

PROGRAMMABLE CONTROLLER
FP0R Analog I/O Unit
User's Manual

[Applicable Models]

- FP0R Analog Input Unit (Model No. AFP0RAD4/AFP0RAD8)
- FP0R Analog Output Unit (Model No. AFP0RDA4)
- FP0R Analog I/O Unit (Model No. AFP0RA21/AFP0RA42)

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.

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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Introduction

Thank you for buying a Panasonic product. Before you use the product, please carefully read the installation instructions and the users manual, and understand their contents in detail to use the product properly.

Types of Manual

- There are different types of users manual for the FP0R series, as listed below. Please refer to a relevant manual for the unit and purpose of your use.
- The manuals can be downloaded on our website:
<https://industry.panasonic.com/global/en/downloads/?tab=manual>

Unit name or purpose of use	Manual name	Manual code
FP0R Control Unit	FP0R User's Manual	ARCT1F475E
FP0R Expansion I/O Unit		
FPΣ Control Unit	FPΣ User's Manual	ARCT1F333E
FP0H Control Unit	FP0H User's Manual (Basic)	WUME-FP0HBAS
FP0R Analog Input Unit	FP0R Analog I/O Unit User's Manual	WUME-FP0RAIO
FP0R Analog Output Unit		
FP0R Analog I/O Unit		
Programming	FP-series Programming Manual	ARCT1F313E
Programming Software FPWIN GR	FPWIN GR Operation Guide (Non-free)	ARCT1F332E

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1

Unit Functions and Restrictions

1.1 Unit Functions and How They Work

1.1.1 Functions of Unit

- **Attaching these units to FP0R Control Unit enables analog I/O control.**
- It is selectable from five types of units in accordance with the intended use.
- **Compatibility mode with conventional models is prepared.**
- The compatibility mode which enables smooth transition from conventional Analog I/O Units (FP0-A80, FP0-A04V, FP0-A04I, FP0-A21) is prepared.
- **14-bit processing mode is added.**
- The high-resolution 14-bit mode (1/16000) is added to the both input and output. Also, ranges for each channel can be specified by user programs.

1.1.2 Unit Type

Name	Specifications	Product number
FP0R Analog Input unit	4-ch input	AFP0RAD4
	8-ch input	AFP0RAD8
FP0R Analog Output Unit	4-ch output	AFP0RDA4
FP0R Analog I/O Unit	2-ch Input, 1-ch output	AFP0RA21
	4-ch Input, 2-ch output	AFP0RA42

1.1.3 Restrictions on Units Combination

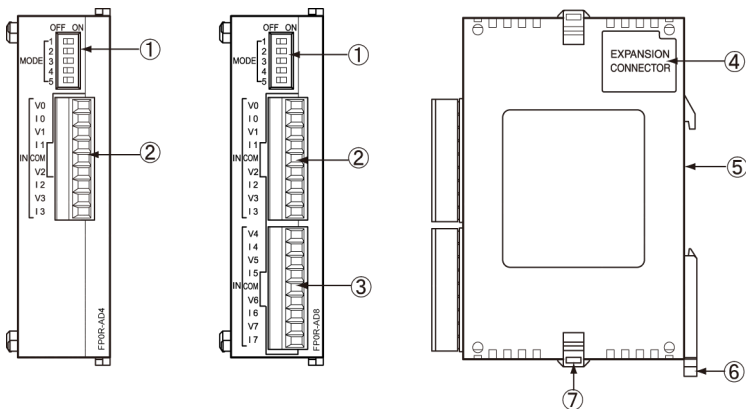
Up to three units can be connected with the control unit including other FP0/FP0R Expansion I/O Unit and intelligent unit.

2

Names and Functions of Parts

2.1 Analog Input Unit (FP0R-AD4/AD8)

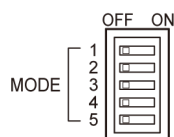
2.1.1 Names and Functions of Parts



■ Names and Functions of Parts

No.	Name	Description
①	Mode setting switch	<ul style="list-style-type: none"> Used for selecting the input range, the number of input channels and whether to use the averaging processing or not. Used for selecting the operation mode (12-bit mode or 14-bit mode compatible with the conventional product FP0-A80).
②	Input terminal for CH0-CH3	Used for connecting the analog input device.
③	Input terminal for CH4-CH7	Used for connecting the analog input device.
④	Expansion connector	Used for connecting the expansion unit with the internal circuit of the Control Unit.
⑤	DIN rail installing groove	It can be installed to a 35-mm-wide DIN rail.
⑥	DIN hook	The unit can be installed to the DIN rail through one-touch operation. This hook is also used for installing the unit to the Slim Type Mounting Plate (AFP0803).
⑦	Expansion hook	Used for securing expansion units.

2.1.2 Setting of Mode Switch



■ Setting of the mode switch

Item	No.	Settings			
Resolution and FP0-A21-compatible 12-bit mode input range	1	OFF	ON	OFF	ON
	2	OFF	OFF	ON	ON
		FP0-A80-compatible 12-bit mode 0 to 5V/0 to 20mA (Note 1)	FP0-A80-compatible 12-bit mode -10 to +10V	FP0-A80-compatible 12-bit mode -100 to +100mV (Note 2)	14-bit mode (Note 3)
The number of converted CH	3	OFF	ON	OFF	ON
	4	OFF	OFF	ON	ON
		2ch (CH0-CH1)	4ch (CH0-CH3)	6ch (CH0-CH5)	8ch (CH0-CH7)
Input averaging	5	OFF: Averaging Not performed, ON: Averaging Performed			

(Note 1): When the both switch No.1 and No.2 are OFF, the voltage/current is switched by the connection method.

(Note 2): This has been implemented in version 1.2 or later. In version 1.1 or earlier, this is reserved for the system (not available).

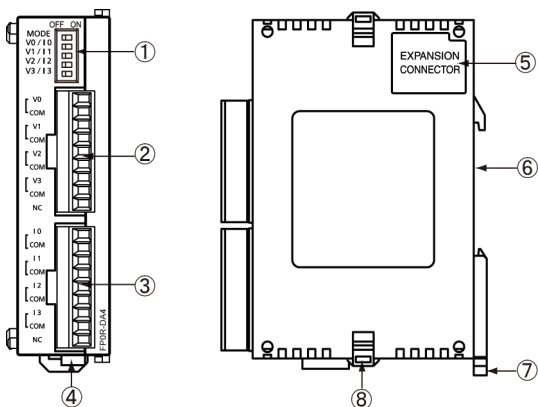
(Note 3): In the 14-bit mode, the input range is set by writing into the operation memory WY with a user program.

(Note 4): All the switches are set to OFF at the factory.

(Note 5): The switch settings will be valid when the power is turned ON from OFF. The settings will not change if the operation power supply is switched when it is ON.

2.2 Analog Output Unit (FP0R-DA4)

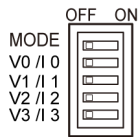
2.2.1 Names and Functions of Parts



■ Names and Functions of Parts

No.	Name	Description
①	Mode setting switch	<ul style="list-style-type: none"> Used for selecting the output range and the output method (voltage/current). Used for selecting the operation mode (12-bit mode or 14-bit mode compatible with the conventional product FP0-A04V/A04I).
②	Voltage output terminal for CH0-CH3	<ul style="list-style-type: none"> Used for connecting the analog output device. The voltage and current vary according to the settings of the mode switch. They can be selected for each channel.
③	Current output terminal for CH0-CH3	
④	Power connector	24 V DC is supplied from an external power supply. For connection, use the power supply cable (AFP0581) that comes with the Unit.
⑤	Expansion connector	Used for connecting the expansion unit with the internal circuit of the Control Unit.
⑥	DIN rail installing groove	It can be installed to a 35-mm-wide DIN rail.
⑦	DIN hook	The unit can be installed to the DIN rail through one-touch operation. This hook is also used for installing the unit to the Slim Type Mounting Plate (AFP0803).
⑧	Expansion hook	Used for securing expansion units.

2.2.2 Setting of Mode Switch



■ Setting of the mode switch

Item	No.	Settings
Resolution	1	OFF : FP0-A04V/A04I compatible 12-bit mode, ON : 14-bit mode (Note 1)
Output switch	2	CH0
	3	CH1
	4	CH2
	5	CH3
		OFF : Voltage output ON : Current output (Note 2)

(Note 1): In the 14-bit mode, the output range is set by writing into the operation memory WY with a user program.

(Note 2): For the both FP0-A04V/A04I compatibility 12-bit mode and 14-bit mode, the output can be selected for each channel.

(Note 3): All the switches are set to OFF at the factory.

(Note 4): The switch settings will be valid when the power is turned ON from OFF. The settings will not change if the operation power supply is switched when it is ON.

