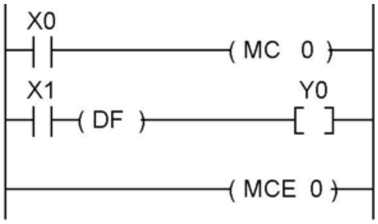
<Example 2> CT (counter) instruction



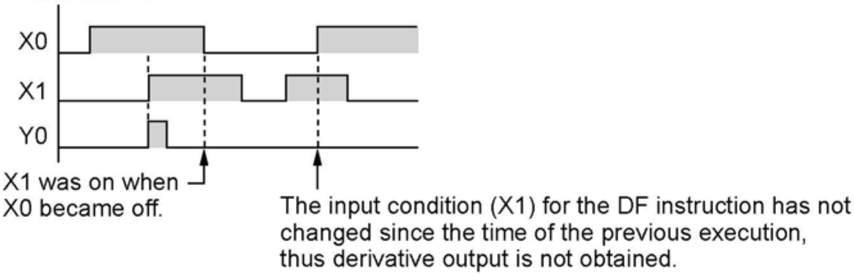
11.5.3 Precautions When Using a Control Instruction

• 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.

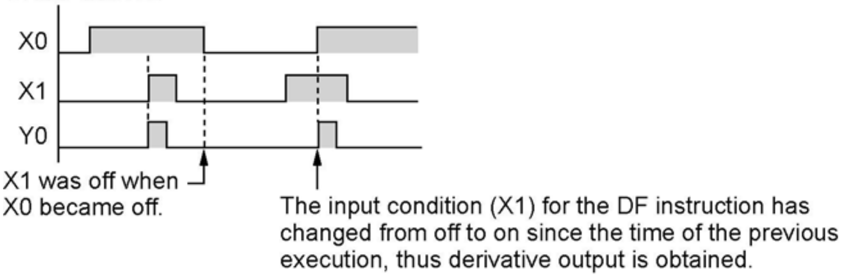
<Example 1> Using the DF instruction between MC and MCE instructions



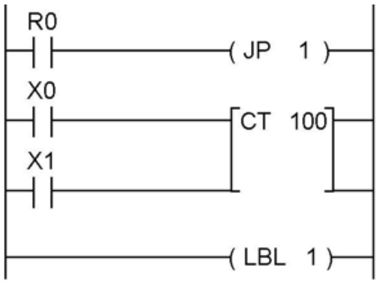
[Time chart 1]



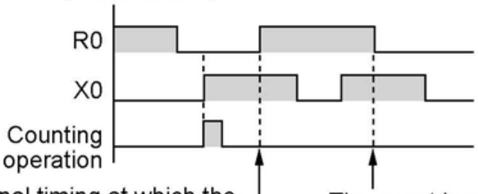
[Time chart 2]



<Example 2> Using the CT instruction between JP and LBL instructions



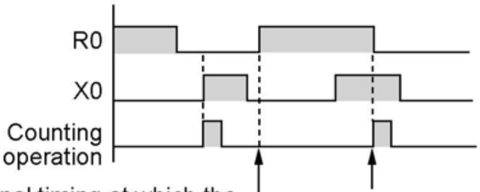
[Time chart 1]



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.

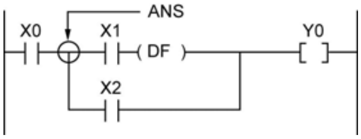
The count is not incremented, because the count input changed from off to on after the final timing at which the previous JP instruction was not executed.

11.6 Precautions for Programming

Programs which are not executed correctly

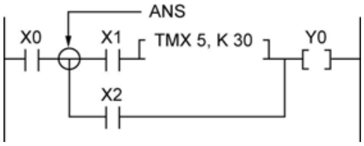
Do not write the following programs as they will not be executed correctly.

<Example 1>



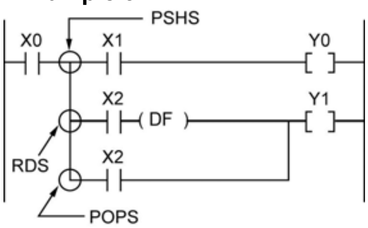
• When X1 was on prior to X0, Y0 will not be on even if X0 becomes on.

<Example 2>



• TMX will activate if X1 becomes on whether X0 is on or off.

<Example 3>

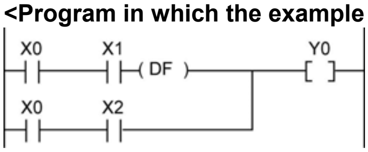


• When X2 was on prior to X0, Y1 will not be on even if X0 becomes on.

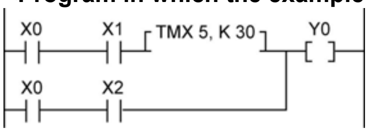
When a combination of contacts are set as the trigger (execution condition) of a differential instruction (DF) or timer instruction, do not use an AND stack (ANS) instruction, read stack (RDS) instruction, or pop stack (POPS) instruction.

Examples in which the above programs are rewritten

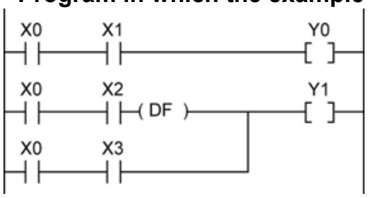
<Program in which the example 1 is rewritten>



<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

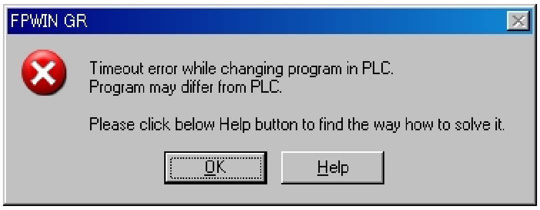
All set values specified with decimal constants (K) in timer and counter instructions are preset in the corresponding set value areas (SV). Values in the elapsed value area (EV) do not change.

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.

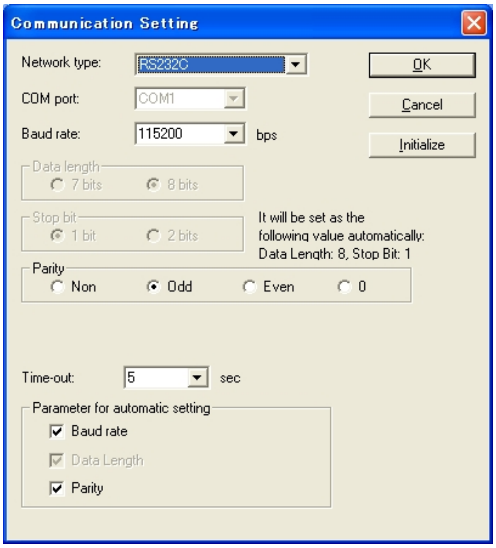
11.7.2 Cases Where Rewriting During Run is not Possible

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, rewritng is not possible during RUN in case of other syntax errors.

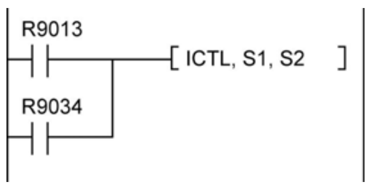
2. During the forced input/output operation

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)



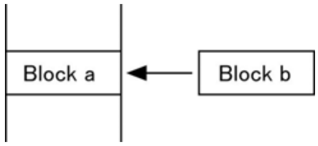
2. The high-speed counter will continue to count.
   Target value match on/off instructions (F166/F167) will continue.
   Coincidence interrupt programs will be disabled when the F166/F167 instruction is running.

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.

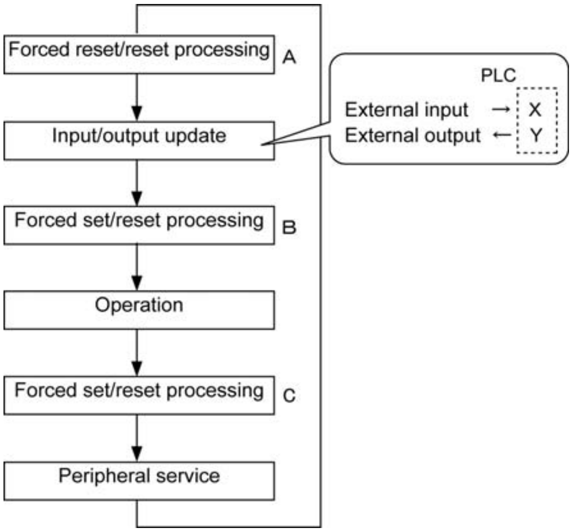
11.7.3 Procedures and Operation of Rewrite During RUN

Item		FPWIN GR Ladder symbol mode	FPWIN GR Boolean mode
Rewrite procedure		Maximum jof 128 steps. Changes are performed by block. When PG conversion is executed online, the program will be rewritten.  	Rewriting performed by step. Caution is required as rewriting takes place simultaneously with the change.
Operation of each instruciton	**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 sattus. To turn them off in the RUN mode, use forced output.
	TM/CT	• 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.)	• 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.	• 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.	Write in the order: RET, SUB, CALL Delete in the order: CALL, SUB, RET
	INT/IRET	An interrupt program is an program appearing between INTn and IRET instructions. Be sure to write it to an address which follows the ED instruction.	Write in the orde: IRET, INT Delete in the order: INT, IRET

Item		FPWIN GR Ladder symbol mode	FPWIN GR Boolean mode
Operation of each instruciton	**SSTP/STPE**	A distance with the same number cannot be defined twice. An SSTP instruction cannot be written in a subprogram.	Writign 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 inptu 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/ouput in the above procedure A. At this time, the area of output Y in the operation memory will be forcedly 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

12.2 Table of Specifications

12.2.1 General Specifications

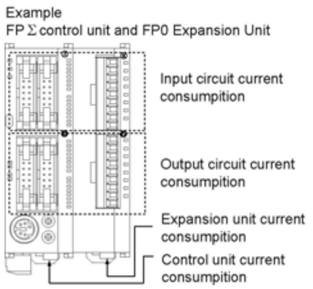
<table>
<tr><th colspan="2">Item</th><th colspan="2">Description</th></tr>
<tr><td colspan="2">Rated operating voltage</td><td colspan="2">24V DC</td></tr>
<tr><td colspan="2">Operating voltage range</td><td colspan="2">21.6 to 26.4V DC</td></tr>
<tr><td rowspan="2">Allowed momentary power off time</td><td>C32
C28</td><td colspan="2">4ms at 21.6V, 7ms at 24V, 10ms at 26.4V</td></tr>
<tr><td>C24</td><td colspan="2">3ms at 21.6V, 5ms at 24V, 8ms at 26.4V</td></tr>
<tr><td colspan="2">Ambient temperature</td><td colspan="2">0 to +55 °C</td></tr>
<tr><td colspan="2">Storage temperature</td><td colspan="2">−20 to +70°C</td></tr>
<tr><td colspan="2">Ambient humidity</td><td colspan="2">30 to 85%RH (at25°C non-condensing)</td></tr>
<tr><td colspan="2">Storage humidity</td><td colspan="2">30 to 85%RH (at25°C non-condensing)</td></tr>
<tr><td rowspan="6">Breakdown voltage</td><td rowspan="2">C32
C28</td><td>Between input/output terminals and power supply terminal/function earth</td><td rowspan="2">500VAC for 1 minute Note)</td></tr>
<tr><td>Between input terminal and output terminal</td></tr>
<tr><td rowspan="4">C24</td><td>Between input terminals (X0 to X7)/input terminals (X8 to XF) and power supply terminal/function earth</td><td>500VAC for 1 minute Note)</td></tr>
<tr><td>Between output terminals and power supply terminal/function earth</td><td>1500VAC for 1 minute Note)</td></tr>
<tr><td>Between input terminals (X0 to X7) and input terminals (X8 to XF)</td><td>500VAC for 1 minute Note)</td></tr>
<tr><td>Between input terminals (X0 to X7)/input terminals (X8 to XF) and output terminals</td><td>1500VAC for 1 minute Note)</td></tr>
<tr><td rowspan="6">Insulation resistance</td><td>C32</td><td>Between input/output terminals and power supply terminal/function earth</td><td rowspan="6">Min. 100MΩ (measured with a 500V DC megger)</td></tr>
<tr><td>C28</td><td>Between input terminal and output terminal</td></tr>
<tr><td rowspan="4">C24</td><td>Between input terminals (X0 to X7)/input terminals (X8 to XF) and power supply terminal/function earth</td></tr>
<tr><td>Between output terminals and power supply terminal/function earth</td></tr>
<tr><td>Between input terminals (X0 to X7) and input terminals (X8 to XF)</td></tr>
<tr><td>Between input terminals (X0 to X7)/input terminals (X8 to XF) and output terminals</td></tr>
<tr><td colspan="2">Vibration resistance</td><td colspan="2">10 to 55 Hz, 1 cycle/min, double amplitude of 0.75 mm, 10 min on 3 axes</td></tr>
<tr><td colspan="2">Shock resistance</td><td colspan="2">Shock of 98 m/s^2, 4 times on 3 axes</td></tr>
<tr><td colspan="2">Noise immunity</td><td colspan="2">1000 Vp-p with pulse widths 50 ns and 1μs (based on in-house measurements</td></tr>
<tr><td colspan="2">Operation condition</td><td colspan="2">Free from corrosive gases and excessive dust</td></tr>
</table>

Note) Cutoff current : 10 mA However, excluding varister 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-PN2AN/PN4AN/PN8AN	Approx. 90g
	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/RTD6	Approx. 75g

Unit’s current consumption table



		Control unit current consumption	Expansion unit current consumption	Input circuit current consumption	Output circuit current consumption
		This is the current consumed form 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 cosumed 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-PN2AN FPG-PN4AN FPG-PN8AN	90mA 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/RTD6	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	AIGT0030 AIGT0032 AIGT0130 AIGT0132	80mA or less	–	–	–
C-NET adapter S2	AFP15402	50mA or less	–	–	–

12.2.2 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 (upt 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	1184 points		
		External output (Y) Note1)	512 points	1184 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			
	Memory 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 laddars		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) Note6), 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)			
Bettery 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 kindls of comments, including I/O comments, remarks and block comments can be sotred.			
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 rea 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.
Note6) The contact information and the elapsed value (EV) of the counter is backed up. The setting value (SV) is not held.

FPΣ 32k type

Item			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 (upt 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)			
Ope-ration me-mory	**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			
	Mem ory 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 laddars		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) Note6), 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)			
Bettery 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 kindls of comments, including I/O comments, remarks and block comments can be sotred. (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 rea 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.
Note6) The contact information and the elapsed value (EV) of the counter is backed up. The setting value (SV) is not held.

