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Panasonic

PROGRAMMABLE CONTROLLER

FP2 New Analog Unit
Technical Manual

ARCT1F397E-6

2013.7 | panasonic.net/id/pidsx/global

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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Precautions Before You Start

Differences with the conventional unit A:Available

Input type	Type	Measurement range	Remarks (between channels)	FP2-AD8 AFP2400	FP2-AD8VI AFP2400L	FP2-AD8X AFP2401	FP2-RTD AFP2402
Voltage	±10 V	-10 to +10 V	Non-isolated	A	A	A	
			Isolated			A	
	1 to 5 V	1 to 5 V	Non-isolated	A	A	A	
			Isolated			A	
	±100 mV	-100 to +100 mA	Non-isolated	A		A	
			Isolated			A	
Current	±20 mA	-20 to +20 mA	Non-isolated	A	A		
	4 to 20 mA	4 to 20 mA	Non-isolated	A	A		
Thermo-couple	S	0 to +1500 °C	Non-isolated (FP2-AD8) Isolated (FP2-AD8X)	A		A	
	J	-200 to +750 °C		A		A	
	J	-100 to 400 °C				A	
	K	-200 to +1000 °C		A		A	
	K	-200 to 1200 °C				A	
	K	-100 to 600 °C				A	
	T	-200 to +350 °C		A		A	
	R	0 to +1500 °C		A		A	
	N	-200 to 1300 °C				A	
Resistance thermo-meter device	Pt100	-100 to +500 °C	Non-isolated	A			
	Pt100	-200 to +650 °C				A	A
	Pt100	-100 to 200 °C				A	A
	JPt100	-200 to +650 °C				A	A
	JPt100	-100 to 200 °C				A	A
	Pt1000	-100 to +100 °C		A		A	A

About a similar manual

For FP2 Analog Input Unit, there are two manuals, which is for FP2-AD8 (traditional type), and for FP2-AD8VI, AD8X and RTD (new type).
The appropriate manual must be referred to use each product.
(Two manuals for FP2 Analog Output Unit FP2-DA4 include the same contents.)

	Manual Name	Manual No.	Relevant models
This manual	FP2 New Analog Unit	ARCT1F397	FP2-AD8VI,FP2-AD8X,FP2-RTD
Traditional manual	FP2 Analog Unit	ARCT1F283	FP2-AD8

Current input with FP2-AD8X

If inputting current with FP2-AD8X, install the provided resistor between the “B/-“ terminal and the “V/b” terminal, and input after converting it to voltage.



Reference: <3.2.2 Analog Input Unit (FP2-AD8X)>

For further details, refer to the specifications in the following manuals before you use.

- FP/FP2SH Hardware Manual ARCT1F320
- FP series Programming Manual ARCT1F353

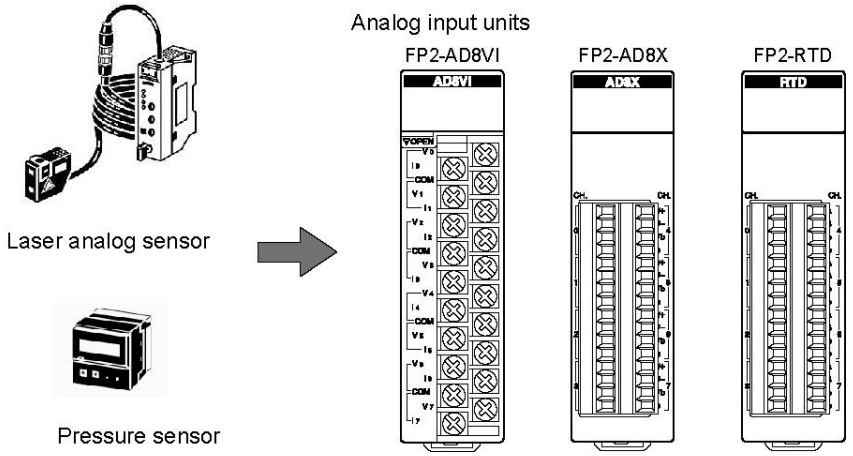
Chapter 1

Functions and Restrictions of the Unit

1.1 Features and Functions of the Unit

Features of analog input unit

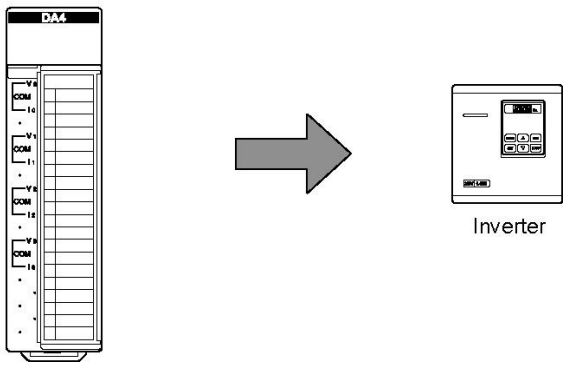
- This is a unit to import various analog values (such as voltage, current or temperature) of displacement sensors or pressure sensors, and to convert them to digital values in the unit.
- Input with multiple channels is available.
  Analog input unit: 8 channels
  Twenty types of input range such as voltage and temperature sensor are selectable and available for various connection devices.(FP2-AD8X)
- Resistance thermometer device and thermocouple can be directly connected. (FP2-AD8X, FP2-RTD)
- High-speed conversion of 500 µs/channel for voltage/current range, etc.
- The resolution is 1/13107 to 1/65536 (temperature sensor is 0.1 °C. The input analog values are converted to a maximum of 16-bit digital data.



Features of analog output unit

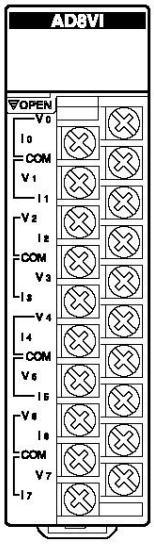
- This is a unit to convert the data within the unit to analog values, and to output them to analog drive devices such as inverter.
- Two types of output range are available (voltage: -10 V to +10 V and current: 0 to 20 mA).
  Analog output unit: 4 channels
  High-speed D/A conversion of 500 µs/channel.
- The resolution is 1/4096 and the data to output is treated as 12-bit digital data.

Analog output unit

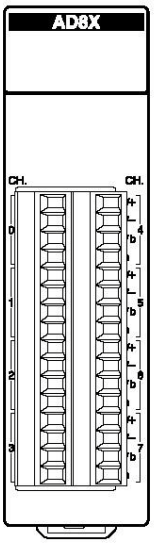


1.2 Type of Unit

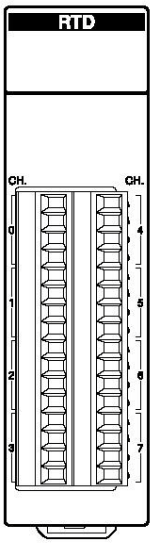
■Analog input units



FP2-AD8VI
AFP2400L

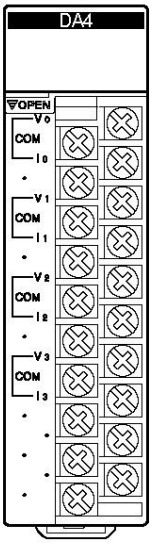


FP2-AD8X
AFP2401



FP2-RTD
AFP2402

■Analog output unit



FP2-DA
AFP2410

Name	No. of channels	Part No.	Product No.
FP2 analog input unit (Voltage/current type)	Input 8 chs	FP2-AD8VI	AFP2400L
FP2 analog input unit (Channel isolation type)	Input 8 chs	FP2-AD8X	AFP2401
FP2 RTD input unit	Input 8 chs	FP2-RTD	AFP2402
FP2 Analog output unit	Output 4 chs	FP2-DA4	AFP2410

1.3 Analog I/O Data Processing Functions

1.3.1 Analog Input

The following process is performed.