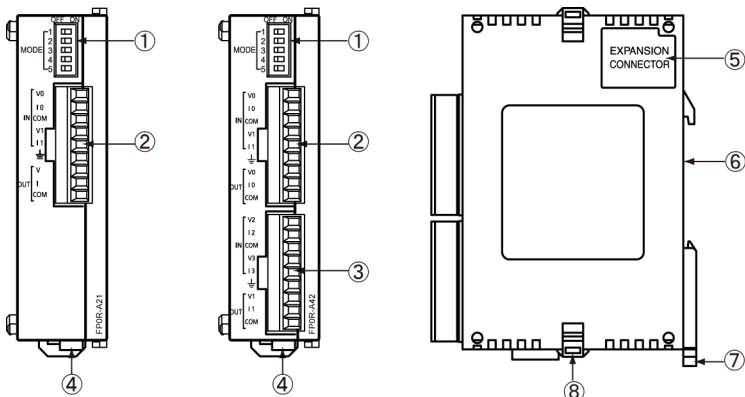


◆ KEY POINTS

- In the FP0-A04V/A04I compatibility 12-bit mode, the voltage output range is -10 to +10 V, and the current output range is 4 to 20 mA.

2.3 Analog I/O Unit (FP0R-A21/A42)

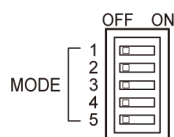
2.3.1 Names and Functions of Parts



■ Names and Functions of Parts

No.	Name	Description
①	Mode setting switch	<ul style="list-style-type: none"> Used for selecting the input and output ranges, the output method (voltage/current), and whether to perform the input averaging processing or not. Used for selecting the operation mode (12-bit mode or 14-bit mode compatible with the conventional product FP0-A21).
②	I/O terminal Input for CH0-CH1 Output for CH0	<ul style="list-style-type: none"> Used for connecting the analog input device or analog output device. The voltage and current vary according to the settings of the mode switch. They can be selected for each channel.
③	I/O terminal Input for CH2-CH3 Output for CH1	
④	Power connector	The supply 24 V DC from an external power supply. For connection, use the power supply cable (AFP0581) that comes with the Unit.
⑤	Expansion connector	Used for connecting the expansion unit with the internal circuit of the Control Unit.
⑥	DIN rail installing groove	It can be installed to a 35-mm-wide DIN rail.
⑦	DIN hook	The unit can be installed to the DIN rail through one-touch operation. This hook is also used for installing the unit to the Slim Type Mounting Plate (AFP0803).
⑧	Expansion hook	Used for securing expansion units.

2.3.2 Setting of Mode Switch



■ Setting of the mode switch

Item	No.	Settings			
I/O resolution and FP0-A21-compatible 12-bit mode input range	1	OFF	ON	OFF	ON
	2	OFF	OFF	ON	ON
		FP0-A21-compatible 12-bit mode 0 to 5V/0 to 20mA (Note 1)	FP0-A21-compatible 12-bit mode -10 to +10V	Reserved for system (Not settable)	14-bit mode (Note 2)
FP0-A21-compatible 12-bit mode output range (Note 3)	3	OFF	ON	OFF	ON
	4	OFF	OFF	ON	ON
		FP0-A21-compatible 12-bit mode 0 to 20mA	Reserved for system (Not settable)	FP0-A21-compatible 12-bit mode -10 to +10V	Reserved for system (Not settable)
14-bit mode output switch (Note 4)	3	OFF	ON	OFF	ON
	4	OFF	OFF	ON	ON
		CH0 Voltage output CH1 Voltage output	CH0 Current output CH1 Voltage output	CH0 Voltage output CH1 Current output	CH0 Current output CH1 Current output
Input averaging	5	OFF: Averaging Not performed, ON: Averaging Performed			

(Note 1): When the both switch No.1 and No.2 are OFF, the input voltage/current is switched by the connection method.

(Note 2): In the 14-bit mode, the input and output ranges are set by writing into the operation memory WY with a user program.

(Note 3): The setting of "FP0-A21 compatibility 12-bit mode output switch" of the switches No.3 and No.4 is valid when the switch No.2 is off.

(Note 4): The setting of "14-bit mode output switch" of the switches No.3 and No.4 is valid when the both switch No.1 and No.2 are on. Switching CH1 is available only for A42 type.

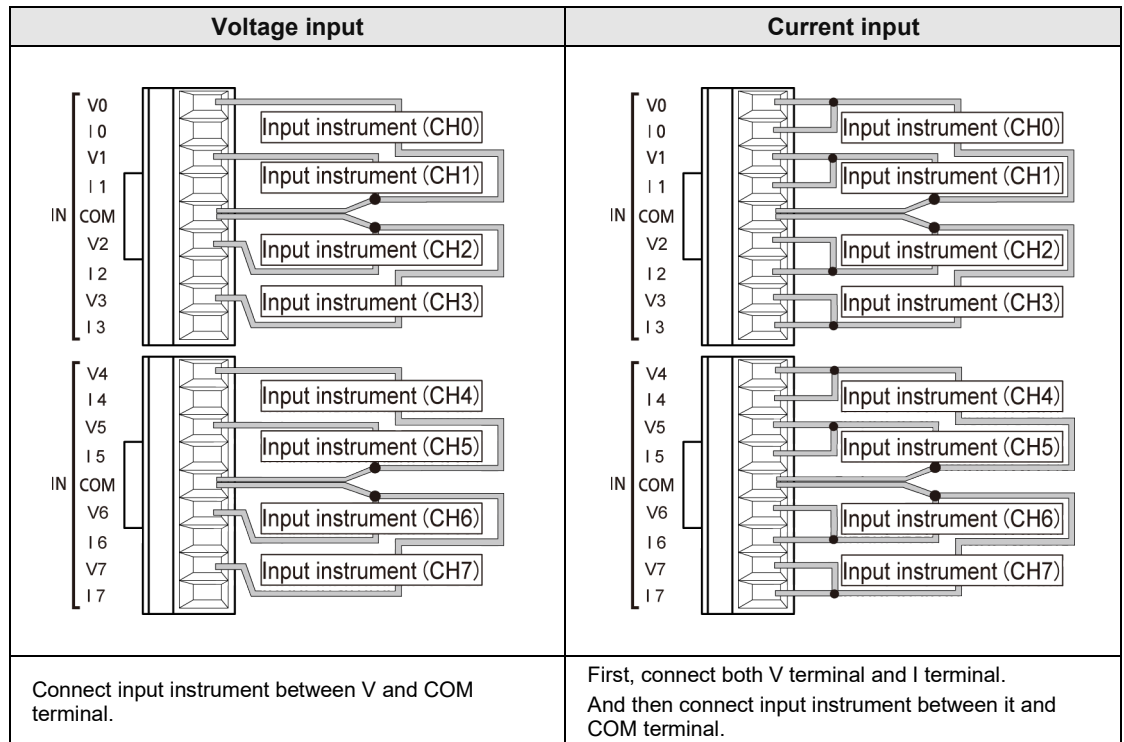
(Note 5): All the switches are set to OFF at the factory.

(Note 6): The switch settings will be valid when the power is turned ON from OFF. The settings will not change if the operation power supply is switched when it is ON.

3

Wiring

3.1.2 Wiring of Analog Input Unit



(Note 1): Two COM terminals are connected internally.

(Note 2): Two cables or less must be inserted to COM terminal as above (two channel once combined).

(Note 3): Recommend using the twisted and shielded communication cables for analog lines and grounding the end of shield.