High-speed counter, pulse output and PWM output specifications

Item		Descriptions	
High speed coun-ter	**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 reslution 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 communi-cation	1:N communi-cation	1:1 communi-cation	1:N communi-cation		1:1 communi-cation	1:N communi-cation
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
Commu-nication method	Half-duplex communi-cation	Two-wire, half-duplex communi-cation	Half-duplex communi-cation	Two-wire, half-duplex communi-cation	Token bus (Floating master)	Half-duplex communi-cation	Two-wire, half-duplex communi-cation

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).

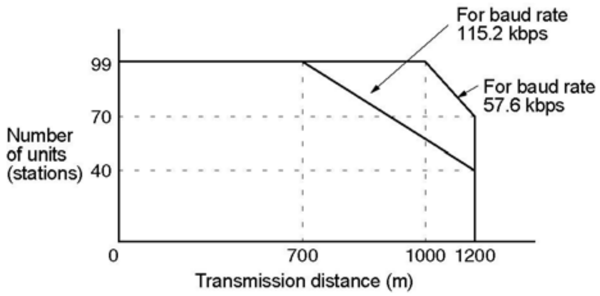
Note2) The number of units of the PC(PLC) link with RS232C is two.

Communication specifications

Item		Specifications	
Interface		RS232C (non-isolated)	RS485 (isolated) [Note1) 2)]
Communication mode		1:1 communicaion	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	
	General-purpose serial ommunication	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 AFPG803 effective.

The termination resistance of the AFPG806 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 AFPG806 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 AFPG806 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.

12.3 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 FPG-XY64D2P	Input: 32 points	–	X100 to X11F	X180 to X19F	X260 to X27F	X340 to X35F
FPΣ expansion unit	FPG-XY64D2T 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
FPΣ positioning unit	1-axis type: FPG-PP11 FPG-PP12	Output: 16 points	1st axis	Y100 to Y10F	Y180 to Y18F	Y260 to Y26F	Y340 to Y34F
FPΣ positioning unit	2-axis type: FPG-PP21 FPG-PP22	Input: 32 points	1st axis	X100 to X10F	X180 to X18F	X260 to X26F	X340 to X34F
FPΣ positioning unit	2-axis type: FPG-PP21 FPG-PP22	Input: 32 points	2nd axis	X110 to X11F	X190 to X19F	X270 to X27F	X350 to X35F
FPΣ positioning unit	2-axis type: FPG-PP21 FPG-PP22	Output: 32 points	1st axis	Y100 to Y10F	Y180 to Y18F	Y260 to Y26F	Y340 to Y34F
FPΣ positioning unit	2-axis type: FPG-PP21 FPG-PP22	Output: 32 points	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
FPΣ S-LINK unit	FPG-SL	Output	-	Y100 to Y17F	Y180 to Y25F	Y260 to Y33F	Y340 to Y41F
FPΣ Positioning unit RTEX Note)	FPG-PN2AN 2-axis type FPG-PN4AN 4-axis type FPG-PN8AN 8-axis type	Input 128 points	-	X100 to X17F	X180 to X25F	X260 to X33F	X340 to X41F
FPΣ Positioning unit RTEX Note)	FPG-PN2AN 2-axis type FPG-PN4AN 4-axis type FPG-PN8AN 8-axis type	Output 128 points	-	Y100 to Y17F	Y180 to Y25F	Y260 to Y33F	Y340 to Y41F

Note) There is no restriction on installed positions, however, the number of installed units is up to 2 units.

- 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 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-E32T/P	Input: 16 points	X20 to X2F	X40 to X4F	X60 to X6F
		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
FP0 RTD unit	FP0-RTD6	Input (16 points) CH0, 2, 4	WX2 (X20 to X2F)	WX4 (X40 to X4F)	WX6 (X60 to X6F)
		Input (16 points) CH1, 3, 5	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)

- The data of each channel for FP0 A/D conver unit (FP0-A80), FP0 thermocouple unit (FP0-TC4/FP0-TC8), FP0 D/A converter unit (FP0-A04V/P0-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.

12.4 Relays, Memory Areas and Constants

FPΣ 12k type

Item		Number of points and range of memory area available for use: C32T C32TTM	Number of points and range of memory area available for use: C32T2 C23T2TM C24R2 C24R2TM C28P2 C28P2TM	Function
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 speciyfying 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/Couner 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”)		

<table>
<tr><th colspan="2" rowspan="2">Item</th><th colspan="2">Number of points and range of memory area available for use</th><th rowspan="2">Function</th></tr>
<tr><th>C32T
C32TTM</th><th>C32T2
C23T2TM
C24R2
C24R2TM
C28P2
C28P2TM</th></tr>
<tr><td rowspan="6">Constant</td><td rowspan="2">Decimal constants (Integer type) (K)</td><td colspan="3">K-32, 768 to K32, 767 (for 16-bit operation)</td></tr>
<tr><td colspan="3">K-2, 147, 483, 648 to K2, 147, 483, 647 (for 32-bit operation)</td></tr>
<tr><td rowspan="2">Hexadecimal constants (H)</td><td colspan="3">H0 to HFFFF (for 16-bit operation)</td></tr>
<tr><td colspan="3">H0 to HFFFFFFFF (for 32-bit operation)</td></tr>
<tr><td rowspan="2">Floating point type (F)</td><td colspan="3">F-1.175494 x 10^{-38} to F-3.402823 x 10^{38}</td></tr>
<tr><td colspan="3">F-1.175494 x 10^{-38} to F-3.402823 x 10^{38}</td></tr>
</table>

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 ued, 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 C32TH/C32THTM C32T2H/C32T2HTM C24R2H/C24R2HTM C28P2H/C28P2HTM	Function
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 speciyfying 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/Couner 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 ued, 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.

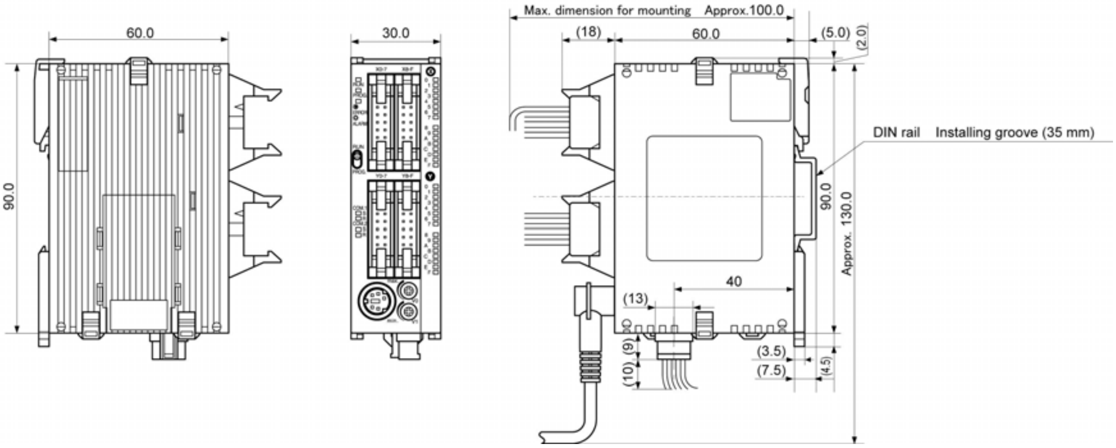
Chapter 13

Dimensions

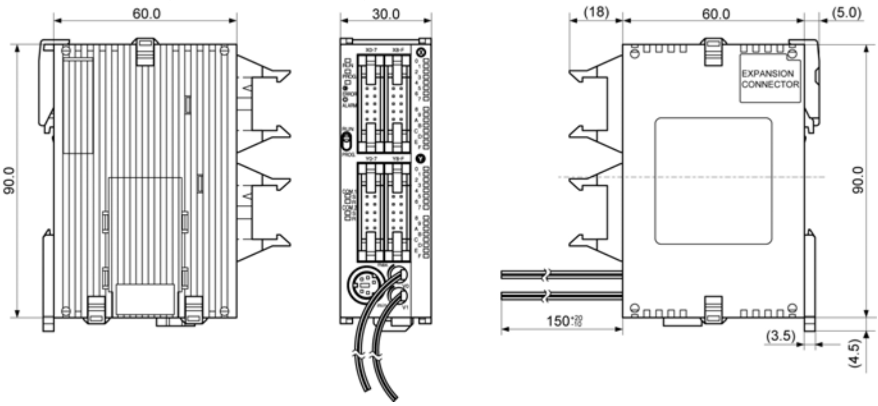
13.1 Dimensions

13.1.1 Control Unit (Transistor Output Type)

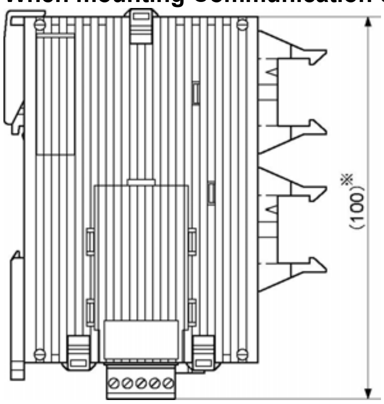
FPG-C32T, FPG-C32T2, FPG-C28P2
FPG-C32TH, FPG-C32T2H, FPG-C28P2H



FPG-C32TTM, FPG-C32T2TM, FPG-C28P2TM
FPG-C32THTM, FPG-C32T2HTM, FPG-C28P2HTM



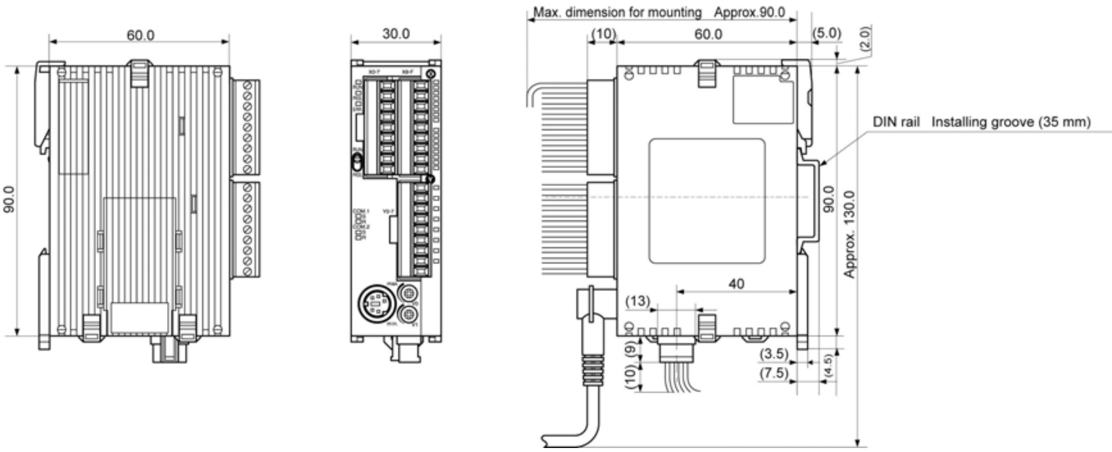
When mounting Communication cassette



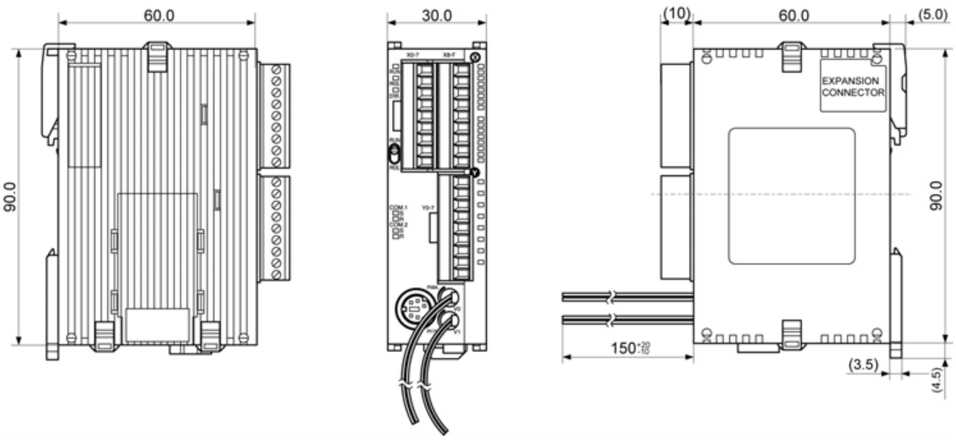
* The dimension with the communication cassette mounted is 105mm.

13.1.2 Control Unit (Relay Output Type)

FPG-C24R2, FPG-C24R2H



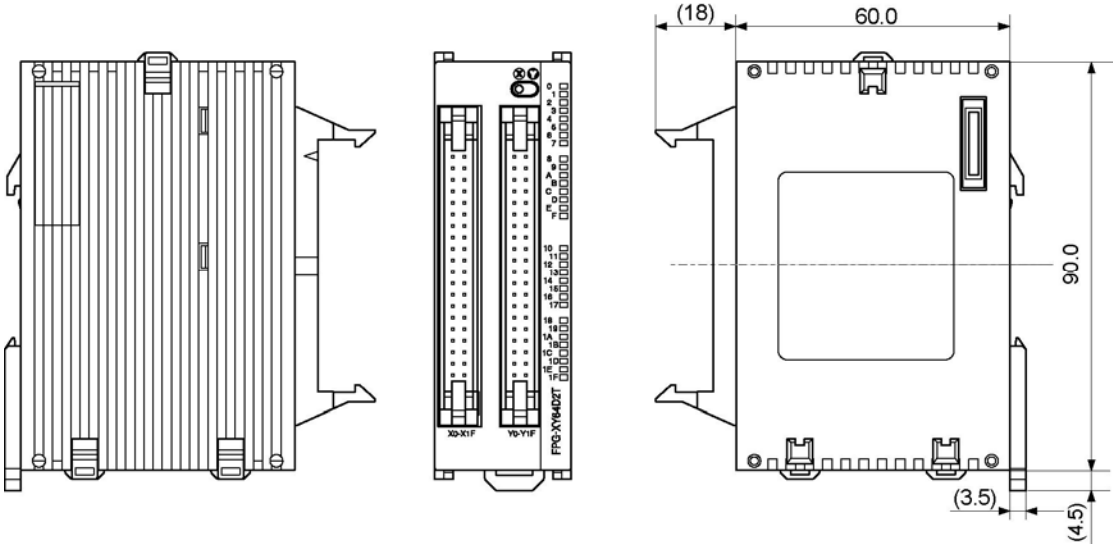
FPG-C24R2TM, FPG-C24R2HTM



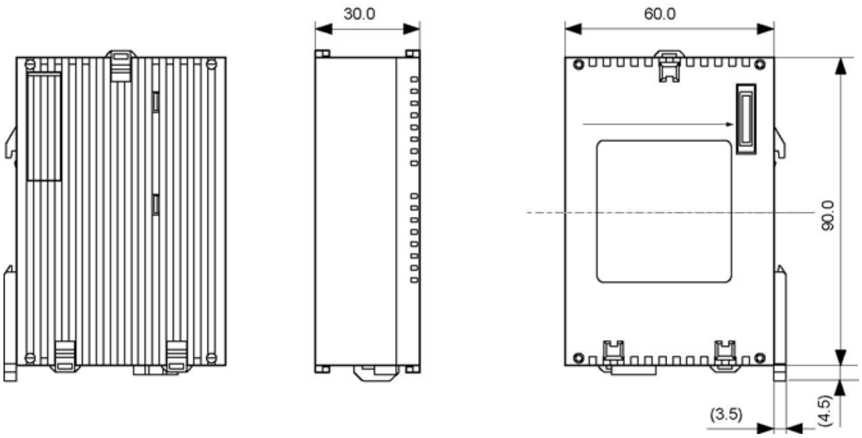
* The dimension with the communication cassette mounted is the same as the transistor output type.