1. Loading of analog input

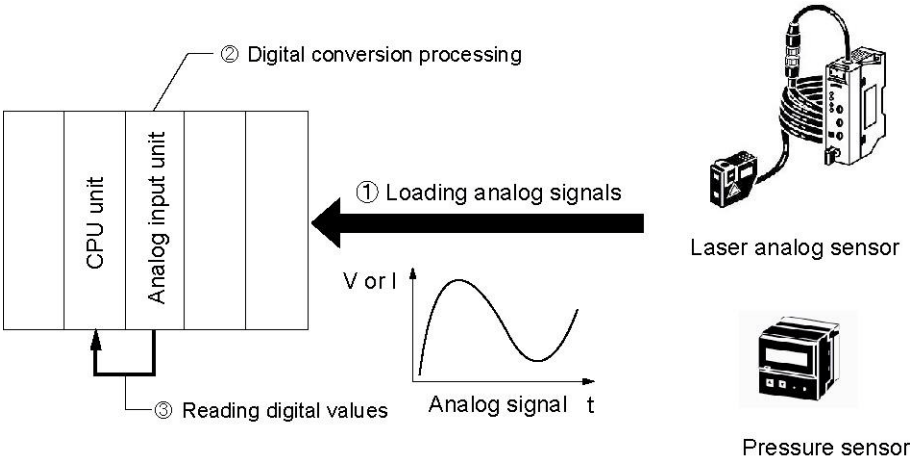
The analog input data of the displacement sensor or pressure sensor are taken in the input part of the analog unit.

2. Digital conversion

The analog input values are automatically converted to digital values successively in the unit.

3. Storage of digital values

The converted digital values are read by the user program as the data of the input relay area (WX).



For the analog input, the following optional settings are available.
The optional settings can be specified by writing into the shared memory using the programs for each channel if necessary.

Setting for No. of times of averaging

Sets the number of times to average the converted data.

Setting for temperature sensor broken wire detection

Sets to detect the disconnection of the input wiring for the input channels which has been set to the temperature sensor range (thermocouple input range and resistance thermometer device).

1.3.2 Analog Output Processing

The following process is performed.

1. Writing of digital data

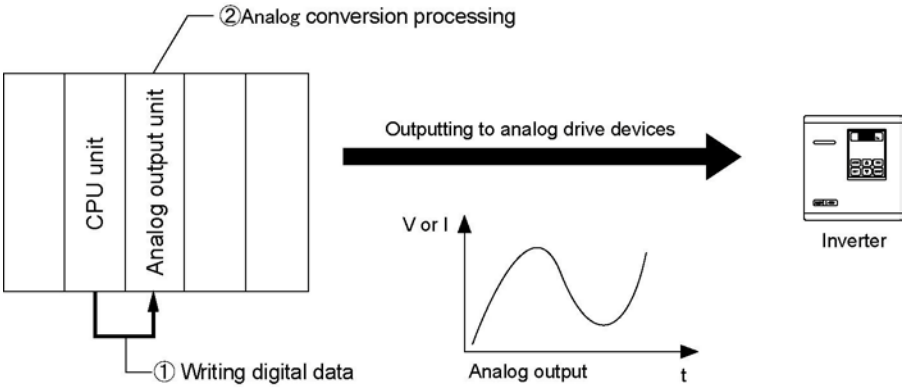
The digital data for the analog output are written in the output relay area (WY) corresponding to each channel by the user program.

2. Analog conversion

The written data are automatically converted to analog values successively in the unit.

3. Output to analog drive devices

The converted analog values are output to analog drive devices such as inverter.



For the analog output, the following optional settings are available.
The optional settings can be specified by writing into the shared memory using the programs for each channel if necessary.

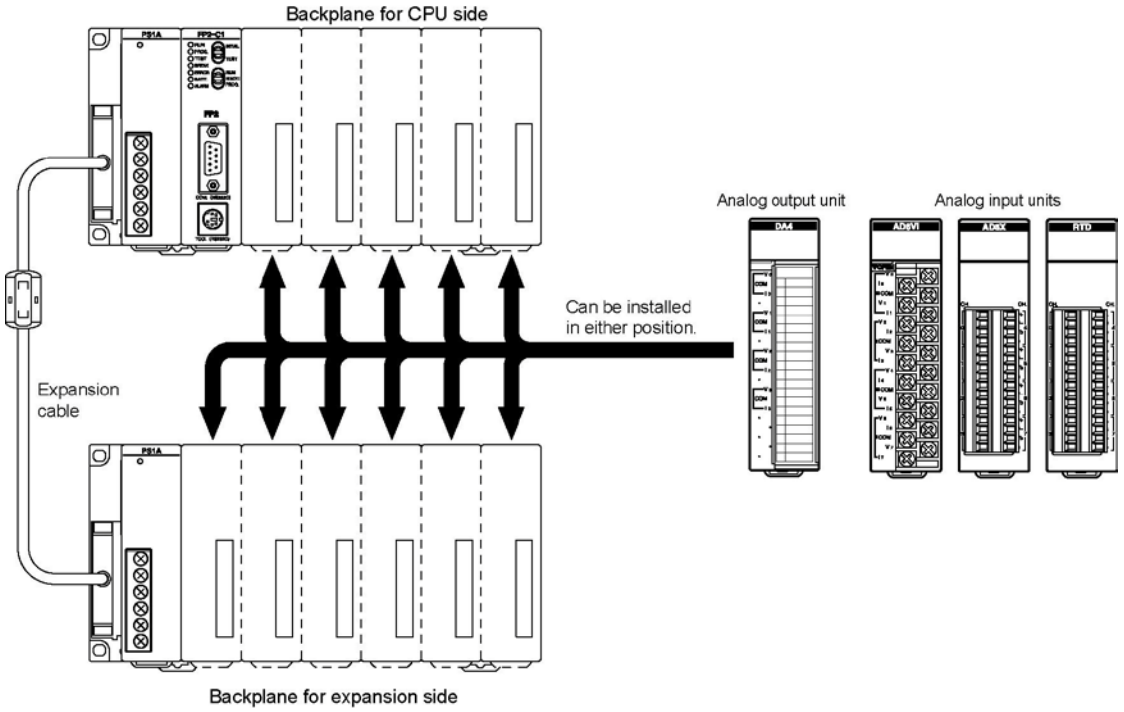
Analog output hold setting

Sets to either “not hold”, “hold” or “hold (any value)” when changing to the FP2 CPU unit PROG. mode.

1.4 Installation Restrictions

1.4.1 Installation Position of Analog Input Unit and Output Unit

Can be installed in any slots on the CPU backplane and the expansion backplane except the slots for the power supply unit and the CPU unit.



1.5 Current Consumption

The internal current consumption values for the FP2 analog units noted below.
When the system is configured, the other units being used should be taken into consideration, and a power supply unit with a sufficient capacity should be used.

Name	Part No.	Product No.	Current consumption (at 5 V DC)
FP2 analog input unit (Voltage/current type)	FP2-AD8VI	AFP2400L	400 mA or less
FP2 analog input unit (Channel isolation type)	FP2-AD8X	AFP2401	300 mA or less
FP2 RTD input unit	FP2-RTD	AFP2402	300 mA or less
FP2 Analog output unit	FP2-DA4	AFP2410	600 mA or less

 **Reference:** For information on the internal current consumption of other units, see <FP2/FP2SH User's Manual ARCT1F320>.