3.2 Analog Output Unit (FP0R-DA4)

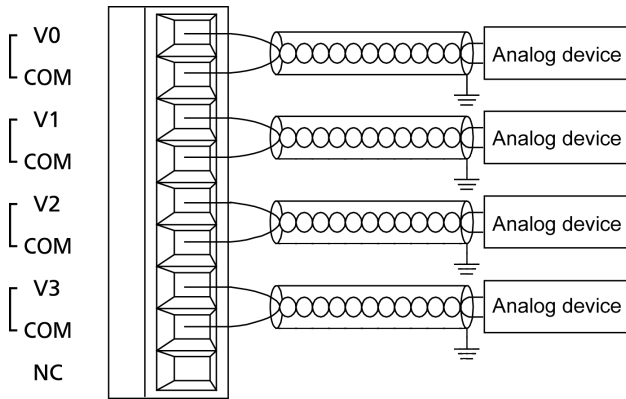
3.2.1 Terminal Layout Diagrams

Appearance	Pin No.	Name	Function		
	1	V0	Analog output	CH0	Voltage signal output
	2	COM		---	Output common
	3	V1		CH1	Voltage signal output
	4	COM		---	Output common
	5	V2		CH2	Voltage signal output
	6	COM		---	Output common
	7	V3		CH3	Voltage signal output
	8	COM		---	Output common
	9	NC		Unused	
	Pin No.	Name	Function		
	1	I0	Analog output	CH0	Current signal output
	2	COM		---	Output common
	3	I1		CH1	Current signal output
	4	COM		---	Output common
	5	I2		CH2	Current signal output
	6	COM		---	Output common
	7	I3		CH3	Current signal output
	8	COM		---	Output common
9	NC	Unused			

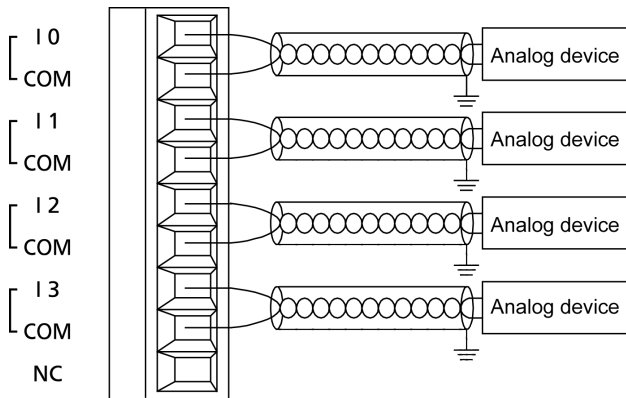
(Note): All COM terminals are connected within the unit.

3.2.2 Wiring of Analog Output Unit

■ When the voltage output



■ When current output



(Note): All COM terminals of the voltage output terminal block and current output terminal block are connected internally.

3.3 Analog I/O Unit (FP0R-A21/A42)

3.3.1 Terminal Layout Diagrams

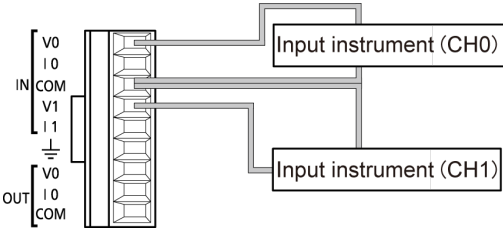
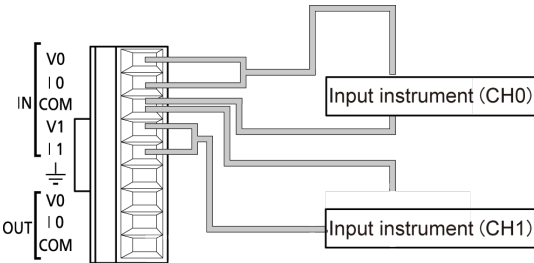
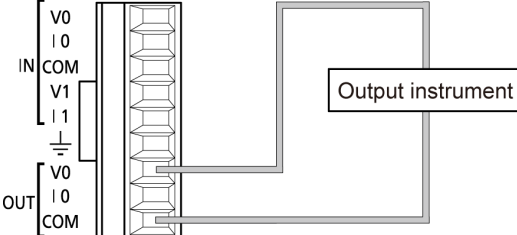

Appearance	Pin No.	Name		Function			
	1	IN	V0	Analog input	CH0	Voltage signal input	
	2	IN	I0		CH0	Current signal input	
	3	IN	COM		---	Input common	
	4	IN	V1		CH1	Voltage signal input	
	5	IN	I1		CH1	Current signal input	
	6	FG		For shield connection of analog signal cable			
	7	OUT	V0	Analog output	CH0	Voltage signal output	
	8	OUT	I0		CH0	Current signal output	
	9	OUT	COM		---	Output common	
	Pin No. Name Function						
	1	IN	V0	Analog input	CH2	Voltage signal input	
	2	IN	I0		CH2	Current signal input	
	3	IN	COM		---	Input common	
	4	IN	V1		CH3	Voltage signal input	
	5	IN	I1		CH3	Current signal input	
6	FG		For shield connection of analog signal cable				
7	OUT	V1	Analog output	CH1	Voltage signal output		
8	OUT	I1		CH1	Current signal output		
9	OUT	COM		---	Output common		

(Note 1): For inputting a current signal to the analog input part, connect the V terminal and I terminal externally.

(Note 2): All COM terminals are connected within the unit.

3.3.2 Wiring of Analog I/O Unit

■ Analog input

Voltage input	Current input
	
<p>Connect input instrument between IN/V and IN/COM terminal.</p>	<p>First, connect both IN/V terminal and IN/I terminal. And then connect input instrument between it and IN/COM terminal.</p>
Voltage output	Current output
	
<p>Connect output instrument between OUT/V and OUT/COM terminal.</p>	<p>Connect output instrument between OUT/I and OUT/COM terminal.</p>

(Note 1): In the above figure, the input (CH0/CH1) and output CH0 are described as representative examples.

The input (CH2/CH3) and output CH1 of A42 type also have the same terminal layouts.

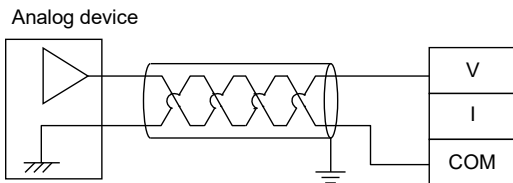
(Note 2): All COM terminals are connected within the unit.

3.4 Common Precautions

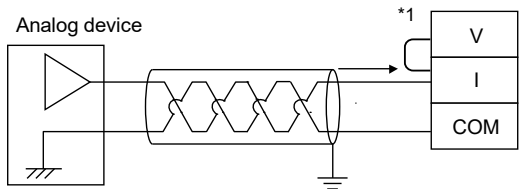
3.4.1 Wiring of Analog I/O Unit

■ **Wiring diagram**

Voltage input

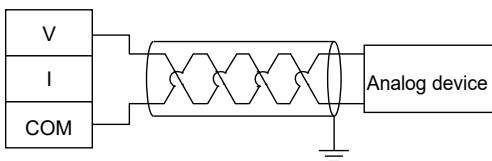


Current input

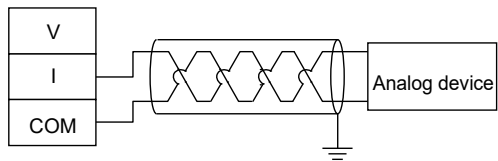


*1: For the current input, short-circuit the V and I terminals.

Voltage output



Current output



■ **Precautions on Wiring**

- Use double-core twisted-pair shielded wires. It is recommended to ground the shielding. However, depending on the conditions of the external noise, it may be better not to ground the shielding.
- Do not have the analog input wiring close to AC wires, power wires, or load wires.
- Do not have the analog output wiring close to AC wires, power wires, or load wires.

■ **Compatible cable (twisted wire)**

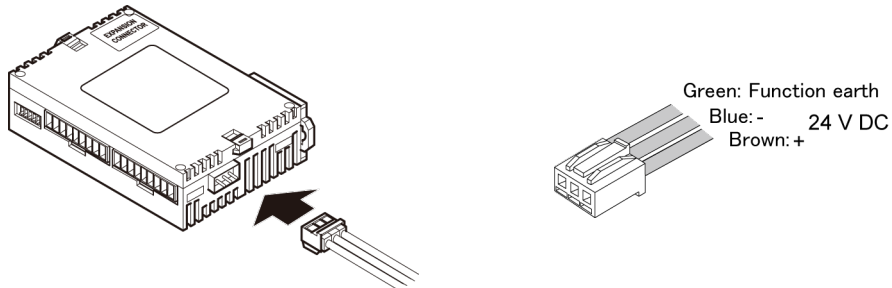
Size	Nominal cross section area
AWG#28-16	0.08 mm ² -1.25 mm ²

■ **Special tools**

Manufacturer	Serial number (model number)
Phoenix Contact Co.	SZS0.4×2.5(1205037)

3.4.2 Wiring of Power Cable (FP0R-DA4 / FP0R-A21 / FP0R-A42)

The power needs to be supplied to the analog output unit (FP0R-DA4) and analog I/O unit (FP0R-A21/FP0R-A42) for operation.



■ Precautions on Wiring

- It is connected using the cable (Part number:AFP0581) supplied with the unit.
- The input voltage range of the power supply for operating the unit is 20.4 to 28.8 VDC.
- Use the power supply of SELV (Safety Extra-Low Voltage) and LIM (Limited Energy Circuit).
- In order to avoid influence of noise, the function earth terminal must be grounded.