13.1.3 Expansion Unit

FPG-XY64D2T, FPG-XY64D2P

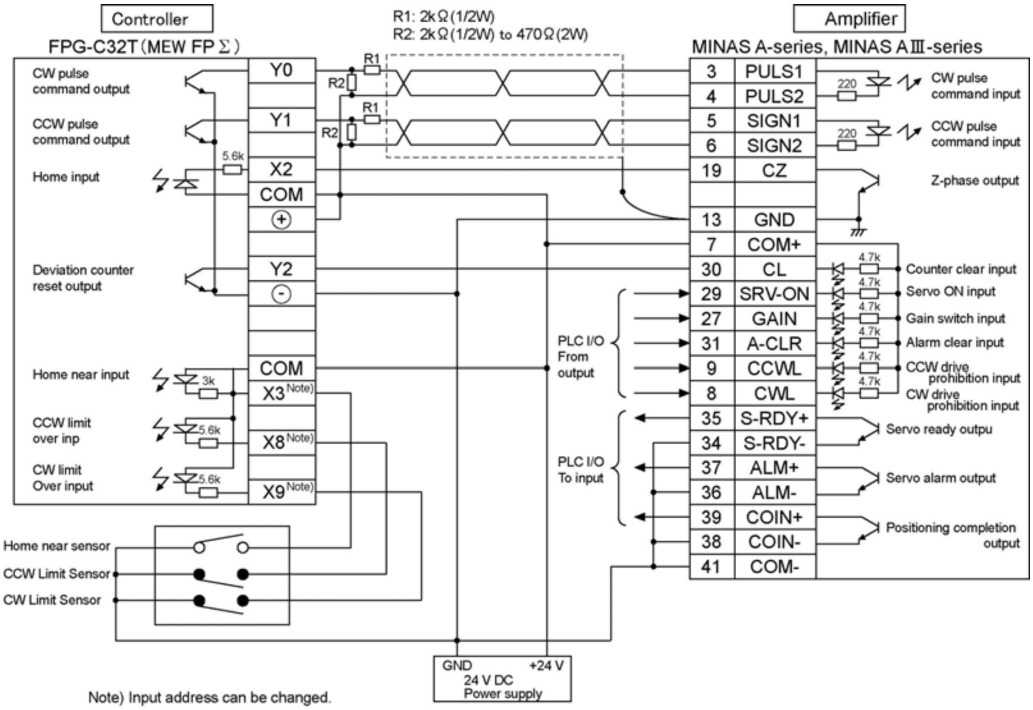


FPG-EM1

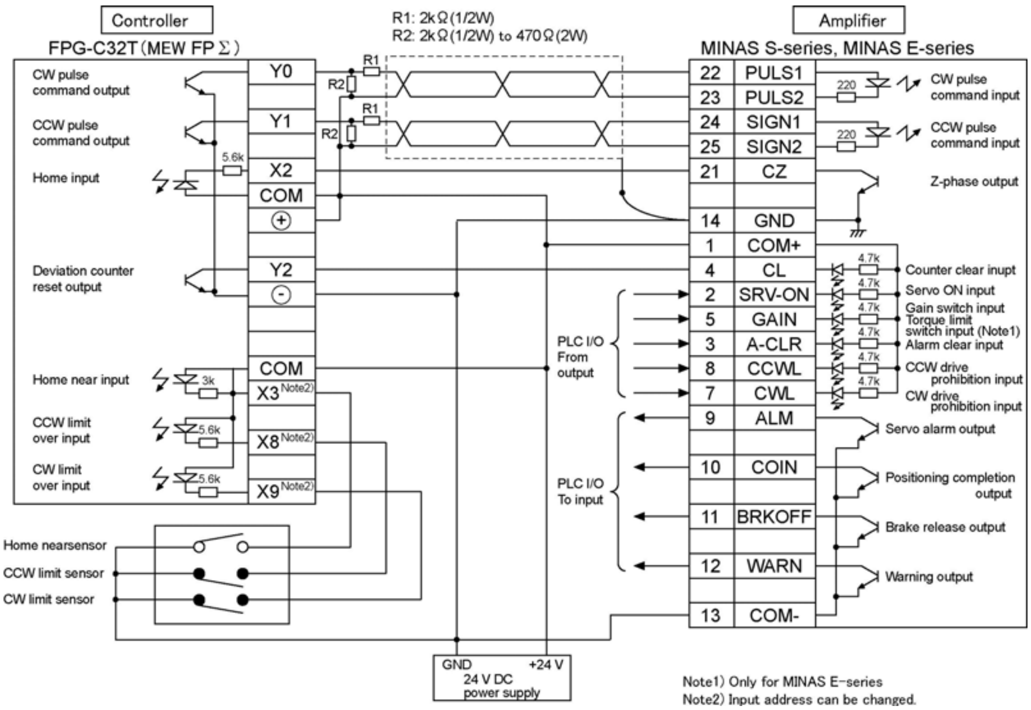


13.2 Connection Diagram with Motor Driver

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



13.3 FP0 Power Supply Unit (AFP0634)

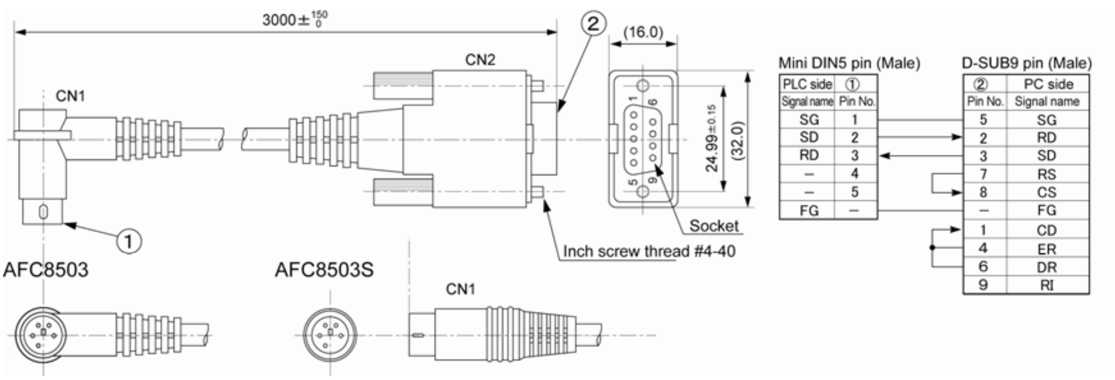
Item		Description
Input	Rated operationg voltage	100-240 V AC
	Operating voltage range	85-264 V AC
	Rated frequency	50/60 Hz
	Operating frequency	47-63 Hz
	The number of phase	Single phase
	Inrush current	30 A(0-p) or less (Cold start)
	Leakage current	0.75 mA or less
	Holding time	10 ms or more
Output	Reted output	24 V (±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)

13.4 Cable/Adapter Specifications

13.4.1 Type of Cable/Adapter

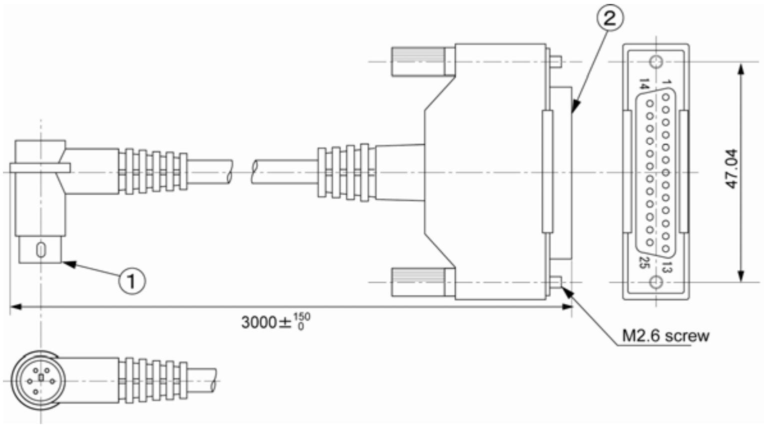
Type of Cable/Adapter	Usable model								
						EOL (end-of-life) models			
	FP-X	FP Σ	FP0	FP-e	FP2/ FP2SH	FP10SH	FP-M	FP1	FP3
AFC8503 AFC8503S	○	○	○	○	○		○		
AFC8513	○	○	○	○	○		○		
AFC8521 AFC8523			○		○		○		
AFB85853					○	○	○	○	○
AFB85813					○	○	○	○	○
AFB85843					○	○	○	○	○
AFC85305 AFC8531 AFC8532	○	○	○	○	○		○		
AIP81862N					○	○	○	○	○
AFP15205 AFP1523								○	
AFP5520 AFP5523									○
AFP8550								○	○

13.4.2 AFC8503/AFC8503S (DOS/V PC)



(Unit: mm)

13.4.3 AFC8513 (PC98 PC)



Mini DIN5 pin (Male)

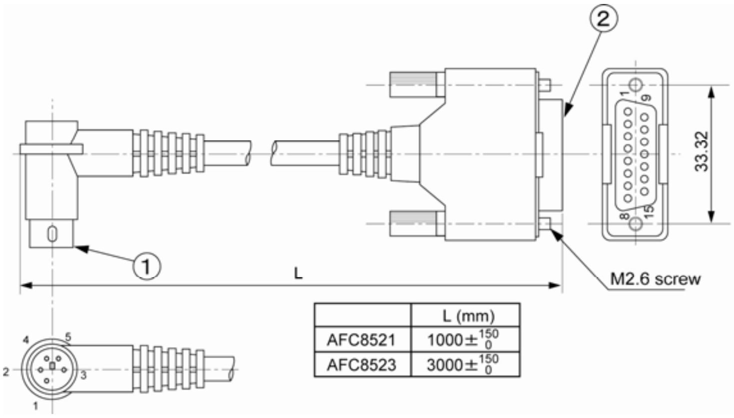
PLC side	①
Signal name	Pin No.
FG	–
SG	1
SD	2
RD	3
–	4
+5V	5

D-SUB9 pin (Male)

②	PC side
Pin No.	Signal name
–	FG
7	SG
3	RD
2	SD
4	RS
5	CS
6	DR
8	CD
20	ER

(Unit: mm)

13.4.4 AFC8521/AFC8523 (Programmer)



	L (mm)
AFC8521	1000 $\pm^{150}_{0}$
AFC8523	3000 $\pm^{150}_{0}$

Mini DIN5 pin (Male)

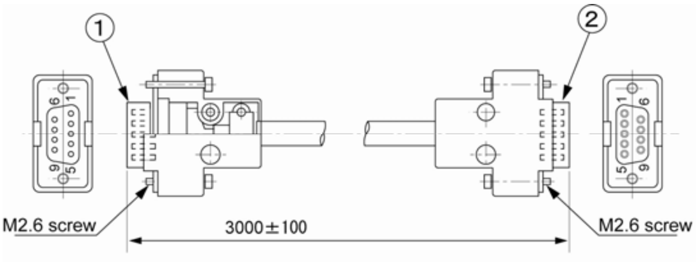
PLC side	①
Signal name	Pin No.
FG	–
SG	1
SD	2
RD	3
–	4
+5V	5

D-SUB15 pin (Male)

②	FP programmer side
Pin No.	Signal name
–	FG
2	SG
3	RD
11	SD
1	+5V
10	SG

(Unit: mm)

13.4.5 AFC85853 (9-pin (male) – 9-pin (female))



D-SUB9 pin (Male)

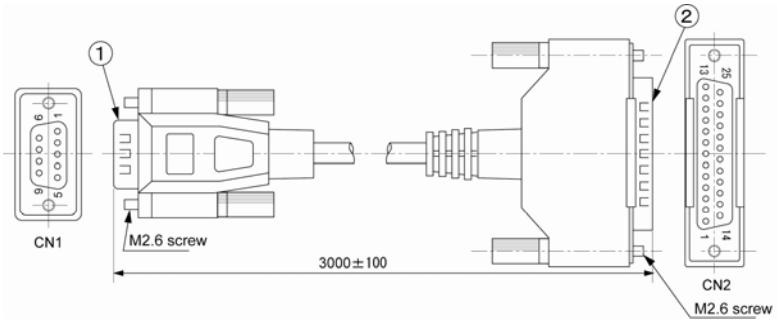
PLC side	①
Signal name	Pin No.
FG	1
SD	2
RD	3
RS	4
CS	5
RI	6
SG	7
CD	8
ER	9

D-SUB9 pin (Female)

②	PC side
Pin No.	Signal name
1	CD
2	RD
3	SD
4	ER
5	SG
6	DR
7	RS
8	CS
9	RI

(Unit: mm)

13.4.6 AFB85813 (9-pin (male) – 25-pin (male))



D-SUB9 pin (Male)

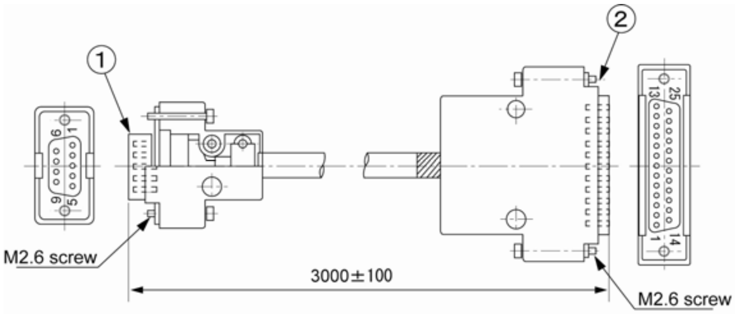
PLC side	①
Signal name	Pin No.
FG	1
SD	2
RD	3
RS	4
CS	5
RI	6
SG	7
CD	8
ER	9

D-SUB25 pin (Female)

②	PC side
Pin No.	Signal name
1	FG
2	SD
3	RD
4	RS
5	CS
6	DR
7	SG
8	CD
20	ER

(Unit: mm)

13.4.7 AFB85843 (Straight cable for connecting a modem: 9-pin (male) – 25-pin (male))



D-SUB9 pin (Male)