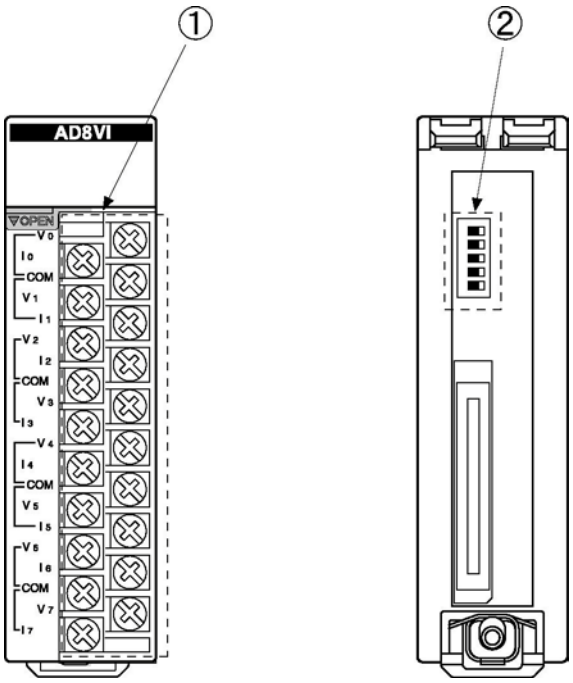
Chapter 2

Parts and Functions

2.1 Analog Input Unit

2.1.1 Analog Input Unit (FP2-AD8VI)

AFP2400L

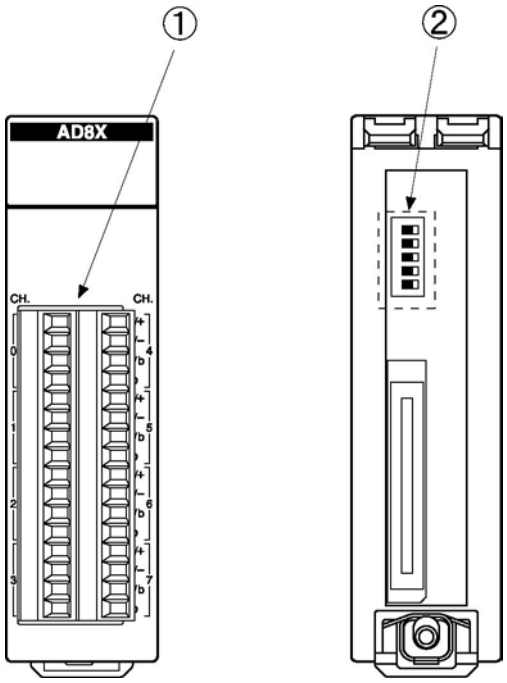


1. Analog input terminals
There are analog input terminals for channels 0 to 7.
The terminal block can be removed to facilitate wiring.
M3 solderless terminals can be used.

2. Range setting switch
Used to set the analog input range.

2.1.2 Analog Input Unit (Channel isolation type) (FP2-AD8X)

AFP2401



1. Analog input terminals

There are analog input terminals for channels 0 to 7.
The terminal block can be removed.
The wiring connections should be carried out with the terminal block removed.
If it is hard to remove the terminal block, insert a driver for the terminal block into a gap between the terminal block and the case to remove the block.

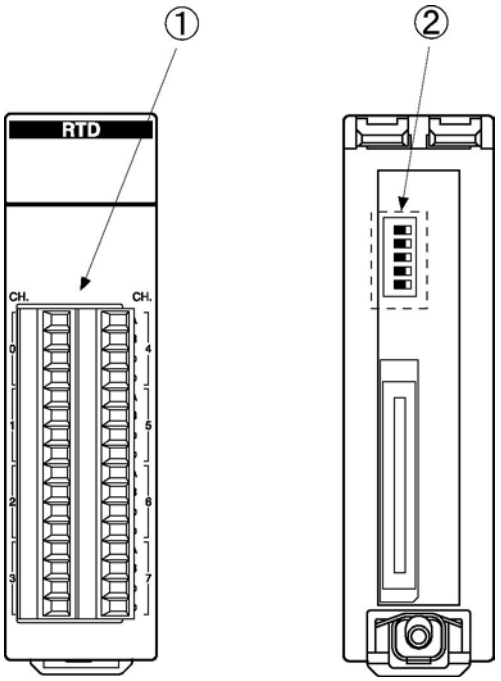
Reference: <3.1 Wiring of Terminal Block>

2. Range setting switch

Used to set the analog input range.

2.1.3 RTD Input Unit (FP2-RTD)

AFP2402



1. Analog input terminals

There are analog input terminals for channels 0 to 7.
The terminal block can be removed.
The wiring connections should be carried out with the terminal block removed.
If it is hard to remove the terminal block, insert a driver for the terminal block into a gap between the terminal block and the case to remove the block.

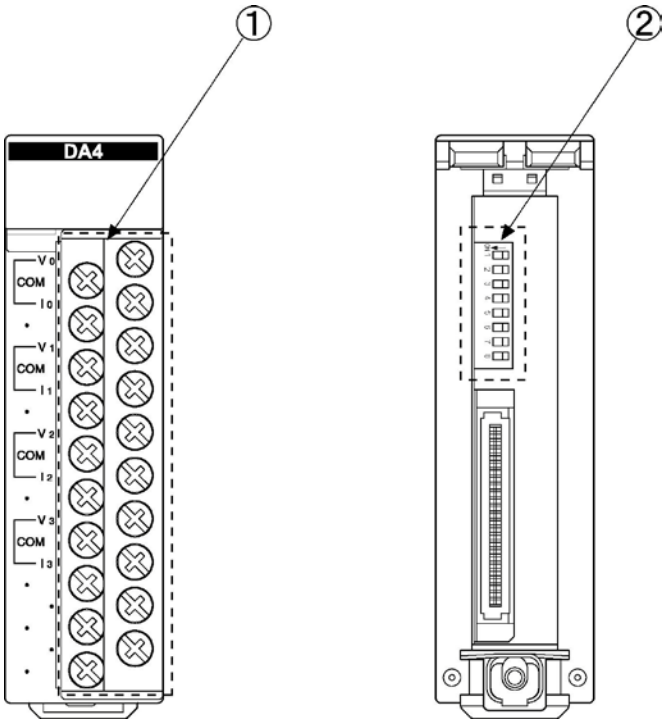
Reference: <3.1 Wiring of Terminal Block>

2. Range setting switch

Used to set the analog input range.

2.2 Analog Output Unit (FP2-DA4)

AFP2410



1. Analog output terminals

There are analog output terminal for 4 channels.
Terminals with a dot mark are not used; however, they are connected to the analog input circuit internally so do not connect anything to them.
The terminal block can be removed to facilitate wiring.
M3 solderless terminals can be used.

2. Range setting switch

Used to set the analog output range.

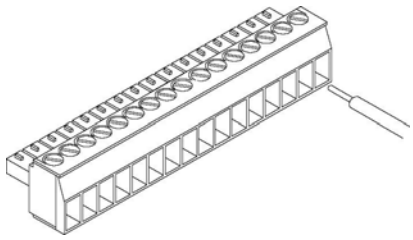
Chapter 3

Wiring

3.1 Wiring of Terminal Block

3.1.1 Input Unit (FP2-AD8X) (FP2-RTD)

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



Terminal block socket

Item	Description
Number of pin	16 pins
Manufacturer	Phoenix Contact Co.
Model No.	MC1,5/16-ST-3,5
Product No.	1840502

Suitable wires

No. of wires	Size	Nominal cross-sectional area
1 wire	AWG #28 to 16	0.08 to 1.25mm^2
2 wires	AWG #28 to 20	0.08 to 1.5mm^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.	
			With insulating sleeve	Without insulating sleeve
Phoenix Contact Co.	0.25	AWG #24	AI 0,25-6 BU	A 0,25-7
	0.34	AWG #22	AI 0,34-6 TQ	A 0,34-7
	0.50	AWG #20	AI 0,5-6 WH	A 0,5-6
	0.75	AWG #18	AI 0,75–6 GY	A 0,75-6
	1.00	AWG #18	-	A 1-6
	0.5×2	AWG #20 (for 2 pcs)	AI-TWIN 2X 0,5-8 WH	-

Pressure welding tool for pole terminals

Manufacturer	Part No.	Product No.
Phoenix Contact Co.	CRIMPFOX 6	1212034

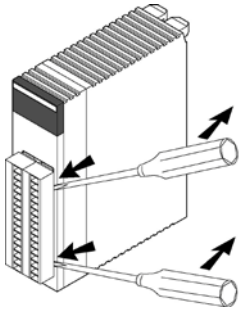
For tightening the terminal block

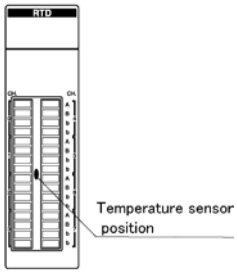
When tightening the terminals of the terminal block, use a screwdriver (Phoenix contact Co., Product No. 1205037) with a blade size of 0.4 × 2.5 (Part No. SZS 0,4×2,5).
The tightening torque should be 0.22 to 0.25 N·m (2.3 to 2.5 kgf·cm) or less.