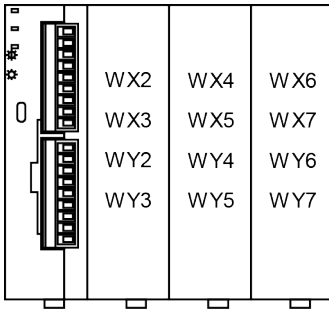
4

Creating Programs

4.1 I/O Allocation

4.1.1 I/O Allocation

- For analog input data and analog output data, input relays (WX) and output relays (WY) are read and written to the control unit.
- I/O numbers do not need to be set as I/O allocation is performed automatically.
- I/O numbers vary according to installation positions.
- The allocated contents vary according to the type of units and mode. For details, refer to the chapters 4.2 to 4.4.



Type of unit	Allocation content	I/O number		
		Expansion unit 1	Expansion unit 2	Expansion unit 3
FP0R Analog input unit AFP0RAD4 (Note 1) AFP0RAD8	Input CH0/CH2/CH4/CH6	WX2 (X20~X2F)	WX4 (X40~X4F)	WX6 (X60~X6F)
	Input CH1/CH3/CH5/CH7	WX3 (X30~X3F)	WX5 (X50~X5F)	WX7 (X70~X7F)
	Output 14-bit mode range setting	WY2 (Y20~Y2F)	WY4 (Y40~Y4F)	WY6 (Y60~Y6F)
	Output 14-bit mode range averaging setting	WY3 (Y30~Y3F)	WY5 (Y50~Y5F)	WY7 (Y70~Y7F)
FP0R Analog output unit AFP0RDA4	Input Status information (Power ON/OFF, Write state)	WX2 (X20~X2F)	WX4 (X40~X4F)	WX6 (X60~X6F)
		WX3 (X30~X3F)	WX5 (X50~X5F)	WX7 (X70~X7F)
	Output (Note 2) CH0/CH2	WY2 (Y20~Y2F)	WY4 (Y40~Y4F)	WY6 (Y60~Y6F)
	Output (Note 2) CH1/CH3	WY3 (Y30~Y3F)	WY5 (Y50~Y5F)	WY7 (Y70~Y7F)
FP0R Analog I/O unit AFP0RA21 (Note 3) AFP0RA42	Input CH0/CH2	WX2 (X20~X2F)	WX4 (X40~X4F)	WX6 (X60~X6F)
	Input CH1/CH3	WX3 (X30~X3F)	WX5 (X50~X5F)	WX7 (X70~X7F)
	Output (Note 4) CH0	WY2 (Y20~Y2F)	WY4 (Y40~Y4F)	WY6 (Y60~Y6F)
	Output (Note 4) CH1	WY3 (Y30~Y3F)	WY5 (Y50~Y5F)	WY7 (Y70~Y7F)

(Note 1):On AFP0RAD4, data of CH0 to CH3 is handled.

(Note 2):It can be also used for switching the output range in the 14-bit mode.

(Note 3):On AFP04A21, data of input CH0/CH1 and output CH0 is handled.

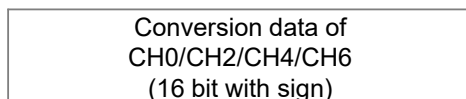
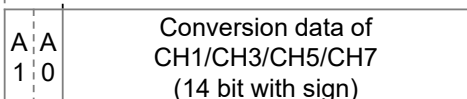
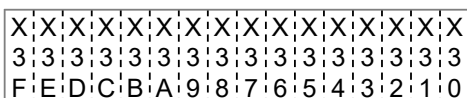
(Note 4):It can be also used for the input range, averaging setting for input and switching the output range in the 14-bit mode.

4.2 Analog input unit (FP0R-AD4/AD8)

4.2.1 Reading of Input Data (Common to 12-bit Mode and 14-bit Mode)

The analog input unit uses the most significant 2 bits as a flag for switching channels and reads conversion data sequentially.

■ I/O allocation (External input WX)



Conversion data switch flag

A1	A0	WX3	WX2
0	0	CH1 data	CH0 data
0	1	CH3 data	CH2 data
1	0	CH5 data	CH4 data
1	1	CH7 data	CH6 data

■ Role of conversion data switching flag

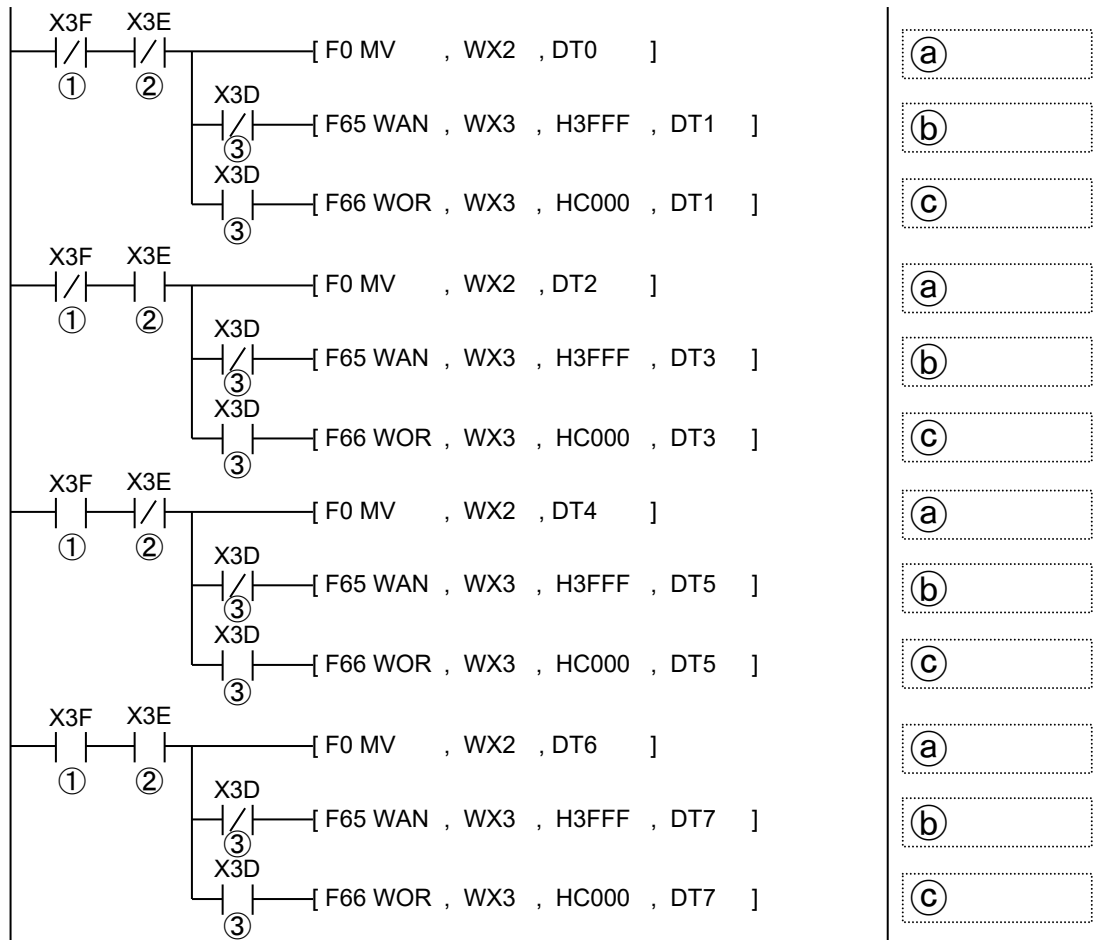
- The analog input unit reads the analog input data of a maximum of 8 channels using two memory areas (WX2 and WX3). The most significant two bits are allocated as a conversion data switching flag for distinguishing channels.
- Conversion data of even numbered channels can be read as 16-bit data as they are.
- As conversion data of odd numbered channels contain the conversion data switching flag of most significant two bits, mask processing needs to be applied to the data with a user program. Plus conversion data should be masked by "00", and minus conversion data should be masked by "11". Create a program in reference to the following programs.

(Example):For reading data of CH3

CH3 data	WX3	Data after masking	Description
1	0100 0000 0000 0001	0000 0000 0000 0001	Most significant two bits are masked by "00".
-1	0111 1111 1111 1111	1111 1111 1111 1111	Most significant two bits are masked by "11".