PLC side	①
Signal name	Pin No.
FG	1
SD	2
RD	3
RS	4
CS	5
RI	6
SG	7
CD	8
ER	9

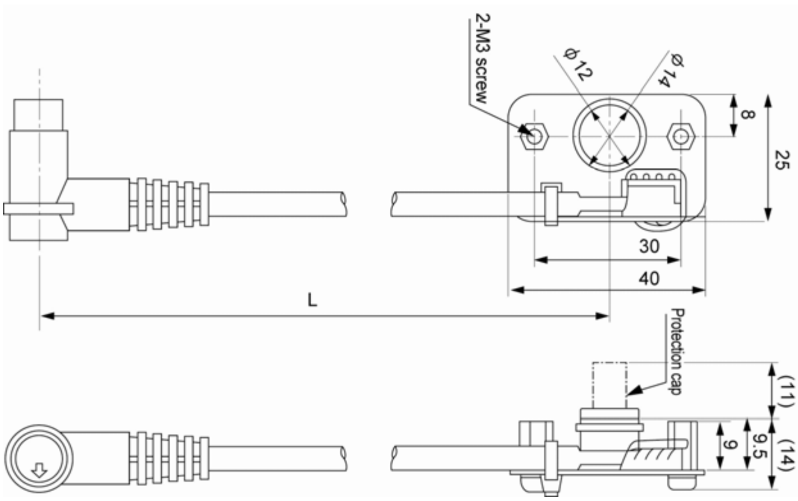
Open

D-SUB25pin (Male)

②	Modem side
Pin No.	Signal name
1	FG
2	SD
3	RD
4	RS
5	CS
6	DR
7	SG
8	CD
20	ER
22	RI

(Unit: mm)

13.4.8 AFC85305/AFC8531/AFC8532 (For extending for the tool port)

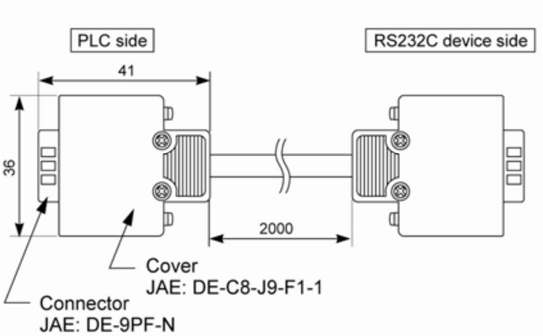


	L (mm)
AFC85305	500^{+100}_{0}
AFC8531	1000^{+100}_{0}
AFC8532	2000^{+100}_{0}

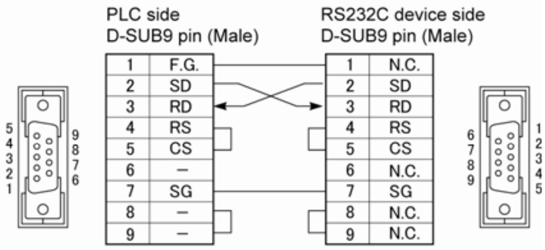
(Unit: mm)

13.4.9 AIP81862N (RS232 port)

・Dimensions (Unit: mm)



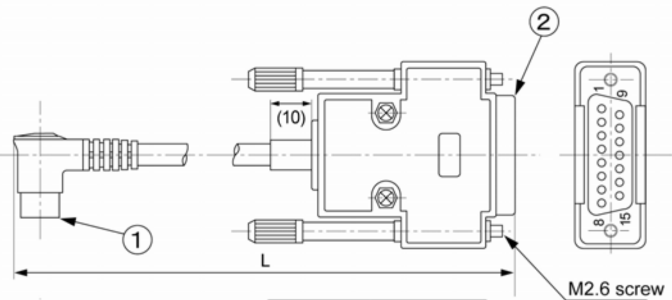
・Wiring diagram



PLC side D-SUB9 pin (Male)		RS232C device side D-SUB9 pin (Male)	
1	F.G.	1	N.C.
2	SD	2	SD
3	RD	3	RD
4	RS	4	RS
5	CS	5	CS
6	—	6	N.C.
7	SG	7	SG
8	—	8	N.C.
9	—	9	N.C.

(Unit: mm)

13.4.10 AFP15205/AFP1523 (End-of-life (EOL) product)



	L (mm)
AFP15205	$500\pm^{150}_{0}$
AFP1523	$3000\pm^{150}_{0}$

8 pin (Male)

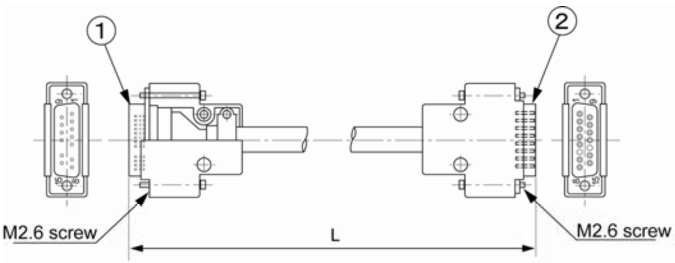
FP1 side Signal name	① Pin No.
FG	—
SG	1
SDA	2
RDA	3
Not used	4
SDB	5
RDB	6
Not used	7
+5V	8

D-SUB15 pin (Female)

② Pin No.	Peripheral side Signal name
8	FG
2	SG
6	RDA
7	SDA
14	RDB
15	SDB
3	Not used
1	+5V
4	CSA
5	RSA
12	CSB
13	RSB
9	Not used
10	Not used
11	Not used

(Unit: mm)

13.4.11 AFP5520/AFP5523 (End-of-life (EOL) product)



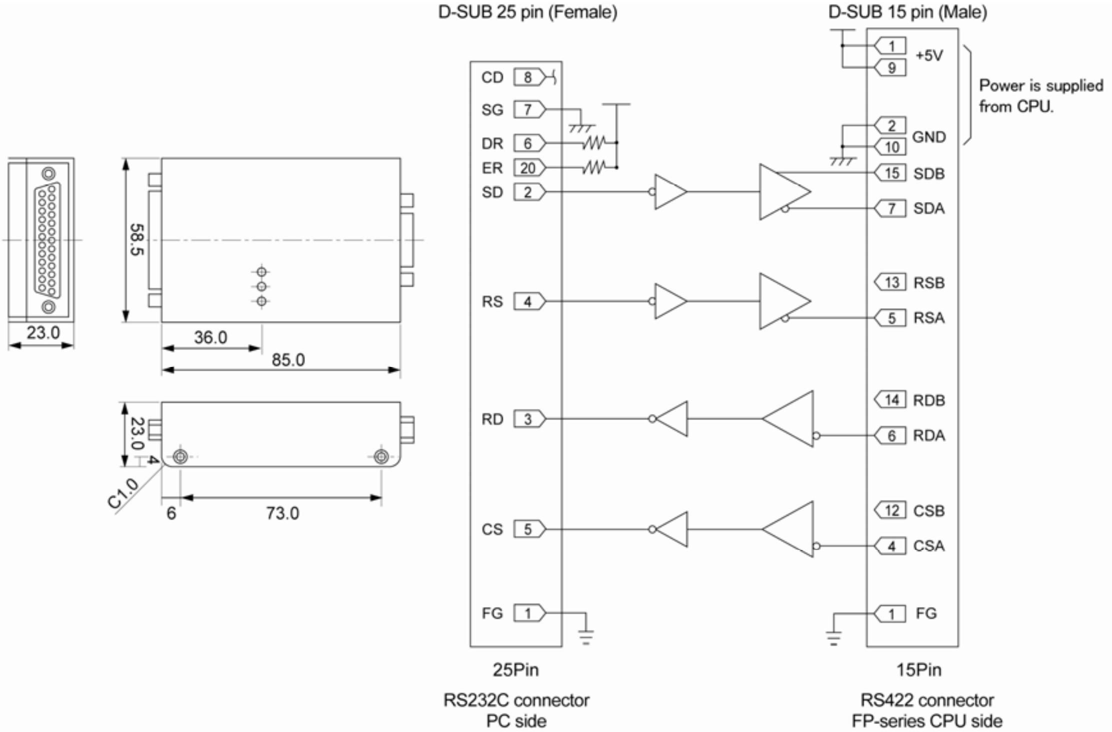
	L (mm)
AFP5520	$500\pm^{150}_{0}$
AFP5523	$3000\pm^{150}_{0}$

D-SUB15 pin (Male) — Case — D-SUB15 pin (Female)

FP3 side Signal name	① Pin No.	② Pin No.	Conversion adapter side Signal name
FG	1	8	FG
SDA	2	7	SDA
RDA	3	6	RDA
RSA	4	5	RSA
CSA	5	4	CSA
—	6	3	—
SG	7	2	SG
+5V	8	1	+5V
SDB	9	15	SDB
RDB	10	14	RDB
RSB	11	13	RSB
CSB	12	12	CSB
—	13	11	—
SG	14	10	SG
+5V	15	9	+5V

(Unit: mm)

13.4.12 AFP8550 (End-of-life (EOL) product)



(Unit: mm)

Chapter 14

Appendix

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 t 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 FP Σ

<table>
<tr><th></th><th>No.</th><th>Name</th><th>Default value</th><th colspan="3">Descriptions</th></tr>
<tr><td rowspan="6">Hold/ Non-hold 1</td><td>5</td><td>Starting number setting for counter</td><td>1008</td><td colspan="2">0 to 1024</td><td rowspan="6">• 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.</td></tr>
<tr><td>6</td><td>Hold type area starting number setting for timer and counter</td><td>1008</td><td colspan="2">0 to 1024</td></tr>
<tr><td>7</td><td>Hold type area starting number setting for internal relays</td><td>12k: 90
32k: 0 to 256</td><td colspan="2">12k: 0 to 98
32k: 0 to 256</td></tr>
<tr><td>8</td><td>Hold type area starting number setting for data registers</td><td>32710</td><td colspan="2">0 to 32765</td></tr>
<tr><td>14</td><td>Hold or non-hold setting for step ladder process</td><td>Non-hold</td><td colspan="2">Hold/Non-hold</td></tr>
<tr><td>4</td><td>Previous value is held for a leading edge detection instruction (DF instrucion) with MC Note)</td><td>Hold</td><td colspan="2">Hold/
Non-hold</td></tr>
<tr><td rowspan="4">Hold/ Non-hold 2</td><td>10</td><td>Hold type area starting word number for PC(PLC) link relays (for PC(PLC) link 0)</td><td>64</td><td colspan="3">0 to 64</td></tr>
<tr><td>11</td><td>Hold type area starting word number for PC(PLC) link relays (for PC(PLC) link 1)</td><td>128
(32k only)</td><td colspan="3">64 to 128</td></tr>
<tr><td>12</td><td>Hold type area starting number for PC(PLC) link registers (for PC(PLC) link 0)</td><td>128</td><td colspan="3">0 to 128</td></tr>
<tr><td>13</td><td>Hold type area starting number for PC(PLC) link registers (for PC(PLC) link 1)</td><td>256
(32k only)</td><td colspan="3">128 to 256</td></tr>
<tr><td rowspan="5">Action on error</td><td>20</td><td>Disable or enable setting for duplicated output</td><td>Disabled</td><td colspan="3">Disabled/Enabled</td></tr>
<tr><td>23</td><td>Operation setting when an I/O verification error occurs</td><td>Stop</td><td colspan="3">Stop/Continuation of operation</td></tr>
<tr><td>26</td><td>Operation setting when an operation error occurs</td><td>Stop</td><td colspan="3">Stop/Continuation of operation</td></tr>
<tr><td rowspan="2">4</td><td rowspan="2">Alarm battery error
(Operating setting when battery error occurs)</td><td rowspan="2">Disabled</td><td>Dis-abled:</td><td colspan="2">When a battery error occurs, a self-diagnostic error is not issued and the ERROR/ ALARM LED does not flash.</td></tr>
<tr><td>Ena-bled:</td><td colspan="2">When a battery error occurs, a self-diagnostic error is issued and the ERROR/ ALARM LED flashes.</td></tr>
</table>

Note) The 12k type is available with Ver. 1.4 to 1.9, 2.4 or later.

	No.	Name	Default value	Descriptions
Time set-ting	**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 set-ting	**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 tranmission	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 set-ting (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 tranmission	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 coun-ter	**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 inptu (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	X0 X1 X2 X3 X4 X5 X6 X7 Specify the input contacts used as pulse catch input.
	403	**Interrupt input settings**	Not set	X0 X1 X2 X3 X4 X5 X6 X7 Specify the input contacts used as intrrupt input. X0 X1 X2 X3 X4 X5 X6 X7 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 follwing 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 set-ting	**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 lenght bit: 8 bits Parity check: “with odd” Stop bit: 1 bit	Enter the settings for the various items. - Data lenght 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
	421	**Buffer capacity setting for data received of general (serial data) communication mode**	0	0 to 2048
COM 1 port set-ting	**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 lenght bit: 8 bits Parity check: Odd Stop bit: 1 bit	Enter the settings for the various items. - Data lenght 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 AFPG806 must be identically set by the system register and the dip switch in the communication cassette.

<table>
<tr><th></th><th>No.</th><th>Name</th><th>Default value</th><th>Descriptions</th></tr>
<tr><td rowspan="7">COM 2 port set-ting</td><td>411</td><td>Unit No. setting</td><td>1</td><td>1 to 99</td></tr>
<tr><td rowspan="2">412</td><td>Communication mode setting</td><td>Computer link</td><td>Computer link
General-purpose serial communication
MODBUS RTU</td></tr>
<tr><td>Selection of modem connection</td><td>Disabled</td><td>Enabled/Disabled</td></tr>
<tr><td>414</td><td>Communication format setting</td><td>Data lenght bit: 8 bits
Parity check: “with odd”
Stop bit: 1 bit</td><td>Enter the settings for the various items.
- Data lenght 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</td></tr>
<tr><td>415</td><td>Communication speed (Baud rate) setting</td><td>9600 bps</td><td>2400 bps
4800 bps
9600 bps
19200 bps
38400 bps
57600 bps
115200 bps</td></tr>
<tr><td>416</td><td>Starting address for received buffer of general (serial data) communication mode</td><td>2048</td><td>0 to 32764</td></tr>
<tr><td>417</td><td>Buffer capacity setting for data received of general (serial data) communication mode</td><td>2048</td><td>0 to 2048</td></tr>
</table>

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 AFPG806 must be identically set by the system register and the dip switch in the communication cassette.