Wiring method

(1) Remove the terminal block.

If it is hard to remove, insert a driver for the terminal block into a gap between the terminal block and the case, and remove the terminal block





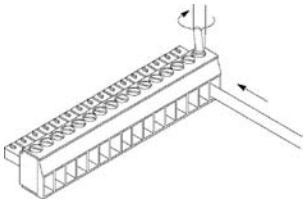
1. Firstly, remove the terminal block at the side of ch4 to ch7. Insert the driver into the ch4 side and ch7 alternately.

2. Remove the terminal block at the side of ch0 to ch3. At this time, take care not to damage a temperature sensor located in the center of the terminal block.

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



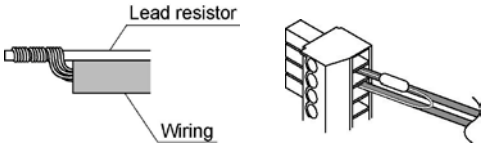
(3) Insert the wire into the terminal block until it contacts the back of the block socket, and then tighten the screw clockwise to fix the wire in place. (Tightening torque: 0.22 N·m to 0.25 N·m (2.3 kgf·cm to 2.5 kgf·cm))



When using FP2-AD8X as current input

If 250Ω resistor is connected, 4 to 20 mA is converted to 1 to 5V, and –20 to +20 mA is converted to –5V to +5V.

- Crimp the provided resistor and the wiring using a pole terminal manufactured by Phoenix Contact Co. (AI-TWIN2X0.5-8WH), and then connect to the terminal block. Use the wiring of which size is AWG22 (cross-sectional area: 0.33 mm^2) or AWG20 (cross-sectional area: 0.5 mm^2).
- When the pole terminal is not used, the tensile strength can be increased by winding the lead of the resistor round the wiring.



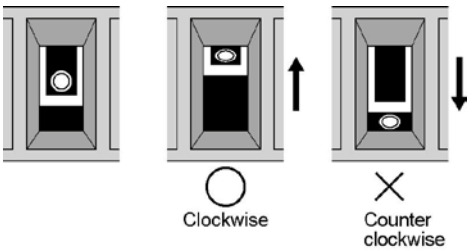
Specifications of resistor for current input

- Resistance value 250Ω
- Rated power 0.25 W
- TCR ±25 ppm/°C
- Resistance value tolerance ±0.1%

(4) Insert the terminal block into the unit firmly.

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.

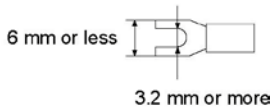


3.1.2 Input Unit (FP2-AD8VI)/Output Unit (FP2-DA4)

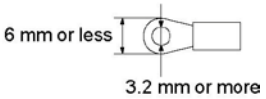
Suitable terminals and wires

M3 terminal screws are used for the terminals of analog input and output units. The following suitable solderless terminals are recommended for the wiring to the terminals

●Fork type terminal



●Round type terminal



Suitable solderless terminals

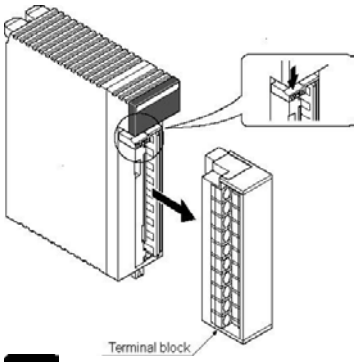
Manufacturer	Shape	Part No.	Suitable wires (mm^2)
JST Mfg. Co., Ltd.	Round type	1.25-MS3	0.25 to 1.65
	Fork type	1.25-B3A	
	Round type	2-MS3	1.04 to 2.63
	Fork type	2-N3A	

Suitable wires

Suitable wires	Tightening torque
AWG22 to 14 (0.3 to 2.0mm^2)	0.5 to 0.6 N·m

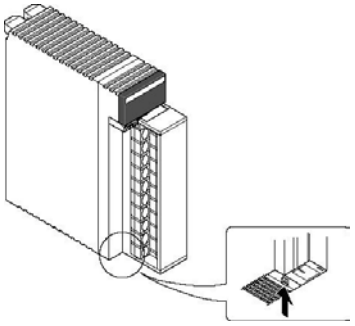
Wiring to terminal block

Remove the terminal block before beginning the wiring operations. To remove the terminal block, push downward on the release lever located at the top of the terminal block.



Note:

Install the terminal block by inserting it all the way to its original position and pressing the lock button on the bottom of the unit. Then confirm that the terminal block is securely attached and cannot be removed.



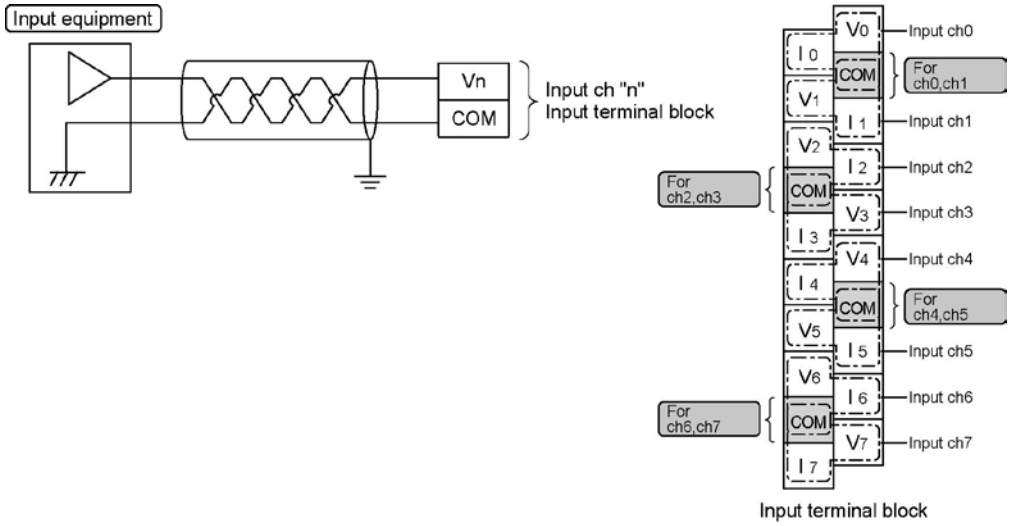
Accessory terminal blocks can be purchased separately.