■ **Sample program (Analog input: For ranges of -10 V to +10 V and -5 V to +5 V)**

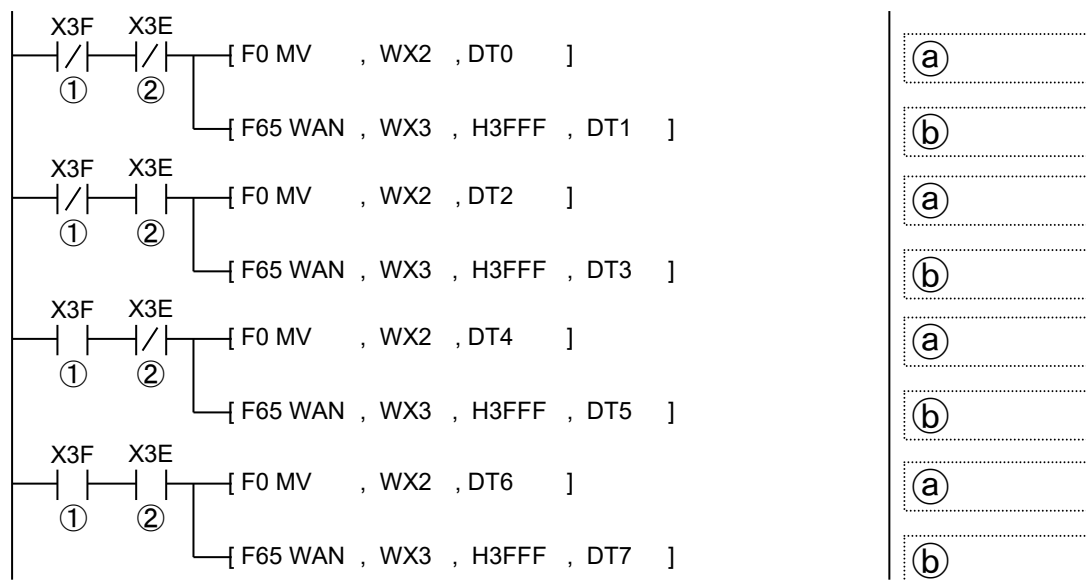
The following program shows the case that conversion data of the first expansion analog input unit (CH0 to CH7) is read and stored in DT0 to DT7.



①	X3F	The channels of conversion data read by turning on/off the conversion data switching flags X3F and X3E are distinguished.
②	X3E	
③	X3D	The signs of conversion data of read odd numbered channels are distinguished. When plus, OFF. When minus, ON.
Ⓐ	Conversion data of even numbered channels CH0/CH2/CH4/CH6 is transferred as is.	
Ⓑ	When the data of odd numbered channels CH1/CH3/CH5/CH7 is positive, the most significant two bits are masked by "00" with F65 WAN (AND) instruction, and the data is stored in DT1/DT3/DT5/DT7.	
Ⓒ	When the data of odd numbered channels CH1/CH3/CH5/CH7 is negative, the most significant two bits are masked by "11" with F66 WOR (OR) instruction, and the data is stored in DT1/DT3/DT5/DT7.	

■ **Sample program (For ranges of 0 to 10 V, 0 to 5 V and 0 to 20 mA)**

The following program shows the case that conversion data of the first expansion analog input unit (CH0 to CH7) is read and stored in DT0 to DT7.



①	X3F	The channels of conversion data read by turning on/off the conversion data switching flags X3F and X3E are distinguished.
②	X3E	
Ⓐ	Conversion data of even numbered channels CH0/CH2/CH4/CH6 is transferred as is.	
Ⓑ	When the data of odd numbered channels CH1/CH3/CH5/CH7 is positive, the most significant two bits are masked by "00" with F65 WAN (AND) instruction, and the data is stored in DT1/DT3/DT5/DT7.	

4.2.2 Setting of Input Range and Averaging Processing (14-bit Mode Only)

When selecting the 14-bit mode in the analog input unit (FP0R-AD4/AD8), the input range and averaging method can be switched by user programs. They both can be set for each channel.

■ **Default settings**

The default settings are as follows; Input range for all channels: -10 to +10 V, Averaging processing: Moving average processing 10 times (Max. and min. removal). The averaging processing is enabled when the mode switch No. 5 is ON.

■ I/O allocation (External output WY)

Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0		

CH7	CH6	CH5	CH4	CH3	CH2	CH1	CH0
D	D	D	D	D	D	D	D
1	0	1	0	1	0	1	0

D1	D0	Averaging (Common to each channel)
0	0	Moving average 10 times (Max. and min. removal)
0	1	No. of averaging times: 64
1	0	No. of averaging times: 128
1	1	No averaging

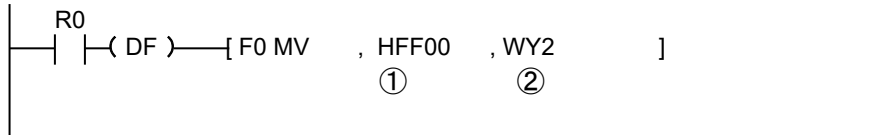
Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0		

CH7	CH6	CH5	CH4	CH3	CH2	CH1	CH0
D	D	D	D	D	D	D	D
1	0	1	0	1	0	1	0

D1	D0	Range (Common to each channel)
0	0	-10V to +10V
0	1	-5V to +5V
1	0	0 to 10V
1	1	0 to 5V / 0 to 20mA

■ Sample program (Switching input range)

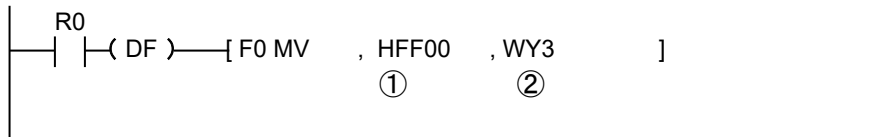
The following program shows the case that the input range of CH0 to CH7 of the first expansion analog input unit is set.



①		Input a constant for specifying an input range. Set it according to the I/O allocation on the previous page. In the above sample program, HFF00 is input for setting Y2F-Y28 to 1 and Y27-Y20 to 0. The range for CH4 to CH7 is 0 to 5 V/0 to 20 mA, and that for CH0 to CH3 is -10 V to +10 V.
②	WY2	Set it for switching the input range.

■ Sample program (Switching averaging processing method)

The following program shows the case that the averaging processing method of CH0 to CH7 of the first expansion analog input unit is set.



①		Input a constant for specifying an averaging method. Set it according to the I/O allocation on the previous page. In the above sample program, HFF00 is input for setting Y3F-Y38 to 1 and Y37-Y30 to 0. The method of CH4 to CH7 is no averaging processing, and that of CH0 to CH3 is moving average 10 times.
②	WY3	Set it for switching the averaging processing method.

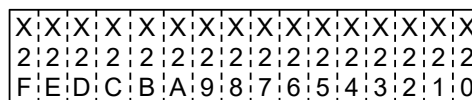
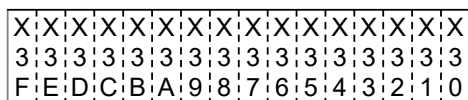
4.3 Analog Output Unit (FP0R-DA4)

4.3.1 Writing of Digital Data for Output (12-bit Mode)

With the analog output unit, the conversion output is performed by using two bits as the switching flags of output channels and writing data.

■ **I/O allocation (12-bit FP0-A04 Compatibility mode)**

Two bits, the bits C and D, are used as the switching flags.



A1	A0	WY3
0	0	D/A conversion: None
0	1	CH1 data
1	0	CH3 data
1	1	D/A conversion: None

A1	A0	WY2
0	0	D/A conversion: None
0	1	CH0 data
1	0	CH2 data
1	1	D/A conversion: None

■ **Writing conversion data**

- The analog output unit writes the analog output digital data of a maximum of 4 channels to two memory areas (WY2/WY3) by user programs. Output data switching flags for specifying channels are allocated to the two bits of the memory area (WY2/WY3).
- In user programs, channels are specified by setting/resetting the output channel switching flag right after setting a digital value in the memory area.
- As CH0 and CH2, and CH1 and CH3 use each common memory area, data cannot be written to the unit in the same scan. Write data separated into two scans using scan pulse relay R9012, etc. In the channels which are not allocated to the same memory area, data can be written in the same scan.

Example	Processing	Description
When CH0 and CH1 are used	Writing CH0 data in WY2 at the time of "n" scan Writing CH1 data in WY3 at the time of "n" scan	Data can be written in WY2 and WY3 at the time of "n" scan.
When CH0 and CH2 are used	Writing CH0 data in WY2 at the time of "n" scan Writing CH2 data in WY2 at the time of "n+1" scan	Data can be written in WY2 once in 2 scanning processes (at the time of "n" and "n+1" scan).

■ When data is regarded as an error

- Digital data from the control unit is written in the analog output unit. When more than the specified amount of data (-2000 to 2000 for voltage type Unit, 0 to 4000 for current type Unit) is written in the Unit, the Unit regards the data as an error and writes the error flag in WX2. As a result, the D/A conversion is not performed. (For analog output, the previous data remains unchanged. When the correct data is written, the error flag is cleared and D/A conversion is executed.)
- Output data and output switching flag are allocated to the same I/O number. Data error can be detected successfully with the flags when the digital input value is within the range of K4096 to K4095. Even when the digital input value is out of the range, however, data conversion may be mistakenly conducted as shown below. To prevent this problem, be sure to set up the program to check the upper and lower limits of the digital value.