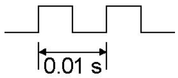
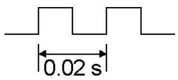
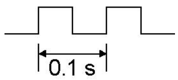
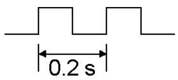
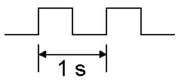
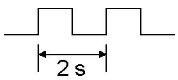
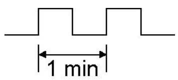
14.1.2 Table of Special Internal Relays for FP Σ

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 an 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 shen 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		- 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 ony the first scan following completion of a rewrite during the RUN operation.
R9035	Not used		-
R9036	Not used		-
R9037	COM1 port communication error flag		- 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		- 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		- 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 abonormality 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 abonormality 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)	Unit No.1	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		Unit No.2	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		Unit No.3	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		Unit No.4	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		Unit No.5	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		Unit No.6	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		Unit No.7	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		Unit No.8	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		Unit No.9	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		Unit No.10	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		Unit No.11	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		Unit No.12	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		Unit No.13	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		Unit No.14	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		Unit No.15	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		Unit No.16	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 FP Σ

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**	When an error occurs at FPΣ expansion I/O unit, the bit corresponding to the unit No. will be set on “1”. Monitor using binary display. 15 11 7 3 2 1 0 (Bit No.) 3 2 1 0 (Unit No.) on "1": error, off "0": normal	A	N/A
DT90003	**Not used**		N/A	N/A
DT90004	**Not used**		N/A	N/A
DT90005	**Not used**		N/A	N/A
DT90006	**Position of abnormal intelligent unit for FPΣ left side expansion**	When an error condition is detected in an intelligent unit, the bit corresponding to the unit No. will turn on . Monitor using binary display. 15 11 7 3 2 1 0 (Bit No.) 3 2 1 0 (Unit No.) on "1": error, off "0": normal	A	N/A
DT90007	**Not used**		N/A	N/A
DT90008	**Not used**		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**	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. 15 11 7 3 2 1 0 (Bit No.) 2 1 0 (Unit No.) on "1": error, off "0": normal	A	N/A

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

Register No.	Name	Descriptions	Read -ing	Writ- ing
DT90011	**Position of I/O verify error unit for FPΣ left side expansion**	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. 15 11 7 3 2 1 0 (Bit No.) 3 2 1 0 (Unit No.) on "1": error, off "0": normal	A	N/A
DT90012	**Not used**		N/A	N/A
DT90013	**Not used**		N/A	N/A
DT90014	**Operation auxiliary register for data shift instruction**	One shift-out hexadecimal digit is stored in bit positions 0 to 3 when the data shift instruction, F105 (BSR) or F106 (BSL) is executed. The value can be read and written by executing F0 (MV) instruction.	A	A
DT90015	**Operation auxiliary register for division instruction**	The divided remainder (16-bit) is stored in DT90015 when the division instruction F32(%) or F52(B%) instruction is executed. The divided remainder (32-bit) is stored in DT90015 and DT90016 when the division instruction F33(D%) or F53(DB%) is executed. The value can be read and written by executing F0(MV) instruction.	A	A
DT90016			A	A
DT90017	**Operation error address (hold type)**	After commencing operation, the address where the first operation error occurred is stored. Monitor the address using decimal display.	A	N/A
DT90018	**Operation error address (non-hold type)**	The address where 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)	The data stored here is increased by one every 2.5 ms. (H0 to HFFFF) Difference between the values of the two points (absolute value) x 2.5 ms = Elapsed time between the two points.	A	N/A
DT90020	**10 μs ring counter** Note1) Note2)	The data stored here is increased by one every 10.24 μs. (H0 to HFFFF) Difference between the values of the two points (absolute value) x 10.24 μs = Elapsed time between the two points. Note) The exact value is 10.24 μs.	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)

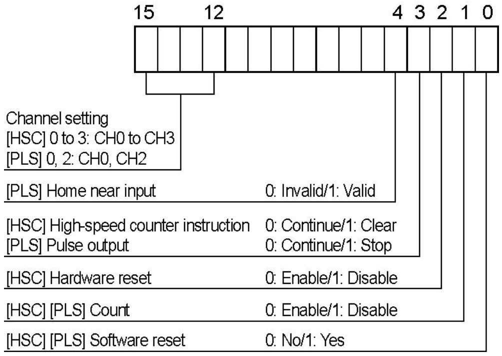
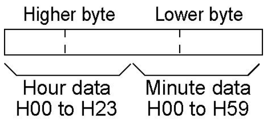
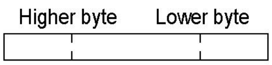
Register No.	Name	Descriptions	Read -ing	Writ- ing
DT90022	**Scan time (current value)** [Note)]	The current scan time is stored here. Scan time is calculated using the formula: Scan time (ms) = stored data (decimal) x 0.1 ms Example: K50 indicates 5 ms.	A	N/A
DT90023	**Scan time (minimum value)** [Note)]	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)** [Note)]	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. 15 11 7 3 0 (Bit No.) 7 3 0 (INT No.) 0: interrupt disabled 1: interrupt enabled	A	N/A
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 lenght) 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 earh time the mode is switched from RUN to PROG.

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

Register No.	Name		Descriptions	Read-ing	Writ-ing
DT90037	**Operation auxiliary register for search instruction F96(SRC)**		The number of data that match the searched data is stored here when F96 (SRC) insturction 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					

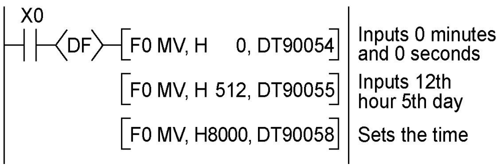
(A: Available, N/A: Not available)

Register No.	Name	Descriptions	Read-ing	Writ-ing
DT90052	**High-speed counter and pulse output control flag**	A value can be written with F0 (MV) instruction to reset the high-speed counter, disable counting, continue or clear high-speed counter instruction. Control code setting  Note) Refer to the “Count for reset input” in “Count 6.3.2 “Input Mode and Count”	N/A	A
DT90053	**Clock/calendar monitor (hour/minute)**	Hour and minute data of the clock/calendar are stored here. This data is read-only data. It cannot be overwritten.  	A	N/A
DT90054	**Clock/calendar setting (minute/second)**	The year, month, day, hour, minute, second and day-of-the-week data for the calender 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)  	A	A
DT90055	**Clock/calendar setting (day/hour)**			
DT90056	**Clock/calendar setting (year/month)**			
DT90057	**Clock/calendar setting (day-of-the-week)**			

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)

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

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

Register No.	Name	Descriptions	Read-ing	Writ-ing
DT90058	**Clock/calendar time setting**	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.) <Example> Set the time to 12:00:00 on the 5th day when the X0 turns on.  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.	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)

<table>
<tr><th>Register No.</th><th>Name</th><th>Descriptions</th><th>Read-ing</th><th>Writ-ing</th></tr>
<tr><td>DT90060</td><td>Step ladder process (0 to 15)</td><td rowspan="22">Indicates the startup condition of the step ladder process. When the process starts up, the bit corresponding to the process number turns on.

Monitor using binary display.

<Example>
15 11 7 3 0 (Bit No.)
DT90060
7 3 0 (Process No.)
1: Executing 0: Not-executing

A programming tool software can be used to write data.</td><td rowspan="22">A</td><td rowspan="22">A</td></tr>
<tr><td>DT90061</td><td>Step ladder process (16 to 31)</td></tr>
<tr><td>DT90062</td><td>Step ladder process (32 to 47)</td></tr>
<tr><td>DT90063</td><td>Step ladder process (48 to 63)</td></tr>
<tr><td>DT90064</td><td>Step ladder process (64 to 79)</td></tr>
<tr><td>DT90065</td><td>Step ladder process (80 to 95)</td></tr>
<tr><td>DT90066</td><td>Step ladder process (96 to 111)</td></tr>
<tr><td>DT90067</td><td>Step ladder process (112 to 127)</td></tr>
<tr><td>DT90068</td><td>Step ladder process (128 to 143)</td></tr>
<tr><td>DT90069</td><td>Step ladder process (144 to 159)</td></tr>
<tr><td>DT90070</td><td>Step ladder process (160 to 175)</td></tr>
<tr><td>DT90071</td><td>Step ladder process (176 to 191)</td></tr>
<tr><td>DT90072</td><td>Step ladder process (192 to 207)</td></tr>
<tr><td>DT90073</td><td>Step ladder process (208 to 223)</td></tr>
<tr><td>DT90074</td><td>Step ladder process (224 to 239)</td></tr>
<tr><td>DT90075</td><td>Step ladder process (240 to 255)</td></tr>
<tr><td>DT90076</td><td>Step ladder process (256 to 271)</td></tr>
<tr><td>DT90077</td><td>Step ladder process (272 to 287)</td></tr>
<tr><td>DT90078</td><td>Step ladder process (288 to 303)</td></tr>
<tr><td>DT90079</td><td>Step ladder process (304 to 319)</td></tr>
<tr><td>DT90080</td><td>Step ladder process (320 to 335)</td></tr>
<tr><td>DT90081</td><td>Step ladder process (336 to 351)</td></tr>
</table>

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

<table>
<tr><th>Register No.</th><th>Name</th><th>Descriptions</th><th>Read-ing</th><th>Writ-ing</th></tr>
<tr><td>DT90082</td><td>Step ladder process (352 to 367)</td><td rowspan="16">Indicates the startup condition of the step ladder process. When the process starts up, the bit corresponding to the process number turns on .

Monitor using binary display.

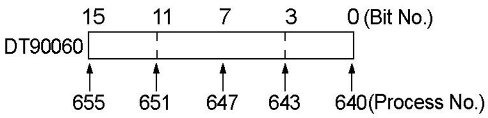
<Example>
15 11 7 3 0 (Bit No.)
DT90060
15 11 7 3 0 (Process No.)
1: Executing 0: Not-executing

A programming tool software can be used to write data.</td><td rowspan="16">A</td><td rowspan="16">A</td></tr>
<tr><td>DT90083</td><td>Step ladder process (368 to 383)</td></tr>
<tr><td>DT90084</td><td>Step ladder process (384 to 399)</td></tr>
<tr><td>DT90085</td><td>Step ladder process (400 to 415)</td></tr>
<tr><td>DT90086</td><td>Step ladder process (416 to 431)</td></tr>
<tr><td>DT90087</td><td>Step ladder process (432 to 447)</td></tr>
<tr><td>DT90088</td><td>Step ladder process (448 to 463)</td></tr>
<tr><td>DT90089</td><td>Step ladder process (464 to 479)</td></tr>
<tr><td>DT90090</td><td>Step ladder process (480 to 495)</td></tr>
<tr><td>DT90091</td><td>Step ladder process (496 to 511)</td></tr>
<tr><td>DT90092</td><td>Step ladder process (512 to 527)</td></tr>
<tr><td>DT90093</td><td>Step ladder process (528 to 543)</td></tr>
<tr><td>DT90094</td><td>Step ladder process (544 to 559)</td></tr>
<tr><td>DT90095</td><td>Step ladder process (560 to 575)</td></tr>
<tr><td>DT90096</td><td>Step ladder process (576 to 591)</td></tr>
<tr><td>DT90097</td><td>Step ladder process (592 to 607)</td></tr>
</table>

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

<table>
<tr><th>Register No.</th><th>Name</th><th>Descriptions</th><th>Read-ing</th><th>Writ-ing</th></tr>
<tr><td>DT90098</td><td>Step ladder process (608 to 623)</td><td rowspan="25">Indicates the startup condition of the step ladder process. When the process starts up, the bit corresponding to the process number turns on “1”.

Monitor using binary display

<Example>


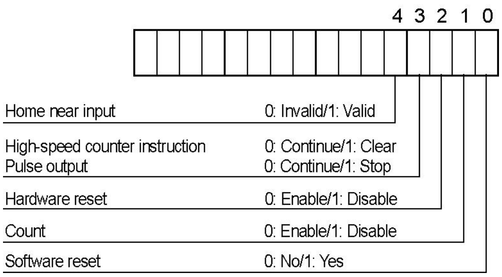
1: Executing 0: Not-executing

A programming tool software can be used to write data.</td><td rowspan="25">A</td><td rowspan="25">A</td></tr>
<tr><td>DT90099</td><td>Step ladder process (624 to 639)</td></tr>
<tr><td>DT90100</td><td>Step ladder process (640 to 655)</td></tr>
<tr><td>DT90101</td><td>Step ladder process (656 to 671)</td></tr>
<tr><td>DT90102</td><td>Step ladder process (672 to 687)</td></tr>
<tr><td>DT90103</td><td>Step ladder process (688 to 703)</td></tr>
<tr><td>DT90104</td><td>Step ladder process (704 to 719)</td></tr>
<tr><td>DT90105</td><td>Step ladder process (720 to 735)</td></tr>
<tr><td>DT90106</td><td>Step ladder process (736 to 751)</td></tr>
<tr><td>DT90107</td><td>Step ladder process (752 to 767)</td></tr>
<tr><td>DT90108</td><td>Step ladder process (768 to 783)</td></tr>
<tr><td>DT90109</td><td>Step ladder process (784 to 799)</td></tr>
<tr><td>DT90110</td><td>Step ladder process (800 to 815)</td></tr>
<tr><td>DT90111</td><td>Step ladder process (816 to 831)</td></tr>
<tr><td>DT90112</td><td>Step ladder process (832 to 847)</td></tr>
<tr><td>DT90113</td><td>Step ladder process (848 to 863)</td></tr>
<tr><td>DT90114</td><td>Step ladder process (864 to 879)</td></tr>
<tr><td>DT90115</td><td>Step ladder process (880 to 895)</td></tr>
<tr><td>DT90116</td><td>Step ladder process (896 to 911)</td></tr>
<tr><td>DT90117</td><td>Step ladder process (912 to 927)</td></tr>
<tr><td>DT90118</td><td>Step ladder process (928 to 943)</td></tr>
<tr><td>DT90119</td><td>Step ladder process (944 to 959)</td></tr>
<tr><td>DT90120</td><td>Step ladder process (960 to 975)</td></tr>
<tr><td>DT90121</td><td>Step ladder process (976 to 991)</td></tr>
<tr><td>DT90122</td><td>Step ladder process (992 to 999) (higher byte is not used.)</td></tr>
</table>

(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/Outptu 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 inerval 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 inerval 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	Read-ing	Writ-ing
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**	This monitors the data specified in DT90052. 	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**			

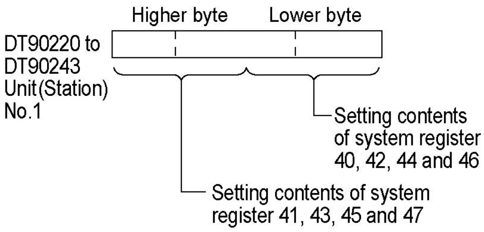
(A: Available, N/A: Not available)

Register No.	Name		Descriptions	Read-ing	Writ-ing
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 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
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)

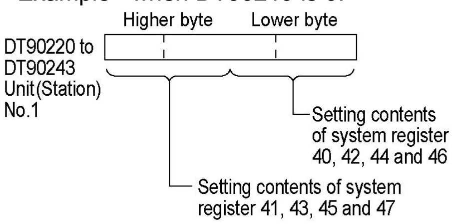
<table>
<tr><th>Register No.</th><th colspan="2">Name</th><th>Descriptions</th><th>Read-ing</th><th>Writ-ing</th></tr>
<tr><td>DT90219</td><td colspan="2">Unit No. (Station No.) selection for DT90220 to DT90251</td><td>0: Unit No. (Station No.) 1 to 8,
1: Unit No. (Station No.) 9 to 16</td><td>A</td><td>N/A</td></tr>
<tr><td>DT90220</td><td rowspan="4">PLC link Unit (station) No. 1 or 9</td><td>System register 40 and 41</td><td rowspan="20">The contents of the system register settings partaining to the PLC inter-link function for the various unit numbers are stored as shown below.