Accessory terminal block for FP2 I/O unit	AFP2800 (5-pack)

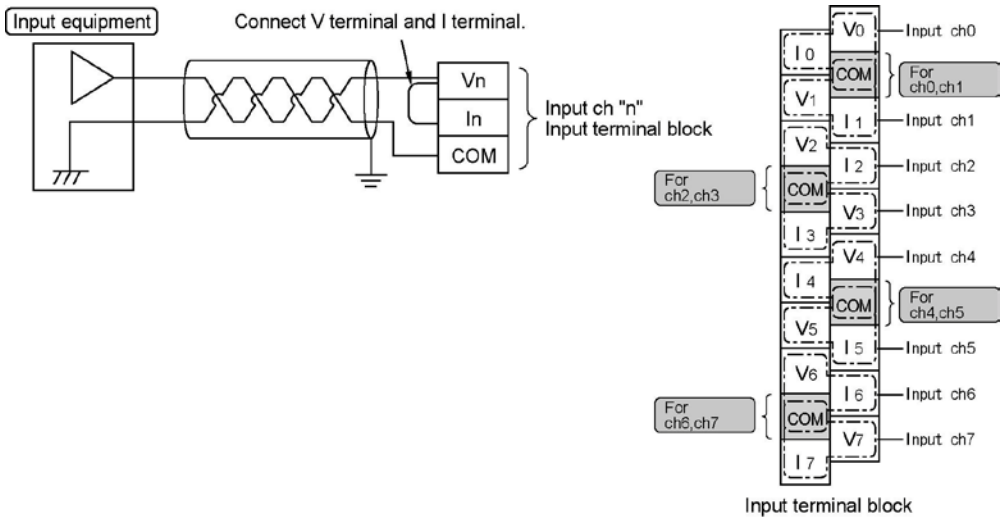
3.2 Wiring for Analog Input

3.2.1 Analog Input Unit (FP2-AD8VI)

Voltage input (1 to 5 V, -10 to +10 V)



Current input (4 to 20 mA, -20 to +20 mA)



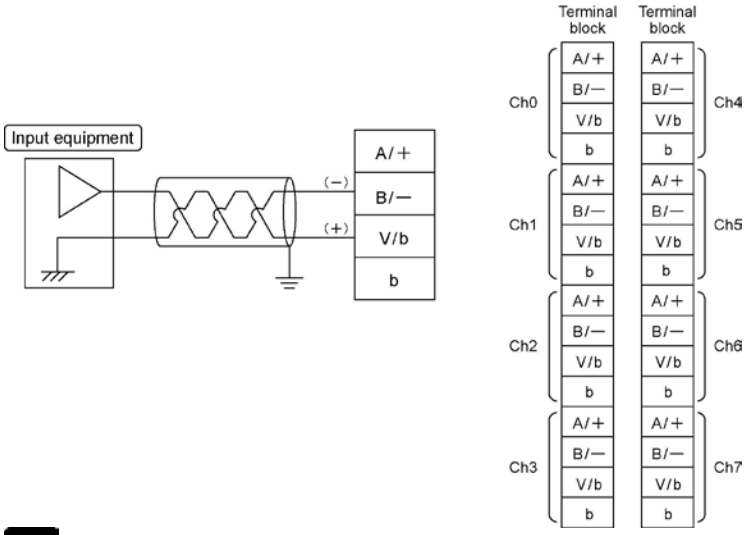
The voltage (approx. –10V) may be output momentarily (for approx. 200 ms) from the output terminal of the analog output unit when the power supply of FP2/FP2SH turns on/off.
If it becomes a problem on the system, take appropriate measures, such as delaying the timing of the power activation of connected external devices from the power activation of the PLC.

Note:

- Use double-core twisted-pair shielded wires. It is recommended to ground them. 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 from sources other than the PLC.

3.2.2 Analog Input Unit (FP2-AD8X)

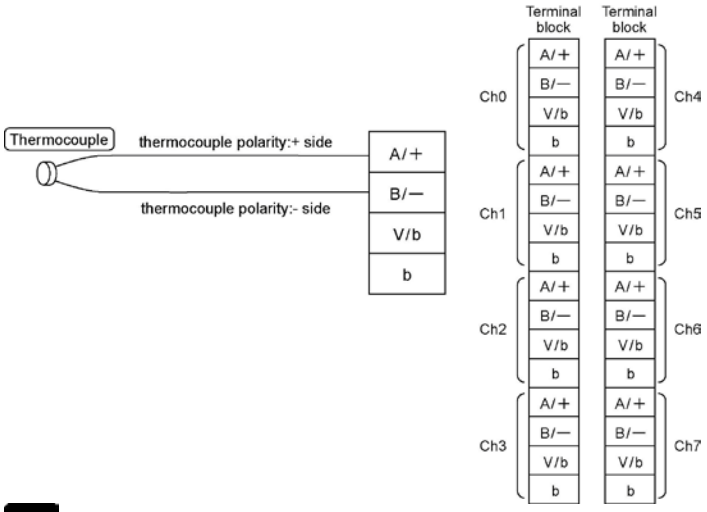
Voltage input (1 to 5 V, -10 to +10 V, -100 to +100 mV)



Note:

- 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 from sources other than the PLC.

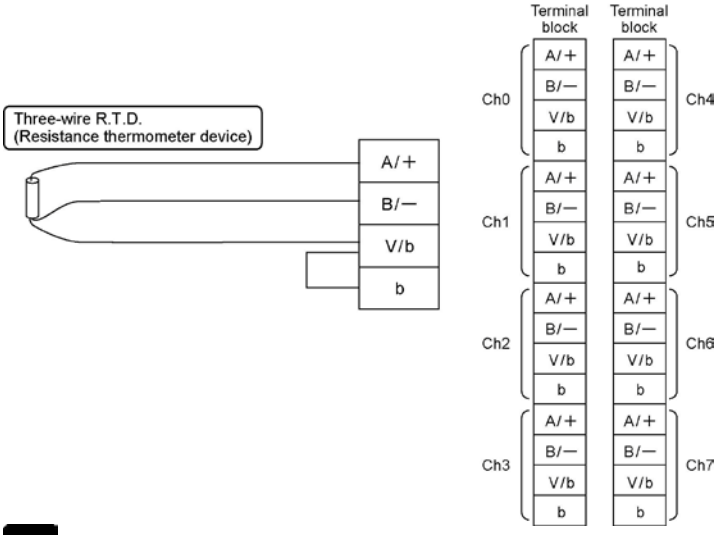
Thermocouple (J, K, R, S, T, N)



Note:

- Perform the wiring correctly according to the polarity of the thermocouple. Also, to lengthen the signal wire of the thermocouple, use the compensating wire of the thermocouple. (It is recommended to use shielded wires and to ground the shielding.)
- Do not have the analog input wiring close to AC wires, power wires, or load wires from sources other than the PLC.

R.T.D. (Resistance thermometer device) (Pt100, JPt100, Pt1000)

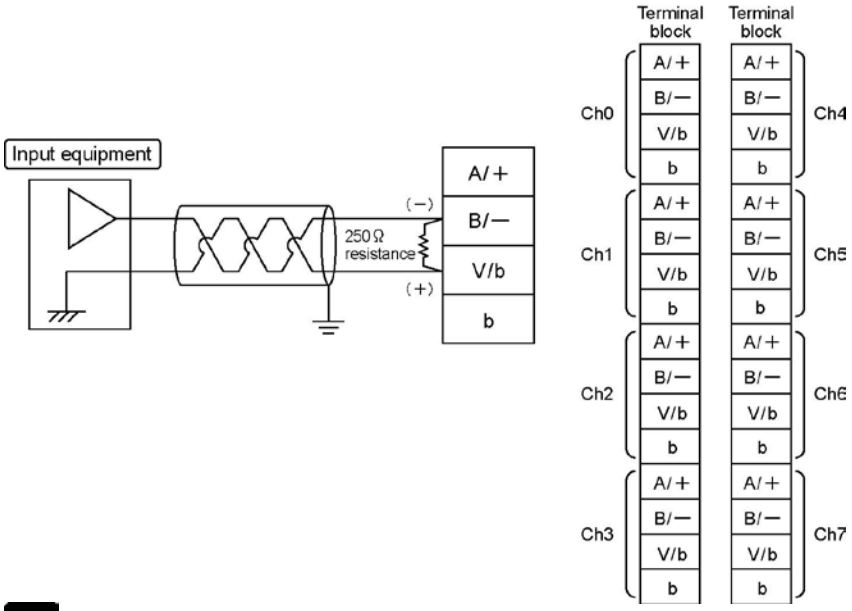


Note:

- For copper wiring used in wiring the R.T.D. (resistance thermometer device), use insulated and thick wiring not to allow a large build-up in electrical resistance. (It is recommended to use shielded wires and to ground the shielding.)
- Do not have the analog input wiring close to AC wires, power wires, or load wires from sources other than the PLC.