(Example): When writing K4096 in WY2

K4096= 0001 0000 0000 0000

Analog Output Unit regards Y2D and Y2C as output switching flags:

Y2D, Y2C = 01 <- CH0

Data =0000 0000 0000 <- 0

Consequently, the analog value that is equivalent to the digital value "0" is output from CH0.

■ Negative data

- When the negative data (minus data) is written, set the output switching flag to two's complement data. When specifying the minus data in the decimal data, the data automatically becomes two's complement data. Then, set the output switching flag to two's complement data in the same way as the plus data.

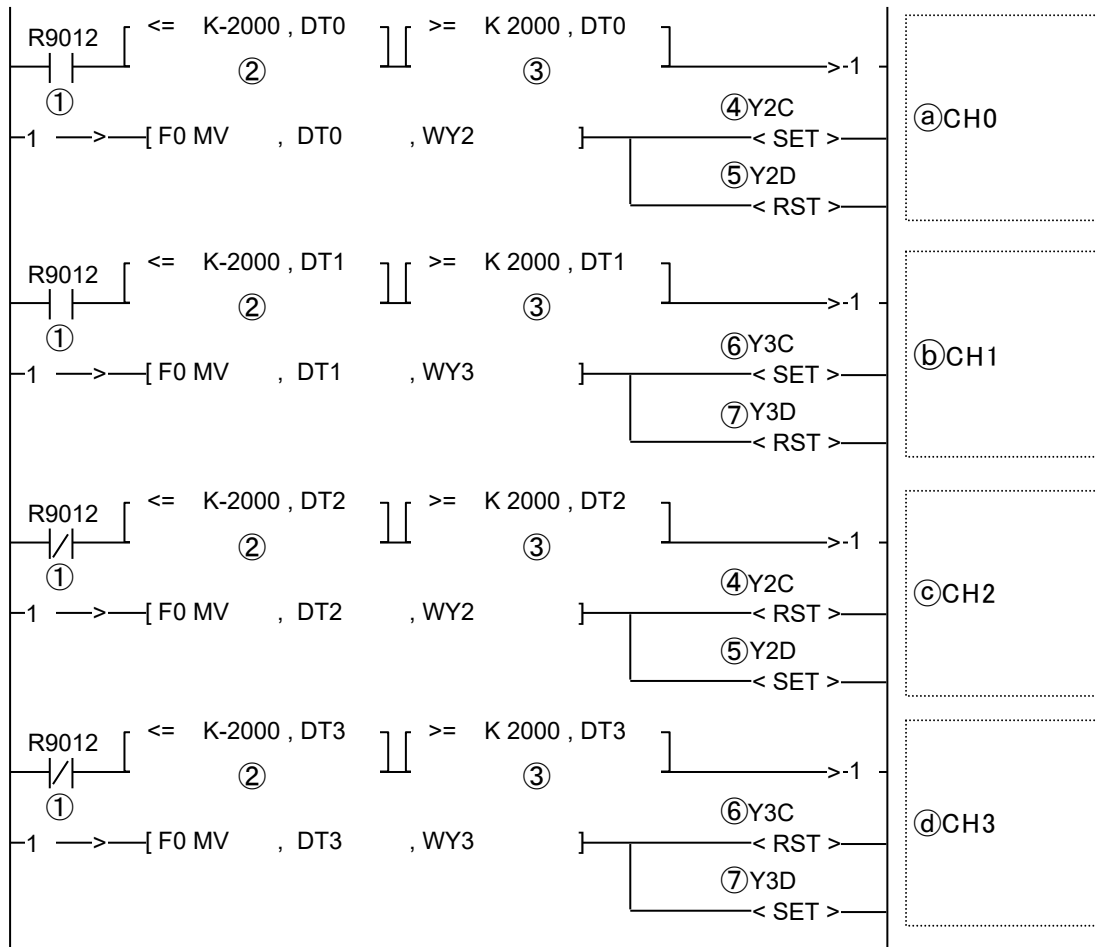
(Example): When writing -1 in CH0

-1=1111 1111 1111 1111 <- Two's complement

Setting the output switching flag: 1101 1111 1111 1111 (Bit C=1, Bit D=0 for CH0)

■ **Sample program (12-bit mode: For the range of -10 V to +10 V)**

The following program shows the case that the data of DT0 to DT3 is converted and output to the CH0 to CH3 of the first expansion analog output unit. The range for checking digital values written in the output area is changed.



①	R9012	Switches the timing of writing data by the scan pulse realy.
②		Checks whether the lower limit value is within the data range that the unit can convert correctly.
③		Checks whether the upper limit value is within the data range that the unit can convert correctly.
④	Y2C	Output data switching flags for even numbered channels. Channel numbers are specified by the two-bit switching flags right after setting conversion data by the transfer instruction F0 MV.
⑤	Y2D	
⑥	Y3C	Output data switching flags for odd numbered channels. Channel numbers are specified by the two-bit switching flags right after setting conversion data by the transfer instruction F0 MV.
⑦	Y3D	
Ⓐ		It is executed when the scan pulse relay is ON and written data is within the upper and lower limits. Data for CH0 is set in DT0, and CH0 is specified by the output data switching flag.
Ⓑ		It is executed when the scan pulse relay is ON and written data is within the upper and lower limits. Data for CH1 is set in DT1, and CH1 is specified by the output data switching flag.
Ⓒ		It is executed when the scan pulse relay is OFF and written data is within the upper and lower limits. Data for CH2 is set in DT2, and CH2 is specified by the output data switching flag.
Ⓓ		It is executed when the scan pulse relay is OFF and written data is within the upper and lower limits. Data for CH3 is set in DT3, and CH3 is specified by the output data switching flag.

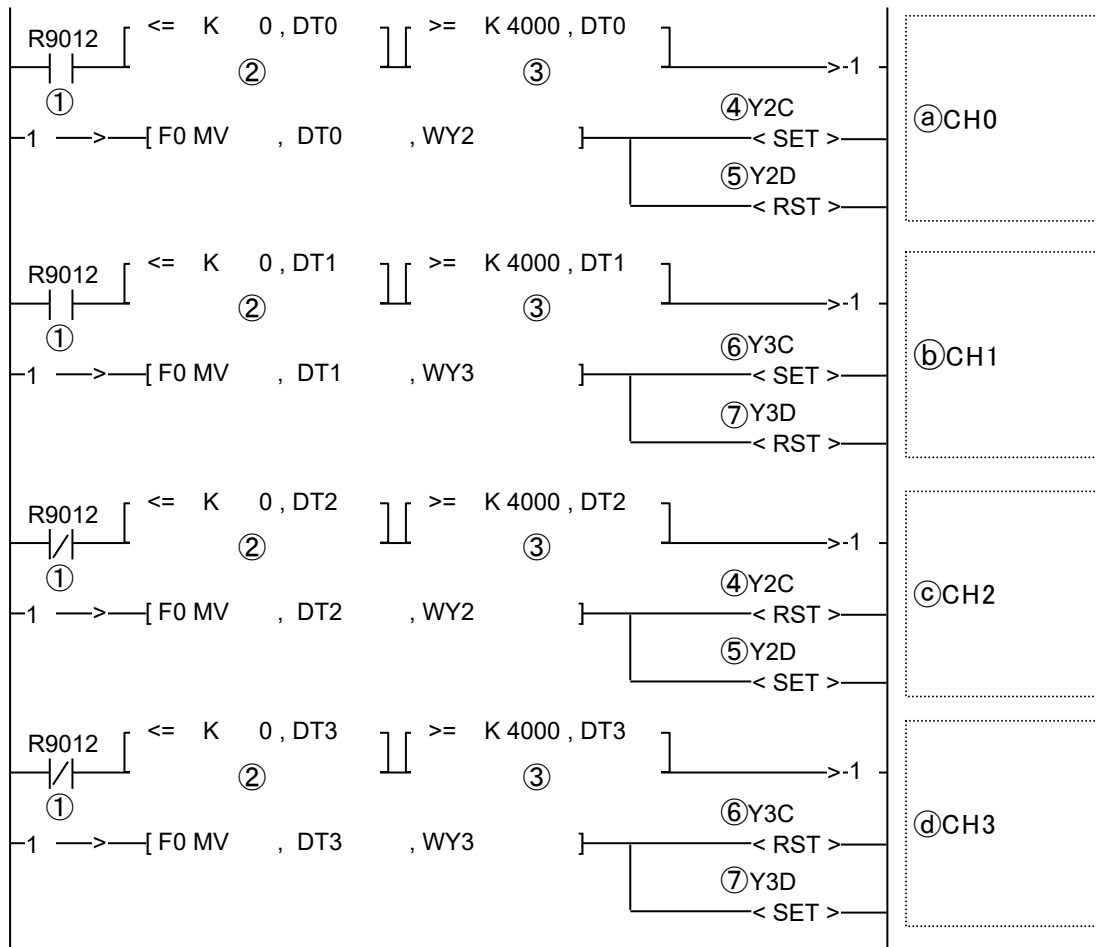


◆ KEY POINTS

- **In the FP0-A04-compatible 12-bit mode, Y2C, Y2D, Y3C and Y3D are used as the output data switching flags. Note that the allocation is different from that in the 14-bit mode.**

■ **Sample program (12-bit mode: For the range of 4 to 20 mA)**

The following program shows the case that the data of DT0 to DT3 is converted and output to the CH0 to CH3 of the first expansion analog output unit. The range for checking digital values written in the output area is changed.