<Example>
When DT90219 is 0


</td><td rowspan="20">A</td><td rowspan="20">N/A</td></tr>
<tr><td>DT90221</td><td>System register 42 and 43</td></tr>
<tr><td>DT90222</td><td>System register 44 and 45</td></tr>
<tr><td>DT90223</td><td>System register 46 and 47</td></tr>
<tr><td>DT90224</td><td rowspan="4">PLC link Unit (station) No. 2 or 10</td><td>System register 40 and 41</td></tr>
<tr><td>DT90225</td><td>System register 42 and 43</td></tr>
<tr><td>DT90226</td><td>System register 44 and 45</td></tr>
<tr><td>DT90227</td><td>System register 46 and 47</td></tr>
<tr><td>DT90228</td><td rowspan="4">PLC link Unit (station) No. 3 or 11</td><td>System register 40 and 41</td></tr>
<tr><td>DT90229</td><td>System register 42 and 43</td></tr>
<tr><td>DT90230</td><td>System register 44 and 45</td></tr>
<tr><td>DT90231</td><td>System register 46 and 47</td></tr>
<tr><td>DT90232</td><td rowspan="4">PLC link Unit (station) No. 4 or 12</td><td>System register 40 and 41</td></tr>
<tr><td>DT90233</td><td>System register 42 and 43</td></tr>
<tr><td>DT90234</td><td>System register 44 and 45</td></tr>
<tr><td>DT90235</td><td>System register 46 and 47</td></tr>
<tr><td>DT90236</td><td rowspan="4">PLC link Unit (station) No. 5 or 13</td><td>System register 40 and 41</td></tr>
<tr><td>DT90237</td><td>System register 42 and 43</td></tr>
<tr><td>DT90238</td><td>System register 44 and 45</td></tr>
<tr><td>DT90239</td><td>System register 46 and 47</td></tr>
</table>

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

<table>
<tr><th>Register No.</th><th colspan="2">Name</th><th>Descriptions</th><th>Read-ing</th><th>Writ-ing</th></tr>
<tr><td>DT90240</td><td rowspan="4">PLC link Unit (station) No. 6 or 14</td><td>System regis-ter 40 and 41</td><td rowspan="12">The contents of the system register settings partaining to the PLC inter-link function for the various unit numbers are stored as shown below.

<Example> when DT90219 is 0.

</td><td rowspan="12">A</td><td rowspan="12">N/A</td></tr>
<tr><td>DT90241</td><td>System regis-ter 42 and 43</td></tr>
<tr><td>DT90242</td><td>System regis-ter 44 and 45</td></tr>
<tr><td>DT90243</td><td>System regis-ter 46 and 47</td></tr>
<tr><td>DT90244</td><td rowspan="4">PLC link Unit (sta-tion) No. 7 or 15</td><td>System regis-ter 40 and 41</td></tr>
<tr><td>DT90245</td><td>System regis-ter 42 and 43</td></tr>
<tr><td>DT90246</td><td>System regis-ter 44 and 45</td></tr>
<tr><td>DT90247</td><td>System regis-ter 46 and 47</td></tr>
<tr><td>DT90248</td><td rowspan="4">PLC link Unit (sta-tion) No. 8 or 16</td><td>System regis-ter 40 and 41</td></tr>
<tr><td>DT90249</td><td>System regis-ter 42 and 43</td></tr>
<tr><td>DT90250</td><td>System regis-ter 44 and 45</td></tr>
<tr><td>DT90251</td><td>System regis-ter 46 and 47</td></tr>
<tr><td>DT90252</td><td colspan="2">Not used</td><td></td><td rowspan="4">N/A</td><td rowspan="4">N/A</td></tr>
<tr><td>DT90253</td><td colspan="2">Not used</td><td></td></tr>
<tr><td>DT90254</td><td colspan="2">Not used</td><td></td></tr>
<tr><td>D590255</td><td colspan="2">Not used</td><td></td></tr>
<tr><td>DT90256</td><td colspan="2">Unit No. (Station No.) switch monitor for COM port</td><td>Used by the system</td><td>N/A</td><td>N/A</td></tr>
</table>

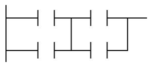
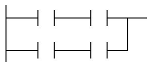
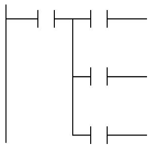
14.2 Table of Basic Instructions

Name	Boolean	Symbol	Description	Steps Note1)
Sequence basic instructions				
Start	**ST**	X, Y, R, T, C, L, P, E	Begins a logic operation with a Form A (normally open) contact.	1 (2)
Start Not	**ST/**	X, Y, R, T, C, L, P, E	Begins a logic operation with a Form B (normally closed) contact.	1 (2)
Out	**OT**	Y, R, L, E	Outputs the operated result to the specified output.	1 (2)
Not	**/**	/	Inverts the operated result up to this instruction.	1
AND	**AN**	X, Y, R, T, C, L, P, E	Connects a Form A (normally open) contact serially.	1 (2)
AND Not	**AN/**	X, Y, R, T, C, L, P, E	Connects a Form B (normally closed) contact serially.	1 (2)
OR	**OR**	X, Y, R, T, C, L, P, E	Connects a Form A (normally open) contact in parallel.	1 (2)
OR Not	**OR/**	X, Y, R, T, C, L, P, E	Connects a Form B (normally closed) contact in parallel.	1 (2)
Leading edge start	**ST↑**	X, Y, R, T, C, L, P, E	Begins a logic operation only for one scan when the leading edge of the trigger is detected.	2
Trailing edge start	**ST↓**	X, Y, R, T, C, L, P, E	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-e	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↑**	X, Y, R, T, C, L, P, E ─┤↑├─	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↓**	X, Y, R, T, C, L, P, E ─┤↓├─	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↑**	X, Y, R, T, C, L, P, E ─┤↑├─	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↓**	X, Y, R, T, C, L, P, E ─┤↓├─	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↑**	P ─[↑]─	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↓**	P ─[↓]─	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**	Y, R, L, E ─<A>─	Inverts the output condition (on/off) each time the leading edge of the trigger is detected.	3
AND stack	**ANS**		Connects the multiple instruction blocks serially.	1
OR stack	**ORS**		Connects the multiple instruction blocks in parallel.	1
Push stack	**PSHS**		Stores the operated result up to this instruction.	1
Read stack	**RDS**		Reads the operated result stored by the PSHS instruction.	1
Pop stack	**POPS**		Reads and clears the operated result stored by the PSHS instruction	1
Leading edge differential	**DF**	─(DF)─	Turns on the contact for only one scan when the leading edge of the trigger is detected.	1
Trailing edge differential	**DF/**	─(DF/)─	Turns on the contact for only one scan when the trailing edge of the trigger is detected.	1

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-e	FP1			FP-M		FP3	FP2	FP2SH	FP10SH
					C14 C16	C24 C40	C56 C72	C16	C20 C32				
Leading edge AND	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 AND	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
Leading edge OR	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 OR	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
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 Note3)	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 Note3)	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.

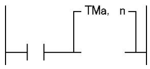
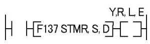
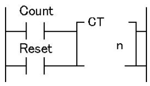
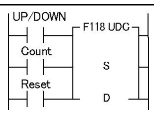
Note3) The allowable number of using the PSHS and RDS instruction depends on the models.

Name	Boolean	Symbol	Description	Steps Note1)
Leading edge differ-ential (initial execution type)	**DFI**	—(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**	Y, R, L, E —<S>—	Output is set to and held at on.	3
Reset	**RST**	Y, R, L, E —<R>—	Output is set to and held at off.	3
Keep	**KP**	Set Reset 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	FPΣ	FP-X	FP-e	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/donw input.	5

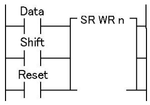
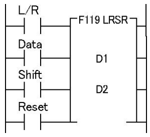
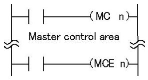
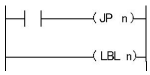
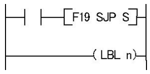
Note1) In the FP2/FP2SH/FP10SH, when timer 256 or higher, or counter 255 or lower, is used, the number of steps is the number in parentheses. Also, in the FP2/FP2SH/FP10SH, when a timer number or counter number has an index modifier, the number of steps is the number in parentheses.

Name	Availability												
	FP0	FPΣ	FP-X	FP-e	FP1			FP-M		FP3	FP2	FP2SH	FP10SH
					C14 C16	C24 C40	C56 C72	C16	C20 C32				
Basic function instructions													
On-delay timer TML	A	A	Partly N/A Note1)	A	N/A	N/A	N/A	N/A	N/A	N/A	A	Partly N/A Note1)	Partly N/A Note1)
On-delay timer TMR	A	A	Partly N/A Note1)	A	A	A	A	A	A	A	A	Partly N/A Note1)	Partly N/A Note1)
On-delay timer TMX	A	A	Partly N/A Note1)	A	A	A	A	A	A	A	A	Partly N/A Note1)	Partly N/A Note1)
On-delay timer TMY	A	A	Partly N/A Note1)	A	A	A	A	A	A	A	A	Partly N/A Note1)	Partly N/A Note1)
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 Note2)	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 Note1)	A	A	A	A	A	A	A	A	Partly N/A Note1)	Partly N/A Note1)
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 **Label**	**JP** **LBL**		The program jumps to the label instruction and continues from there.	2 (3) Note2) 1
Auxiliary jump **Label**	**F19 (SJP)** **LBL**		The program jumps to the label instruction specified by “S” and continues from there.	3 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	FPΣ	FP-X	FP-e	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 **Label**	**LOOP** **LBL**	(LBL n) [LOOP n, S]	The program jumps to the label instruction and continues from there (the number of jumps is set in “S”).	4 (5) Note1) 1
Break	**BRK**	(BRK)	Stops program execution when the predetermined trigger turns on in the TEST/RUN mode only.	1
End	**ED**	(ED)	The operation of program is ended. Indicates the end of a main program.	1
Conditional end	**CNDE**	(CNDE)	The operation of program is ended when the trigger turns on.	1
Eject	**EJECT**	(EJECT)	Adds page break fo ruse when printing.	1
Step ladder instructions				
Start step	**SSTP**	(SSTP n)	The start of program “n” for process control	3
Next step	**NSTL**	(NSTL n)	Start the specified process “n” and clear the process currently started. (Scan execution type)	3
	NSTP	(NSTP n)	Start the specified process “n” and clear the process currently started. (Pulse execution type)	3
Clear step	**CSTP**	(CSTP n)	Resets the specified process “n”.	3
Clear multi-ple steps	**SCLR**	[SCLR n1, n2]	Resets multiple processes specified by “n1” and “n2”.	5
Step end	**STPE**	(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	FPΣ	FP-X	FP-e	FP1			FP-M		FP3	FP2	FP2SH	FP10SH
					C14 C16	C24 C40	C56 C72	C16	C20 C32				
Loop **Label**	A	A	A	A	A	A	A	A	A	A	A	A	A
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 multi-ple 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**	(CALL n)	Executes the specified subroutine. When returning to the main program, outputs in the subroutine program are maintained.	2 (3) Note1)
Output off type subrou-tine call	**FCAL**	(FCAL n)	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**	(SUB n)	Indicates the start of the subroutine program “n”.	1
Subroutine return	**RET**	(RET)	Ends the subroutine program.	1
Interrupt instructions				
Interrupt	**INT**	(INT n)	Indicates the start of the interrupt program “n”.	1
Interrupt return	**IRET**	(IRET)	Ends the interrupt program.	1
Interrupt control	**ICTL**	(DF) [ICTL S1, S2]	Select interrupt enable/disable or clear in “S1” and “S2” and execute.	5

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 paretheses.

Name	Availability												
	FP0	FPΣ	FP-X	FP-e	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				
Communication conditions setting	**SYS1**	(DF) [SYS1, M]	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**	[SYS2, S, D1, D2]	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 Note1)	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 Note2)	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=**	= S1, S2	Begins a logic operation by comparing two 16-bit data in the comparative condition “S1=S2”.	5
	ST<>	< > S1, S2	Begins a logic operation by comparing two 16-bit data in the comparative condition “S1<S2” or “S1>S2”.	5
	ST>	> S1, S2	Begins a logic operation by comparing two 16-bit data in the comparative condition “S1>S2”.	5
	ST>=	>= S1, S2	Begins a logic operation by comparing two 16-bit data in the comparative condition “S1>S2” or “S1=S2”.	5
	ST<	< S1, S2	Begins a logic operation by comparing two 16-bit data in the comparative condition “S1<S2”.	5
	ST<=	< = S1, S2	Begins a logic operation by comparing two 16-bit data in the comparative condition “S1<S2” 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=**	= S1, S2	Connects a Form A (normally open) contact serially by comparing two 16-bit data in the comparative condition “S1=S2”.	5
	AN<>	< > S1, S2	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>	> S1, S2	Connects a Form A (normally open) contact serially by comparing two 16-bit data in the comparative condition “S1>S2”.	5
	AN>=	>= S1, S2	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<	< S1, S2	Connects a Form A (normally open) contact serially by comparing two 16-bit data in the comparative condition “S1<S2”.	5
	AN<=	<= S1, S2	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	FPΣ	FP-X	FP-e	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=**	= S1, S2	Connects a Form A (normally open) contact in parallel by comparing two 16-bit data in the comparative condition “S1=S2”.	5
	OR<>	< > S1, S2	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>	> S1, S2	Connects a Form A (normally open) contact in parallel by comparing two 16-bit data in the comparative condition “S1>S2”.	5
	OR>=	>= S1, S2	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<	< S1, S2	Connects a Form A (normally open) contact in parallel by comparing two 16-bit data in the comparative condition “S1<S2”.	5
	OR<=	<= S1, S2	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	FPΣ	FP-X	FP-e	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=**	D= S1, S2	Begins a logic operation by comparing two 32-bit data in the comparative condition “(S1+1, S1)=(S2+1, S2)”.	9
	STD<>	D<> S1, S2	Begins a logic operation by comparing two 32-bit data in the comparative condition “(S1+1, S1)<(S2+1, S2)” or “(S1+1, S1)>(S2+1, S2)”.	9
	STD>	D> S1, S2	Begins a logic operation by comparing two 32-bit data in the comparative condition “(S1+1, S1)>(S2+1, S2)”.	9
	STD>=	D>= S1, S2	Begins a logic operation by comparing two 32-bit data in the comparative condition “(S1+1, S1)>(S2+1, S2)” or “(S1+1, S1)=(S2+1, S2)”.	9
	STD<	D< S1, S2	Begins a logic operation by comparing two 32-bit data in the comparative condition “(S1+1, S1)<(S2+1, S2)”.	9
	STD<=	D<= S1, S2	Begins a logic operation by comparing two 32-bit data in the comparative condition “(S1+1, S1)<(S2+1, S2)” or “(S1+1, S1)=(S2+1, S2)”.	9

Name	Availability												
	FP0	FPΣ	FP-X	FP-e	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=**	D= S1, S2	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<>	D< > S1, S2	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>	D> S1, S2	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>=	D> = S1, S2	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<	D< S1, S2	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<=	D< = S1, S2	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-e	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=**	D= S1, S2	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<>	D< > S1, S2	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>	D> S1, S2	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>=	D>= S1, S2	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<	D< S1, S2	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<=	D< = S1, S2	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-e	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=**	F= S1, S2	Begins a logic operation by comparing two 32-bit data in the comparative condition “(S1+1, S1)=(S2+1, S2)”.	9
	STF<>	F<> S1, S2	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>	F> S1, S2	Begins a logic operation by comparing two 32-bit data in the comparative condition “(S1+1, S1)>(S2+1, S2)”.	9
	STF>=	F>= S1, S2	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<	F< S1, S2	Begins a logic operation by comparing two 32-bit data in the comparative condition “(S1+1, S1)<(S2+1, S2)”.	9
	STF<=	F<= S1, S2	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-e	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	N/A	N/A	N/A
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	N/A	N/A	N/A
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	N/A	N/A	N/A
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	N/A	N/A	N/A
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	N/A	N/A	N/A
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	N/A	N/A	N/A

• A: Available, N/A: Not available
Note1) This instruction is available for FP-X V1.10 or later and FPΣ 32k .