Current input (4 to 20 mA, -20 to +20 mA)

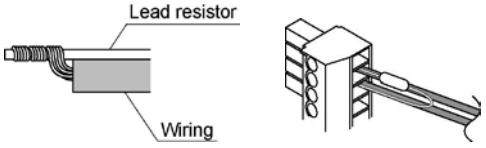
When using FP2-AD8X as current input, connect the provided 250 Ω resistor, and then input after converting it to voltage.



Note: When using FP2-AD8X as current input

If 250Ω resistor is connected, 4 to 20 mA is converted to 1 to 5V, and –20 to +20 mA is converted to –5V to +5V.

- Crimp the provided resistor and the wiring using a pole terminal manufactured by Phoenix Contact Co. (AI-TWIN2X0.5-8WH), and then connect to the terminal block. Use the wiring of which size is AWG22 (cross-sectional area: 0.33 mm^2) or AWG20 (cross-sectional area: 0.5 mm^2).
- When the pole terminal is not used, the tensile strength can be increased by winding the lead of the resistor round the wiring.

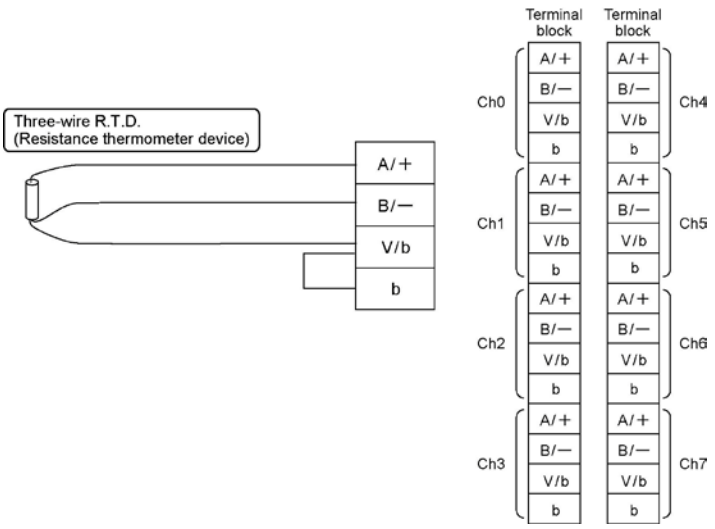


Specifications of resistor for current input

- Resistance value 250Ω
- Rated power 0.25 W
- TCR ±25 ppm/°C
- Resistance value tolerance ±0.1%

3.2.3 RTD Input Unit (FP2-RTD)

R.T.D. (Resistance thermometer device) input (Pt100, JPt100, Pt1000)



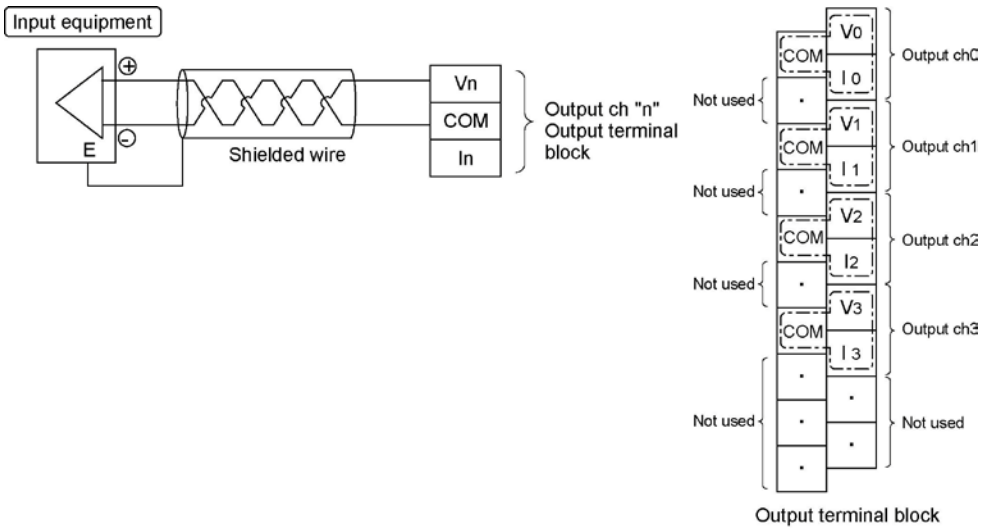
Note:

- For copper wiring used in wiring the R.T.D. (resistance thermometer device), use insulated and thick wiring not to allow a large build-up in electrical resistance. (It is recommended to use shielded wires and to ground the shielding.)
- Do not have the analog input wiring close to AC wires, power wires, or load wires from sources other than the PLC.

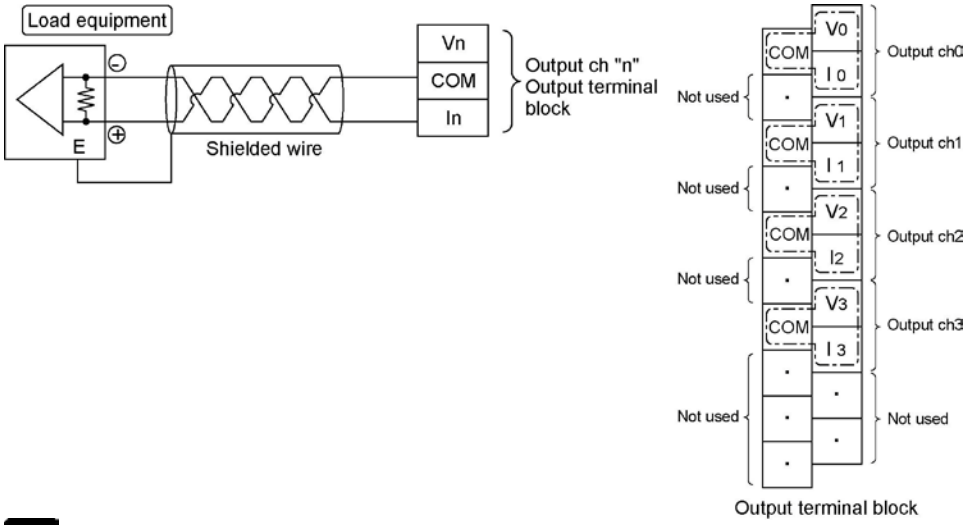
3.3 Wiring for Analog Output

3.3.1 Analog Output Unit (FP2-DA4)

Voltage output (-10 to +10 V)



Current output (0 to 20 mA)



Note:

- For the analog output wiring, always use double-core twisted-pair shielded wires.
- Ground the shielding of the shielded wires at the side of the load devices. However, depending on the conditions of the external noise, it may be necessary to ground externally, or better not to ground the shielding.
- Do not have the analog input wiring close to AC wires, power wires, or load wires from sources other than the PLC.
- The terminals marked with a dot on the input and output terminal blocks are not to be used. However, they may be connected to circuits internally, so be sure not to connect any wiring to them.

Chapter 4

Setting I/O Range and I/O Allocation

4.1 I/O Allocation

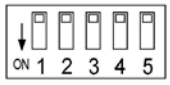
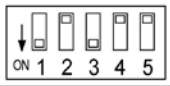
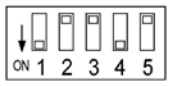
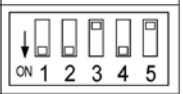
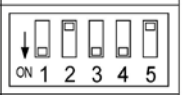
4.1.1 Setting the Analog Input Range

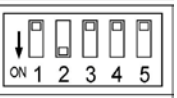
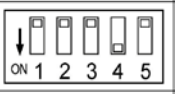
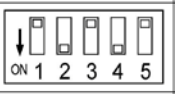
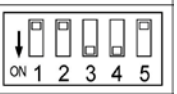
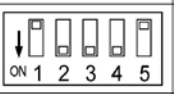
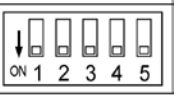
How to set the input range

Set the range setting switch on backside of the unit as described in the table below. The range for all the channels will be set at once.