①	R9012	Switches the timing of writing data by the scan pulse realy.
②		Checks whether the lower limit value is within the data range that the unit can convert correctly.
③		Checks whether the upper limit value is within the data range that the unit can convert correctly.
④	Y2C	Output data switching flags for even numbered channels. Channel numbers are specified by the two-bit switching flags right after setting conversion data by the transfer instruction F0 MV.
⑤	Y2D	
⑥	Y3C	Output data switching flags for odd numbered channels. Channel numbers are specified by the two-bit switching flags right after setting conversion data by the transfer instruction F0 MV.
⑦	Y3D	
Ⓐ		It is executed when the scan pulse relay is ON and written data is within the upper and lower limits. Data for CH0 is set in DT0, and CH0 is specified by the output data switching flag.
Ⓑ		It is executed when the scan pulse relay is ON and written data is within the upper and lower limits. Data for CH1 is set in DT1, and CH1 is specified by the output data switching flag.
Ⓒ		It is executed when the scan pulse relay is OFF and written data is within the upper and lower limits. Data for CH2 is set in DT2, and CH2 is specified by the output data switching flag.
Ⓓ		It is executed when the scan pulse relay is OFF and written data is within the upper and lower limits. Data for CH3 is set in DT3, and CH3 is specified by the output data switching flag.



◆ KEY POINTS

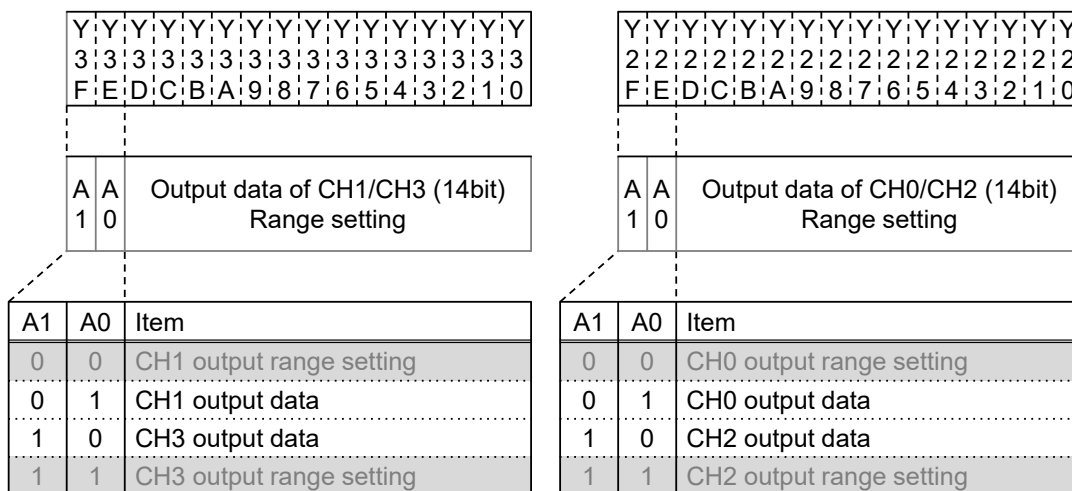
- **In the FP0-A04-compatible 12-bit mode, Y2C, Y2D, Y3C and Y3D are used as the output data switching flags. Note that the allocation is different from that in the 14-bit mode.**

4.3.2 Writing of Digital Data for Output (14-bit Mode)

With the analog output unit, the conversion output is performed by using two bits as the switching flags of output channels and writing data.

■ **I/O allocation (14-bit mode)**

In the 14-bit mode, the most significant two bits are used as the switching flags. They are common to the flags for setting ranges.



■ **Writing data for conversion**

- The analog output unit writes the analog output digital data of a maximum of 4 channels to two memory areas (WY2/WY3) by user programs. Output data switching flags for specifying channels are allocated to the two bits of the memory area (WY2/WY3).
- In user programs, channels are specified by setting/resetting the output channel switching flag right after setting a digital value in the memory area.
- As CH0 and CH2, and CH1 and CH3 use each common memory area, data cannot be written to the unit in the same scan. Write data separated into two scans using scan pulse relay R9012, etc. In the channels which are not allocated to the same memory area, data can be written in the same scan.

Example	Processing	Description
When CH0 and CH1 are used	Writing CH0 data in WY2 at the time of "n" scan Writing CH1 data in WY3 at the time of "n" scan	Data can be written in WY2 and WY3 at the time of "n" scan.
When CH0 and CH2 are used	Writing CH0 data in WY2 at the time of "n" scan Writing CH2 data in WY2 at the time of "n+1" scan	Data can be written in WY2 once in 2 scanning processes (at the time of "n" and "n+1" scan).

■ When data is regarded as an error

- Digital data from the control unit is written in the Analog Output Unit. When more than the specified amount of data (-8000 to 8000 for \pm range, 0 to 16000 for + range) is written in the Unit, the Unit regards the data as an error and writes the error flag in WX2. As a result, the D/A conversion is not performed. For analog output, the previous data remains unchanged. When the correct data is written, the error flag is cleared and D/A conversion is executed.
- Output data and output switching flag are allocated to the same I/O number. Data error can be detected successfully with the flags when the digital input value is within the range of -8192 to +8191 for \pm range, 0 to 16383 for + range. Even when the digital input value is out of the range, however, data conversion may be mistakenly conducted as shown below. To prevent this problem, be sure to set up the program to check the upper and lower limits of the digital value.

(Example): When writing K16384 in WY2

K16384= 0001 0000 0000 0000

Analog Output Unit regards Y2D and Y2C as output switching flags:

Y2F, Y2E = 01 <- CH0

Data =00 0000 0000 0000 <- 0

Consequently, the analog value that is equivalent to the digital value "0" is output from CH0.

■ Negative data

- When the negative data (minus data) is written, set the output switching flag to two's complement data. When specifying the minus data in the decimal data, the data automatically becomes two's complement data. Then, set the output switching flag to two's complement data in the same way as the plus data.