Name	Boolean	Symbol	Description	Steps
Floating point type real number data compare (AND)	**ANF=**	F= S1, S2	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<>	F<> S1, S2	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>	F> S1, S2	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>=	F>= S1, S2	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<	F< S1, S2	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<=	F<= S1, S2	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-e	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	N/A	N/A	N/A
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	N/A	N/A	N/A
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	N/A	N/A	N/A
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	N/A	N/A	N/A
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	N/A	N/A	N/A
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	N/A	N/A	N/A

• A: Available, N/A: Not available
Note1) This instruction is available for FP-X V1.10 or later and FPΣ 32k .

Name	Boolean	Symbol	Description	Steps
Floating point type real number data compare (OR)	**ORF=**	F= S1, S2	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<>	F<> S1, S2	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>	F> S1, S2	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>=	F>= S1, S2	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<	F< S1, S2	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<=	F<= S1, S2	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-e	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	N/A	N/A	N/A
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	N/A	N/A	N/A
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	N/A	N/A	N/A
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	N/A	N/A	N/A
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	N/A	N/A	N/A
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	N/A	N/A	N/A

• A: Available, N/A: Not available

Note1) This instruction is available for FP-X V1.10 or later and FPΣ 32k .

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**	**BKMV** **PBKMV**	S1, S2, D	The data between “S1” and “S2” is transferred to the area starting at “D”.	7

Name	Availability												
	FP0 Note1)	FPΣ Note1)	FP-X Note1)	FP-e	FP1 Note1)			FP-M Note1)		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 Note2)	Partly N/A Note2)	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/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.

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** **F12**	**Data read from IC card/ROM**	**ICRD** **PICRD** **ICRD**	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
F13 **P13** **P13**	**Data write to IC card/ROM**	**ICWT** **PICWT** **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
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 Note1)	FPΣ Note1)	FP-X Note1)	FP-e	FP1 Note1)			FP-M Note1)		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)→(D+1, D)	11
F25 **P25**	**16-bit data subtraction**	**-** **P-**	S, D	(D)-(S)→(D)	5
F26 **P26**	**32-bit data subtraction**	**D-** **PD-**	S, D	(D+1, D)-(S+1, S)→(D+1, D)	7
F27 **P27**	**16-bit data subraction**	**-** **P-**	S1, S2, D	(S1)-(S2)→(D)	7
F28 **P28**	**32-bit data subtraction**	**D-** **PD-**	S1, S2, D	(S1+1, S1)-(S2+1, S2)→(D+1, D)	11
F30 **P30**	**16-bit data multiplication**	***** **P***	S1, S2, D	(S1)X(S2)→(D+1, D)	7
F31 **P31**	**32-bit data multiplication**	**D*** **PD***	S1, S2, D	(S1+1, S1)X(S2+1, S2)→(D+3, D+2, D+1, D)	11
F32 **P32**	**16-bit data division**	**%** **P%**	S1, S2, D	(S1)÷(S2)→quotient (D) remainder (DT9015 for FP0/FP-e/FP1/FP-M/FP3 or DT90015 for FP0 T32/FPΣ/FP2/FP2SH/FP10SH)	7
F33 **P33**	**32-bit data division**	**D%** **PD%**	S1, S2, D	(S1+1, S1)÷(S2+1, S2)→quotient (D+1, D) remainder (DT9016, DT9015 for FP0/FP-e/FP1/ FP-M/FP3 or DT90016, DT90015 for FP0 T32/ FPΣ/FP2/FP2SH/FP10SH)	11
F34 **P34**	**16-bit data multiplication (result in 16 bits)**	***W** **P*W**	S1, S2, D	(S1)X(S2)→(D)	7
F35 **P35**	**16-bit data increment**	**+1** **P+1**	D	(D)+1→(D)	3
F36 **P36**	**32-bit data increment**	**D+1** **PD+1**	D	(D+1, D)+1→(D+1, D)	3

Name	Availability												
	FP0 Note1)	FPΣ Note1)	FP-X Note1)	FP-e	FP1 Note1)			FP-M Note1)		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.

Num-ber	Name	Boolean	Operand	Description	Steps
F37 **P37**	**16-bit data decrement**	**-1** **P-1**	D	(D)-1→(D)	3
F38 **P38**	**32-bit data decrement**	**D-1** **PD-1**	D	(D+1, D)-1→(D+1, D)	3
F39 **P39**	**32-bit data multiplication (result in 32 bits)**	**D*D** **PD*D**	S1, S2, D	(S1+1, S1)x(S2+1, S2)→(D+1, D)	11
BCD arithmetic instructions					
F40 **P40**	**4-digit BCD data addition**	**B+** **PB+**	S, D	(D)+(S)→(D)	5
F41 **P41**	**8-digit BCD data addition**	**DB+** **PDB+**	S, D	(D+1, D)+(S+1, S)→(D+1, D)	7
F42 **P42**	**4-digit BCD data addition**	**B+** **PB+**	S1, S2, D	(S1)+(S2)→(D)	7
F43 **P43**	**8-digit BCD data addition**	**DB+** **PDB+**	S1, S2, D	(S1+1, S1)+(S2+1, S2)→(D+1, D)	11
F45 **P45**	**4-digit BCD data subtraction**	**B-** **PB-**	S, D	(D)-(S)→(D)	5
F46 **P46**	**8-digit BCD data subtraction**	**DB-** **PDB-**	S, D	(D+1, D)-(S+1, S)→(D+1, D)	7
F47 **P47**	**4-digit BCD data subtraction**	**B-** **PB-**	S1, S2, D	(S1)-(S2)→(D)	7

Name	Availability												
	FP0 Note1)	FPΣ Note1)	FP-X Note1)	FP-e	FP1 Note1)			FP-M Note1)		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.

Num-ber	Name	Boolean	Operand	Description	Steps
F48 **P48**	**8-digit BCD data subraction**	**DB-** **PDB-**	S1, S2, D	(S1+1, S1)-(S2+1, S2)→(D+1, D)	11
F50 **P50**	**4-digit BCD data multiplication**	**B*** **PB***	S1, S2, D	(S1)X(S2)→(D+1, D)	7
F51 **P51**	**8-digit BCD data multiplication**	**DB*** **PDB***	S1, S2, D	(S1+1, S1)X(S2+1, S2)→(D+3, D+2, D+1, D)	11
F52 **P52**	**4-digit BCD data division**	**B%** **PB%**	S1, S2, D	(S1)÷(S2)→quotient (D) remainder (DT9015 for FP0/FP-e/FP1/FP-M/FP3 or DT90015 for FP0 T32/FPΣ/FP2/FP2SH/FP10SH)	7
F53 **P53**	**8-digit BCD data division**	**DB%** **PDB%**	S1, S2, D	(S1+1, S1)÷(S2+1, S2)→quotient (D+1, D) remainder (DT9016, DT9015 for FP0/FP-e/FP1/FP-M/FP3 or DT90016, DT90015 for FP0 T32/FPΣ/FP2/FP2SH/FP10SH)	11
F55 **P55**	**4-digit BCD data increment**	**B+1** **PB+1**	D	(D)+1→(D)	3
F56 **P56**	**8-digit BCD data increment**	**DB+1** **PDB+1**	D	(D+1, D)+1→(D+1, D)	3
F57 **P57**	**4-digit BCD data decrement**	**B-1** **PB-1**	D	(D)-1→(D)	3
F58 **P58**	**8-digit BCD data decrement**	**DB-1** **PDB-1**	D	(D+1, D)-1→(D+1, D)	3

Name	Availability												
	FP0 Note1)	FPΣ Note1)	FP-X Note1)	FP-e	FP1 Note1)			FP-M Note1)		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.

Num- ber	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) AND ($\overline{S2}$)} OR {($\overline{S1}$) AND (S2)}→(D)	7
F68 **P68**	**16-bit data exclusive NOR**	**XNR** **PXNR**	S1, S2, D	{(S1) AND (S2)} OR {($\overline{S1}$) AND ($\overline{S2}$)}→(D)	7
F69 **P69**	**16-bit data unite**	**WUNI** **PWUNI**	S1, S2, S3, D	([S1] AND [S3]) OR ([S2] AND [S3])→(D) When (S3) is H0, (S2)→(D) When (S3) is HFFFF, (S1) →(D)	9

Name	Availability												
	FP0 Note1)	FPΣ Note1)	FP-X Note1)	FP-e	FP1 Note1)			FP-M Note1)		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 42 41 44 43 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 44 43 42 41 → 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 32 31 34 33 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 34 33 32 31 → 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 30 30 31 2D 20 20 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 30 30 31 2D 20 20 → 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 Note1)	FPΣ Note1)	FP-X Note1)	FP-e	FP1 Note1)			FP-M Note1)		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 (complement 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 Note1)	FPΣ Note1)	FP-X Note1)	FP-e	FP1 Note1)			FP-M Note1)		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.

Num-ber	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 (distriuted 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 characer 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 if 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 Note1)	FPΣ Note1)	FP-X Note1)	FP-e	FP1 Note1)			FP-M Note1)		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.

Number	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 Note1)	FPΣ Note1)	FP-X Note1)	FP-e	FP1 Note1)			FP-M Note1)		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 Note1)	FPΣ Note1)	FP-X Note1)	FP-e	FP1 Note1)			FP-M Note1)		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** **PDRCR**	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**	**DBCU** **PDBCU**	S, D	Store the number of on bits in the data of (S+1, S) in “D”.	7

Name	Availability												
	FP0 Note1)	FPΣ Note1)	FP-X Note1)	FP-e	FP1 Note1)			FP-M Note1)		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.

Number	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, minutes and seconds 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 Note1)	FPΣ Note1)	FP-X Note1)	FP-e	FP1 Note1)			FP-M Note1)		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 Note2)	A	A	A	N/A	A	A	N/A	A	A	A	A	A
F139 P139	Partly N/A Note2)	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.

Num-ber	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 communica-tion 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 Note1)	FPΣ Note1)	FP-X Note1)	FP-e	FP1 Note1)			FP-M Note1)		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 Note2)	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 Note2)	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 Note2)	Partly N/A Note2)	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 Note2)	Partly N/A Note2)	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 intelli-gent unit**	**READ PREAD**	S1, S2, n, D	Reads the data from the intelligent unit.	9
F151 P151	**Data write into intelli-gent 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 substruction**	**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 communica-tion**	**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 Note1)	FPΣ Note1)	FP-X Note1)	FP-e	FP1 Note1)			FP-M Note1)		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 Note2)	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 Note2)	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 Note6)	Partly N/A Note5)	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A	A
F156 P156	N/A	Partly N/A Note6)	Partly N/A Note5)	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A	A
F157 P157	Partly N/A Note3	A	A	A	N/A	A	A	A	A	A	A	A	A
F158 P158	Partly N/A Note3	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 Note4	Partly N/A Note4	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 Note4	Partly N/A Note4	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.

Number	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 Note1)	FPΣ Note1)	FP-X Note1)	FP-e	FP1 Note1)			FP-M Note1)		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.