If you use different input ranges together, then set the range setting switch to “Enable setting by software” and set the ranges by the shared memory.

Setting of range setting switch

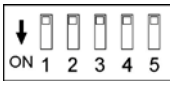
Input range			Setting
FP2-AD8VI	FP2-AD8X	FP2-RTD	
±10V ±20 mA Not isolated between channels (Default)	±10V Not isolated between channels (Default)	Not used	
Not used	±100mV Not isolated between channels	Not used	
Not used	Thermocouple K (−200 to 1000℃)	Not used	
Not used	Thermocouple S (0 to 1500℃)	Not used	
Not used	Pt100 (−200 to 650℃)	Pt100 (−200 to 650℃) (Default)	

Input range			Setting
FP2-AD8VI	FP2-AD8X	FP2-RTD	
1 to 5V 4 to 20 mA Not isolated between channels	1 to 5V Not isolated between channels	Not used	
Not used	Thermocouple J (−200 to 750℃)	Not used	
Not used	Thermocouple R (0 to 1500℃)	Not used	
Not used	Thermocouple T (−200 to 350℃)	Not used	
Not used	Pt1000 (−100～100℃)	Pt1000 (−100～100℃)	
Enable setting by software	Enable setting by software	Enable setting by software	

Note) The range setting switch for FP2-AD8VI is a octal switch. The switches No. 6 to 8 must be used being switched off. If they are on, it does not operate properly.

Default setting

All the switches are off.



Especially note:

Do not set the range setting switch to “not used”. If setting to “not used”, the unit will not operate properly.

For setting different ranges for each input channel

Set the range for each channel respectively by ladder programs.

Always set the range setting switch as below.

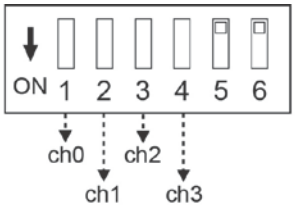
Enable setting by software	

 **Reference:** <12.3.1 Shared Memory of Analog Input Unit>

4.1.2 Setting the Analog Output Range

How to set the output range

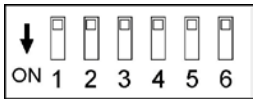
The analog output range setting can only be performed by the range setting switch. At the analog output units, use the range setting switches 1 to 4 to set the range for each channel.



Output range	Setting
Current 0 to 20 mA	ON OFF
Voltage -10 to +10 V	ON ON

Default setting

All the switches are off.



Especially note:

For the analog output unit, be sure to have the range setting switches 5 and 6 set to off. If setting to on, the unit will not operate properly.

4.2 I/O Allocation and Slot Numbers

4.2.1 Occupation I/O Areas and I/O Allocation

During sequence program processing with the FP2, the analog input and output data is allocated to the I/O (X, Y) and refreshed.
The analog input signal for one channel is handled in units of 16 points of the X contact.
The analog output signal for one channel is handled in units of 16 points of the Y contact.
The I/O allocation for the analog input and output data is as shown in the table below.

Analog input unit Occupation number of points: 128 points (Input: 128 points)

Channel		FP2 I/O number	Programming tool software
Analog input	Ch0	WX(n): X(n)0 to X(n)F	128SX
	Ch1	WX(n+1): X(n+1)0 to X(n+1)F	
	Ch2	WX(n+2): X(n+2)0 to X(n+2)F	
	Ch3	WX(n+3): X(n+3)0 to X(n+3)F	
	Ch4	WX(n+4): X(n+4)0 to X(n+4)F	
	Ch5	WX(n+5): X(n+5)0 to X(n+5)F	
	Ch6	WX(n+6): X(n+6)0 to X(n+6)F	
	Ch7	WX(n+7): X(n+7)0 to X(n+7)F	

Analog output unit Occupation number of points: 64 points (Input: 64 points)

Channel		FP2 I/O number	Programming tool software
Analog output	Ch0	WY(n): Y(n)0 to Y(n)F	64SY
	Ch1	WY(n+1): Y(n+1)0 to Y(n+1)F	
	Ch2	WY(n+2): Y(n+2)0 to Y(n+2)F	
	Ch3	WY(n+3): Y(n+3)0 to Y(n+3)F	

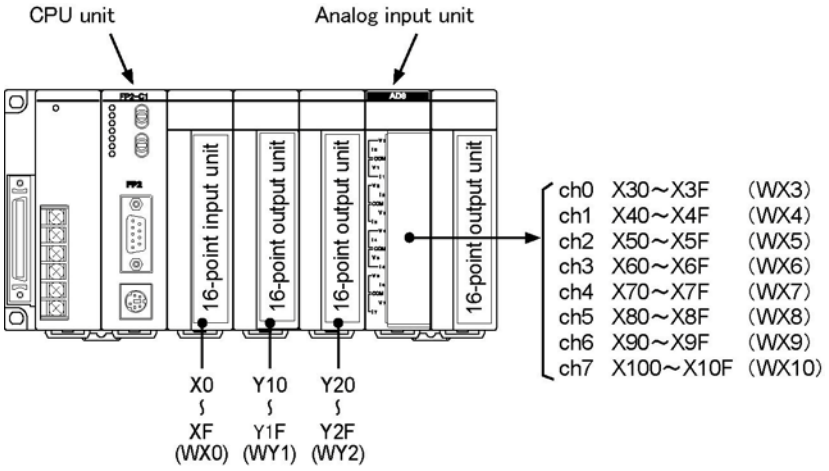
Note:

- The I/O number shown by an “n” in the table above is determined according to the installed slot position and the I/O allocation for other units.
- The occupation number of points remains unchanged even if the number of channels to use has been reduced in the shared memory setting.

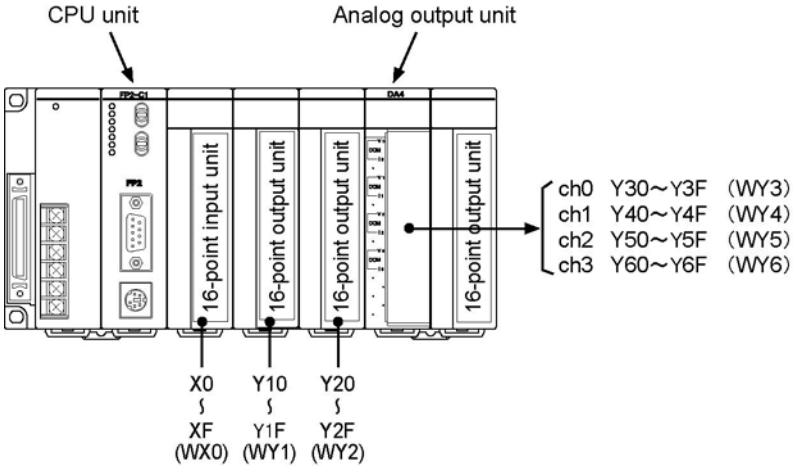
4.2.2 Confirmation of I/O No. Allocation

I/O numbers and slot numbers are necessary to generate programs. Those numbers vary depending on the installation position to the backplane. Confirm they are as per design.
Confirm the occupation I/O areas for all the units installed between the CPU unit and the analog unit. The next number is allocated for the analog unit as I/O area.

Example:
When installing the analog input unit next to three 16-point I/O units.



Example:
When installing the analog output unit next to three 16-point I/O units.