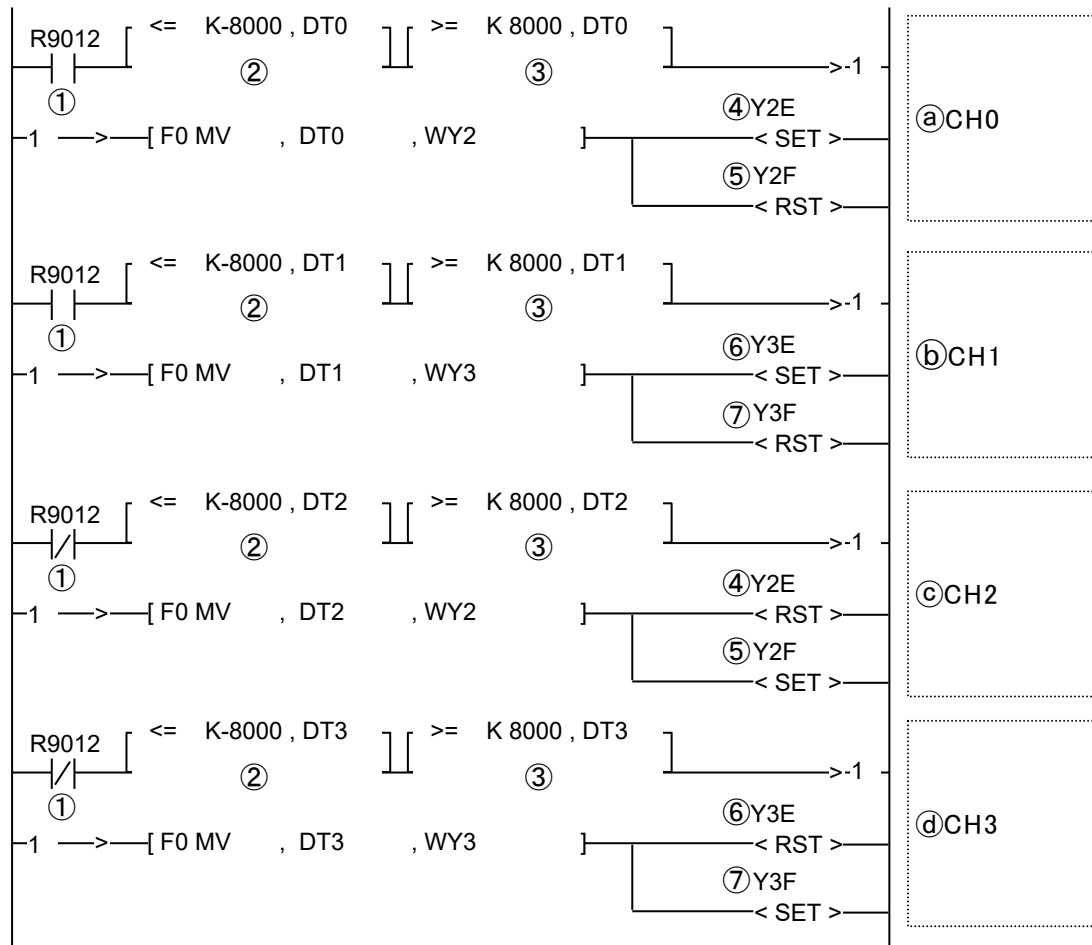
(Example): When writing -1 in CH0

-1=1111 1111 1111 1111 <- Two's complement

Setting the output switching flag: 0111 1111 1111 1111 (Bit F=1, Bit E=0 for CH0)

■ **Sample program (14-bit mode: For ranges of -10 V to +10 V and -5 V to +5 V)**

The following program shows the case that the data of DT0 to DT3 is converted and output to the CH0 to CH3 of the first expansion analog output unit. The range for checking digital values written in the output area is changed.



①	R9012	Switches the timing of writing data by the scan pulse realy.
②		Checks whether the lower limit value is within the data range that the unit can convert correctly.
③		Checks whether the upper limit value is within the data range that the unit can convert correctly.
④	Y2E	Output data switching flags for even numbered channels. Channel numbers are specified by the two-bit switching flags right after setting conversion data by the transfer instruction F0 MV.
⑤	Y2F	
⑥	Y3E	Output data switching flags for odd numbered channels. Channel numbers are specified by the two-bit switching flags right after setting conversion data by the transfer instruction F0 MV.
⑦	Y3F	
Ⓐ		It is executed when the scan pulse relay is ON and written data is within the upper and lower limits. Data for CH0 is set in DT0, and CH0 is specified by the output data switching flag.
Ⓑ		It is executed when the scan pulse relay is ON and written data is within the upper and lower limits. Data for CH1 is set in DT1, and CH1 is specified by the output data switching flag.
Ⓒ		It is executed when the scan pulse relay is OFF and written data is within the upper and lower limits. Data for CH2 is set in DT2, and CH2 is specified by the output data switching flag.
Ⓓ		It is executed when the scan pulse relay is OFF and written data is within the upper and lower limits. Data for CH3 is set in DT3, and CH3 is specified by the output data switching flag.

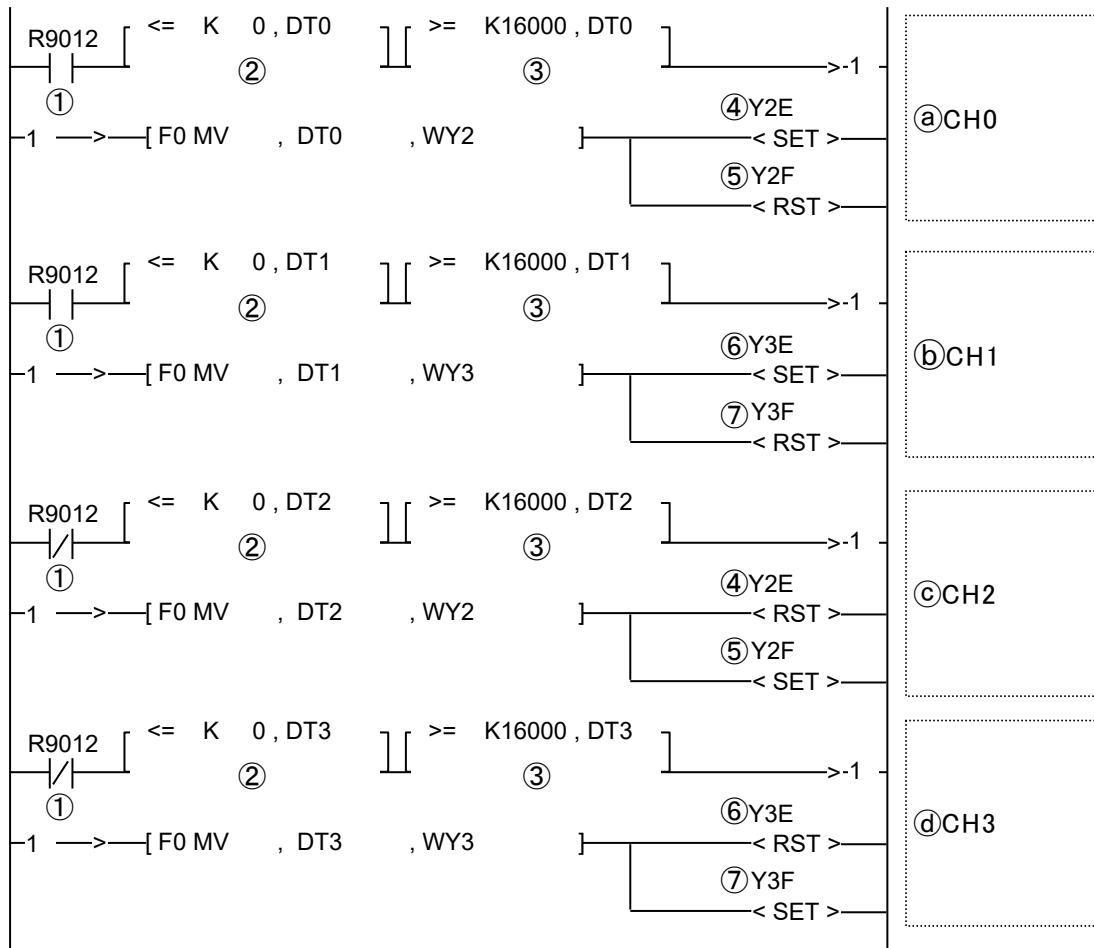


◆ KEY POINTS

- **In the 14-bit mode, Y2E, Y2F, Y3E, and Y3F are used as the output data switching flags. Note that the allocation is different from that in the FP0-A04-compatible 12-bit mode.**

■ **Sample program (14-bit mode: For ranges of 0 to 10 V, 0 to 5 V, 0 to 20 mA and 4 to 20 mA)**

The following program shows the case that the data of DT0 to DT3 is converted and output to the CH0 to CH3 of the first expansion analog output unit. The range for checking digital values written in the output area is changed.



①	R9012	Switches the timing of writing data by the scan pulse realy.
②		Checks whether the lower limit value is within the data range that the unit can convert correctly.
③		Checks whether the upper limit value is within the data range that the unit can convert correctly.
④	Y2E	Output data switching flags for even numbered channels. Channel numbers are specified by the two-bit switching flags right after setting conversion data by the transfer instruction F0 MV.
⑤	Y2F	
⑥	Y3E	Output data switching flags for odd numbered channels. Channel numbers are specified by the two-bit switching flags right after setting conversion data by the transfer instruction F0 MV.
⑦	Y3F	
Ⓐ		It is executed when the scan pulse relay is ON and written data is within the upper and lower limits. Data for CH0 is set in DT0, and CH0 is specified by the output data switching flag.
Ⓑ		It is executed when the scan pulse relay is ON and written data is within the upper and lower limits. Data for CH1 is set in DT1, and CH1 is specified by the output data switching flag.
Ⓒ		It is executed when the scan pulse relay is OFF and written data is within the upper and lower limits. Data for CH2 is set in DT2, and CH2 is specified by the output data switching flag.
Ⓓ		It is executed when the scan pulse relay is OFF and written data is within the upper and lower limits. Data for CH3 is set in DT3, and CH3 is specified by the output data switching flag.



◆ KEY POINTS

- **In the 14-bit mode, Y2E, Y2F, Y3E, and Y3F are used as the output data switching flags. Note that the allocation is different from that in the FP0-A04-compatible 12-bit mode.**

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