Number	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 outptu (Y0 or Y1) according to the contents of the data table beginning at “S”.	5

Name	Availability												
	FP0 Note1)	FPΣ Note1)	FP-X Note1)	FP-e	FP1 Note1)			FP-M Note1)		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 Note1)	FPΣ Note1)	FP-X Note1)	FP-e	FP1 Note1) C14 C16	FP1 Note1) C24 C40	FP1 Note1) C56 C72	FP-M Note1) C16	FP-M Note1) C20 C32	FP3	FP2	FP2SH	FP10SH
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 Note3)	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) AND $\overline{(S2+1, S2)}$} OR {$\overline{(S1+1, S1)}$ AND (S2+1, S2)}→(D+1, D)	12
F218 **P218**	**32-bit data XNR**	**DXNR** **PDXNR**	S1, S2, D	{(S1+1, S1) AND (S2+1, S2)} OR {$\overline{(S1+1, S1)}$ AND $\overline{(S2+1, S2)}$}→(D+1, D)	12
F219 **P219**	**Double word (32-bit) data unites**	**DUNI** **PDUNI**	S1, S2, S3, D	{(S1+1, S1) AND (S3+1, S3)} OR {(S2+1, S2) AND $\overline{(S3+1, S3)}$}→(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 Note1)	FPΣ Note1)	FP-X Note1)	FP-e	FP1 Note1)			FP-M Note1)		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 Note5)	Partly N/A Note4)	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 Note3)	Partly N/A Note6)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Partly N/A Note2	Partly N/A Note2	N/A
F231 **P231**	N/A	Partly N/A Note3)	Partly N/A Note6)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Partly N/A Note2	Partly N/A Note2	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 FPΣ 32k.
Note4) This function is available for FP-X Ver2.0 or later.
Note5) This instruction is available for FPΣ 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 Note1)	FPΣ Note1)	FP-X Note1)	FP-e	FP1 Note1)			FP-M Note1)		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 Note2	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 Note2	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 Note4)	Partly N/A Note3)	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 FPΣ 32k.
Note3) This instruction is available for FP-X Ver2.0 or later.
Note4) This instruction is available for FP FPΣ 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 Note1)	FPΣ Note1)	FP-X Note1)	FP-e	FP1 Note1)			FP-M Note1)		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 Note2	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A
F271 P271	N/A	A	A	Partly N/A Note2	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A
F272 P272	N/A	A	A	Partly N/A Note2	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A
F273 P273	N/A	A	A	Partly N/A Note2	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A
F275 P275	N/A	A	A	Partly N/A Note2	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A
F276 P276	N/A	A	A	Partly N/A Note2	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)**	**LIMT** **PLIMT**	S1, S2, S3, D	When S1>S3, S1→D When S1<S3, S2→D When S1<or = S3<or = S2, S3→D	10
F286 **P286**	**Upper and lower limit control (32-bit data)**	**DLIMT** **PDLIMT**	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)	16
F287 **P287**	**Deadband control (16-bit data)**	**BAND** **PBAND**	S1, S2, S3, D	When S1>S3, S3–S1→D When S2<S3, S3–S2→D When S1<or = S3<or = S2, 0→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)→(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→(D+1, D)	16
F289 **P289**	**Zone control (16-bit data)**	**ZONE** **PZONE**	S1, S2, S3, D	When S3<0, S3+S1→D When S3=0, 0→D When S3>0, S3+S2→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) →(D+1, D) When (S3+1, S3)=0, 0→(D+1, D) When (S3+1, S3)>0, (S3+1, S3)+(S2+1, S2) →(D+1, D)	16

Name	Availability												
	FP0 Note1)	FPΣ Note1)	FP-X Note1)	FP-e	FP1 Note1)			FP-M Note1)		FP3	FP2	FP2SH	FP10SH
					C14 C16	C24 C40	C56 C72	C16	C20 C32				
F277 P277	N/A	A	A	Partly N/A Note2)	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A
F278 P278	N/A	A	A	Partly N/A Note2)	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A
F282 P282	N/A	A	A	Partly N/A Note2)	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 Note3)	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 Note2)	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A
F286 P286	N/A	A	A	Partly N/A Note2)	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A
F287 P287	N/A	A	A	Partly N/A Note2)	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A
F288 P288	N/A	A	A	Partly N/A Note2)	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A
F289 P289	N/A	A	A	Partly N/A Note2)	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A
F290 P290	N/A	A	A	Partly N/A Note2)	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.

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	SIN(S1+1, S1)$\rightarrow$(D+1, D)	6
F301 **P301**	**BCD type cosine operation**	**BCOS** **PBCOS**	S, D	COS(S1+1, S1)$\rightarrow$(D+1, D)	6
F302 **P302**	**BCD type tangent operation**	**BTAN** **PBTAN**	S, D	TAN(S1+1, S1)$\rightarrow$(D+1, D)	6
F303 **P303**	**BCD type arcsine operation**	**BASIN** **PBASIN**	S, D	SIN^{-1}(S1+1, S1)$\rightarrow$(D+1, D)	6
F304 **P304**	**BCD type arccosine operation**	**BACOS** **PBACOS**	S, D	COS^{-1}(S1+1, S1)$\rightarrow$(D+1, D)	6
F305 **P305**	**BCD type arctangent operation**	**BATAN** **PBATAN**	S, D	TAN^{-1}(S1+1, S1)$\rightarrow$(D+1, D)	6

Name	Availability												
	FP0 Note1)	FPΣ Note1)	FP-X Note1)	FP-e	FP1 Note1)			FP-M Note1)		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.

Number	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)→(D+1, D)	8
F310 P310	**Floating-point type data addition**	**F+ PF+**	S1, S2, D	(S1+1, S1)+(S2+1, S2)→(D+1, D)	14
F311 P311	**Floating-point type data subtraction**	**F- PF-**	S1, S2, D	(S1+1, S1)–(S2+1, S2)→(D+1, D)	14
F312 P312	**Floating-point type data multiplication**	**F* PF***	S1, S2, D	(S1+1, S1)×(S2+1, S2)→(D+1, D)	14
F313 P313	**Floating-point type data division**	**F% PF%**	S1, S2, D	(S1+1, S1)÷(S2+1, S2)→(D+1, D)	14
F314 P314	**Floating-point type data sine operation**	**SIN PSIN**	S, D	SIN(S+1, S)→(D+1, D)	10
F315 P315	**Floating-point type data cosine operation**	**COS PCOS**	S, D	COS(S+1, S)→(D+1, D)	10
F316 P316	**Floating-point type data tangent operation**	**TAN PTAN**	S, D	TAN(S+1, S)→(D+1, D)	10
F317 P317	**Floating-point type data arcsine operation**	**ASIN PASIN**	S, D	SIN^{-1}(S+1, S)→(D+1, D)	10
F318 P318	**Floating-point type data arccosine operation**	**ACOS PACOS**	S, D	COS^{-1}(S+1, S)→(D+1, D)	10

Name	Availability												
	FP0 Note1)	FPΣ Note1)	FP-X Note1)	FP-e	FP1 Note1)			FP-M Note1)		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	TAN^{-1}(S+1, S)→(D+1, D)	10
F320 **P320**	**Floating-point type data natural logarithm**	**LN** **PLN**	S, D	LN(S+1, S)→(D+1, D)	10
F321 **P321**	**Floating-point type data exponent**	**EXP** **PEXP**	S, D	EXP(S+1, S)→(D+1, D)	10
F322 **P322**	**Floating-point type data logarithm**	**LOG** **PLOG**	S, D	LOG(S+1, S)→(D+1, D)	10
F323 **P323**	**Floating-point type data power**	**PWR** **PPWR**	S1, S2, D	(S1+1, S1) ^ (S2+1, S2)→(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 Note1)	FPΣ Note1)	FP-X Note1)	FP-e	FP1 Note1)			FP-M Note1)		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.

Number	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 Note1)	FPΣ Note1)	FP-X Note1)	FP-e	FP1 Note1)			FP-M Note1)		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.

Number	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 Note1)	FPΣ Note1)	FP-X Note1)	FP-e	FP1 Note1)			FP-M Note1)		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.

Number	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**	**FLIMT** **PFLIMT**	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 maximum 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 Note1)	FPΣ Note1)	FP-X Note1)	FP-e	FP1 Note1)			FP-M Note1)		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/FPΣ/FP-X/FP1/FP-M, the P type high-level instructions are not available.

Num-ber	Name	Boolean	Operand	Description	Steps
F351 **P351**	**Floating-point type data mini-mum 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 speciified 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 temperautre 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 Note1)	FPΣ Note1)	FP-X Note1)	FP-e	FP1 Note1)			FP-M Note1)		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 Note3)	Partly N/A Note5)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Partly N/A Note2)	Partly N/A Note2)	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 Note4)	Partly N/A Note4)	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/FPΣ/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 FPΣ 32k.

Note4) This instruction is available for FP-X V1.20 or later and FPΣ 32k.

Note5) This instruction is available for FP-X V1.13 or later.

Number	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 Note1)	FPΣ Note1)	FP-X Note1)	FP-e	FP1 Note1)			FP-M Note1)		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/contunually 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 appopriate 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 swirching 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 abnomal 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 contect 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 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 aself-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	Opera-tion status	Description and steps to take	FP0	FP-e	FP Σ	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	Opera-tion status	Description and steps to take	FP0	FP-e	FP Σ	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 combina-tion 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**	Conti-nues	When inputting with the programming tool software,a delection,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	Opera-tion status	Description and steps to take	FP0	FP-e	FP Σ	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,FP Σ ,and FP1 C14,C16:Probably a hardware abnormality. ⇒ Please contact your dealer. 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. 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	Opera-tion status	Description and steps to take	FP0	FP-e	FP Σ	FP-X	FP1/FP-M	FP2	FP2SH	FP10SH	FP3
E29	**Configu-ration 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 interrrupt 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. -FP Σ , 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 (remore 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 proterly 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 register21: -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. MEWNET-TR communication error FP3 and FP10SH: Check the contents of special data registers(FP3:DT9002,DT9003,FP10SH:DT90002,DT90003) and the erroneous master unit and abnormal I/O unit. Then check the unit. Selection of operation status using system register21: -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

A:Available

Error code	Name	Opera-tion status	Description and steps to take	FP0	FP-e	FP Σ	FP-X	FP1/FP-M	FP2	FP2SH	FP10SH	FP3
E41	**Intelligent unit error**	Selec-table	An abnormality in an intelligent unit. FPΣ, FP-X: Check the contetns of special data register “DT90006” and locate the abnormal FP intelligent unit (application cassette for FP-X). 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.. Selection of operation status using system register22: -to continue operation,set 1 -to stop operation,set 0 FP3: Check the contents of special data registers DT9006,DT9007 and locate the abnormal intelligent unit.Then check the unit referring to its manual.. Selection of operation status using system register22: -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
E42	**I/O unit verify error**	Selec-table	I/O unit(Expansion unit) wiring condition has changed compared to that at time fo power-up. ⇒ 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. ⇒ Check the contents of special data register (FP2,FP2SH,and FP10SH:DT90010,DT90011,FP3 DT9010,DT9011) Selection of operation status using system register23: -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	A

A:Available

Error code	Name	Opera-tion status	Description and steps to take	FP0	FP-e	FP Σ	FP-X	FP1/FP-M	FP2	FP2SH	FP10SH	FP3
E43	**System watching dog timer error**	Selec-table	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 staiton connecting time error for MEWNET-F system**	Selec-table	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**	Selec-table	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	Opera-tion status	Description and steps to take	FP0	FP-e	FP Σ	FP-X	FP1/FP-M	FP2	FP2SH	FP10SH	FP3
E46	**Remote I/O commu-nication error**	Selec-table	S-LINK error Occurs only in FP0-SL1 When one of the S-LINK errors (ERR1, 3 or 4) has been deteced,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								
		Selec-table	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**	Selec-table	In the unit on the slave station, an abnormallty 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	Opera-tion status	Description and steps to take	FP0	FP-e	FP Σ	FP-X	FP1/FP-M	FP2	FP2SH	FP10SH	FP3
E50	**Backup battery errror**	Conti-nues	The voltage of the backup battery lowered or the backup battery of conrol 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**	Conti-nues	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 synchro-nous error**	Conti-nues	Set the INITIALIZE/TEST selecto1inmjvbgycfrde892 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 regis-tration error (CPU2 only)**	Conti-nues	Abnormality was detected when the multi-CPU system ws used. Please contact your dealer.								A	A
E54	**IC memory card back-up battery error**	Conti-nues	The voltage of the backup battery for the IC memory card lowered. The BATT.LED does not turn on. Charge or replace the backup battry of IC memory card.(The contents of the IC memory card cannot be guaranteed.)							A	A	
E55	**IC memory card back-up battery error**	Cont-inues	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	**Incompat-ible IC memory card error**	Cont-inues	The IC memory card installed is not compatible. Replace the IC memory card compatible with FP2SH/FP10SH.							A	A	
E57	**No unit for the configu-ration**	Conti-nues	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-e	FP Σ	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		Conti-nues		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
!21	**NACK error**	Link system error
!22	**WACK error**	Link system error
!23	**Unit No. overlap**	Link system error
!24	**Transmission format error**	Link system error
!25	**Link unit hardware error**	Link system error
!26	**Unit No. setting error**	Link system error
!27	**No support error**	Link system error
!28	**No response error**	Link system error
!29	**Buffer closed error**	Link system error
!30	**Time-out error**	Link system error
!32	**Transmission impossible error**	Link system error
!33	**Communication stop**	Link system error
!36	**No destination error**	Link system error
!38	**Other communication error**	Link system error
!40	**BCC error**	A transfer error occurred in the received data.
!41	**Format error**	A command was received that does not fit the format.
!42	**No support error**	A command was received that is not supported.
!43	**Multiple frames procedure error**	A different command was received when processing multiple frames.
!50	**Link setting error**	A route number that does not exist was spacified. Verify the route number by designating the transmission station.
!51	**Transmission time-out error**	Transmission to anather device not possible because transmissition buffer is congested.
!52	**Transmit disable error**	Transmission processing to another device is not possible.(Link unit runaway,etc.)
!53	**Busy error**	Command process cannot be received because of multiple frame processing.Or,cannot be received because command being processed is congested.
!60	**Parameter error**	Content of spacified parameter does not exist or cannot be used.
!61	**Data error**	There was a mistake in the contact,data area,data number desigination,size designation,range,or format designation.
!62	**Registration over error**	Operation was does when number of registrations was exceeded or when there was no registration.
!63	**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 theb 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. Alsi.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 ellapsed 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 areaof 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
b3	b2	b1	b0	R \ C	0	1	2	3	4	5	6	7
0	0	0	0	0	NUL	DEL	SPACE	0	@	P	`	p
0	0	0	1	1	SOH	DC1	!	1	A	Q	a	q
0	0	1	0	2	STX	DC2	"	2	B	R	b	r
0	0	1	1	3	ETX	DC3	#	3	C	S	c	s
0	1	0	0	4	EOT	DC4	$	4	D	T	d	t
0	1	0	1	5	ENQ	NAK	%	5	E	U	e	u
0	1	1	0	6	ACK	SYN	&	6	F	V	f	v
0	1	1	1	7	BEL	ETB	'	7	G	W	g	w
1	0	0	0	8	BS	CAN	(	8	H	X	h	x
1	0	0	1	9	HT	EM	)	9	I	Y	i	y
1	0	1	0	A	LF	SUB	*	:	J	Z	j	z
1	0	1	1	B	VT	ESC	+	;	K	[	k	{
1	1	0	0	C	FF	FS	,	<	L	¥	l	|
1	1	0	1	D	CR	GS	-	=	M	]	m	}
1	1	1	0	E	SO	RS	.	>	N	^	n	~
1	1	1	1	F	SI	US	/	?	O	_	o	DEL

Record of changes

Manual No.	Date	Description of changes
ARCT1F333E	Sepr.2001	First edition
ARCT1F333E-1	Feb.2002	2nd edition -Addisions: Control units FPG-C32T2,FPG-C24R2 Expansion unit FPG-XY64D2T Tool software FPWIN Pro Ver.4
ARCT1F333E-2	Nov.2002	3rd edition Additions : Control units FPG-C28P2(PNP output) Thermistor input function type (part nmber ending in TM) Expansion units Add information about inteligent units
ARCT1F333E-3	May.2004	4th edition Additions:Communication cassette AFPG806 Expansion unit FPG-XY64D2P(PNP type) Expansion Data Memory Unit FPG-EM1 Change of a chapter -Communication cassette -Computer Link -General-purpose Serial communication -PLC link →Chapter7 Communication cassette
ARCT1F333E-4	Apr.2006	5th edition Additions : FPΣ 32k Type
ARCT1F333E-5	Jan.2007	6th edition
ARCT1F333E-6	Jun.2007	7th edition Function addition only of FPΣ 32k Type Ver.3.10 or more
ARCT1F333E-7	Jun.2008	8th edition
ARCT1F333E-8	Feb.2009	9th edition Change in Corporate name

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