Note:

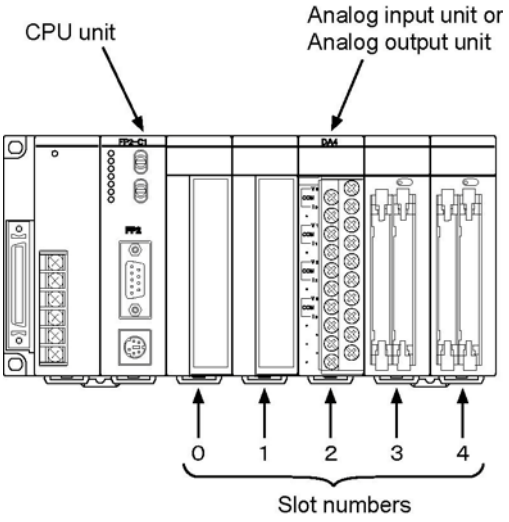
- If there are any blank slots between the CPU unit and the analog unit, confirm whether the I/O areas have been allocated for the blank slots.
- The areas for 16 points are automatically allocated for each blank slots during “I/O mounting allocation” or “automatic allocation”
- When using the two-module type CPU unit, also confirm the I/O area allocated by the unit built in the CPU units.

4.2.3 Slot Numbers

Slot numbers are necessary to set various items by programs for the analog unit.

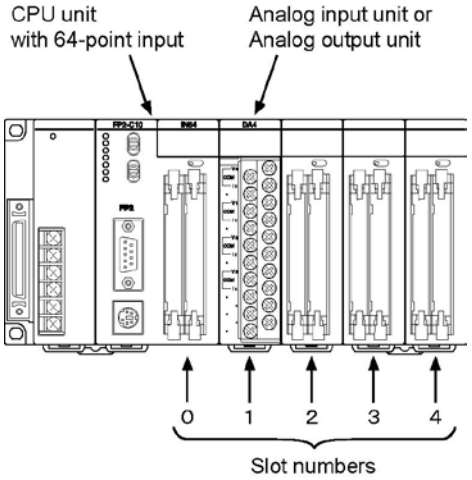
Analog input/output unit
The slot number for the unit is determined depending on the installation position on the backplane.

When installing on the backplane of the CPU side
The right-hand slot of the CPU unit is counted as “0”.

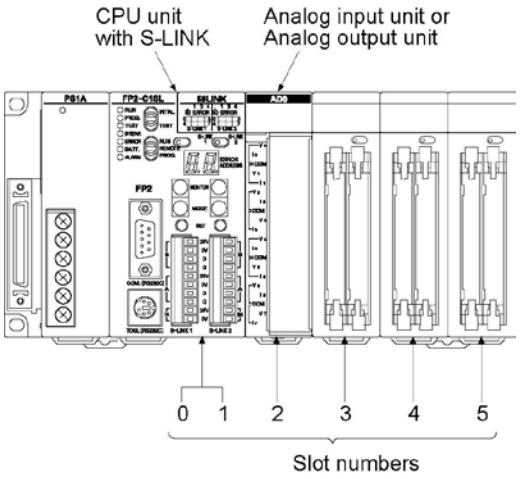


Note:

When using the two-module type CPU unit, the slot No. “0” is allocated to the unit built in the CPU.

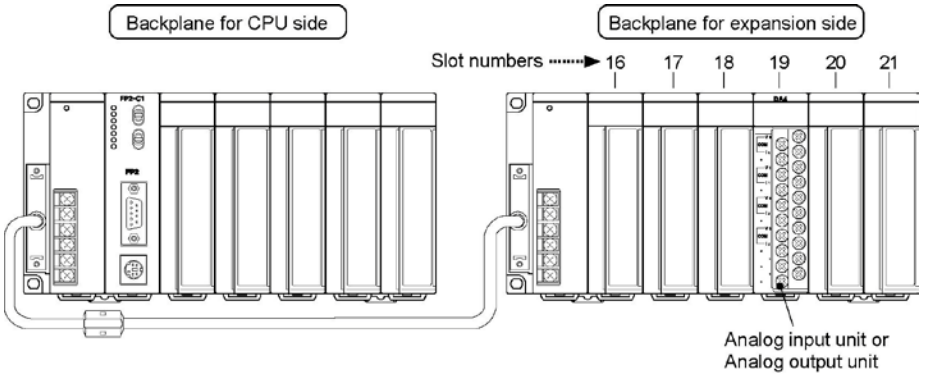


When installing on the backplane which the CPU unit with the S-Link is mounted, count the slot numbers for the unit built in the CPU unit as “0, 1”.



When installing on the backplane of the expansion side

Count the right-hand slot number of the power supply unit on the backplane of the expansion side as “16”.



Chapter 5

Power On/Off and Initial Settings

5.1 Unit Operation When turning the Power On/Off

5.1.1 Analog Input Operation

When turning the power off to on

The time from the startup of the FP2 until the converted first analog input data is written in the shared memory differs depending on the input range set for the channel. Once the reading is available, the preparation completion flag in the shared memory turns on.

The time from the startup of the FP2 until the first analog input data is written in the shared memory

Input range	Analog input unit		R.T.D. (Resistance thermometer device) unit
	FP2-AD8VI	FP2-AD8X	FP2-RTD
Non-isolated voltage input range	430 ms	500 ms	-
Isolated voltage input range	-	4500 ms	-
Current input range	430 ms	-	-
Thermocouple input range	-	4500 ms	-
R.T.D. (Resistance thermometer device) input range	-	4500 ms	4500 ms

- The preparation completion flag in the shared memory area No. 10 changes from off to on only when the power supply turns on. The flag does not change when switching the RUN mode/PROG. mode.
- The values of the shared memory right after turning the power supply on are preset to the default values specified for every memory area numbers.

When turning the power on to off

The value set in the shared memory of the unit is cleared.

5.1.2 Analog Output Operation

When turning the power off to on

- The voltage (approx. –10V) may be output momently (for approx. 200 ms) from the output terminal of the analog output unit when the power supply of FP2/FP2SH turns on/off.
  If it becomes a problem on the system, take appropriate measures, such as delaying the timing of the power activation of connected external devices from the power activation of the PLC.
- The values of the shared memory right after turning the power supply on are preset to the default values specified for every memory area numbers. Program to execute the initial setting program after turning the power on if necessary.
- The analog output values are output according to the values written in the output relay area (WY). After turning the power on, the program is executed and the values equivalent to zero for WY are output until the data is written in the output relay area (WY).

Example: For the range of 0 to 20 am

The value 0 [am] equivalent to the digital value K0 is output.

When turning the power on to off

The value set in the shared memory of the unit is cleared.

5.2 Initial Setting Programs

5.2.1 Input Settings

No execution channel of analog input conversion processing setting
(Shared memory addresses: 16, 17)
Can specify the channels not to execute the analog input processing.
Specify when you want to shorten the conversion processing time for unused input channels.

The items for the initial settings
- **Slot numbers to install analog input units**

Sets to K0 when installing in the slot number 0.

- **Execution channels of analog input conversion processing**

Specifies H11(H0011) to set ch0 and ch1 to execute and ch2 and ch3 not to execute the conversion processing.

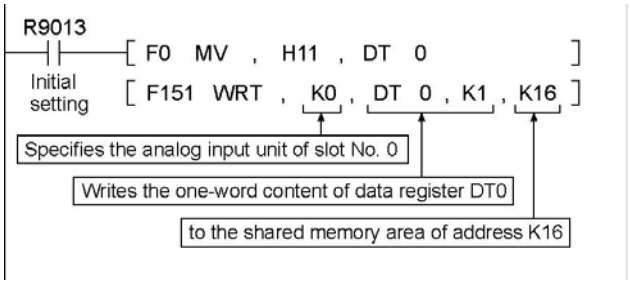
- **No. of data**

Specifies the number of words to be written in the shared memory.

- **Address of shared memory**

Specifies the address allocated for the no execution channel of analog input conversion processing setting.

Program example:



Optional settings (to be specified for each channel by programs if necessary)
- **Analog input offset change setting**

Specifies the digital value for the offset when performing the process to add the offset to the conversion data.

- **Average processing times setting**

Specifies the number of times to perform average processing for conversion data.

- **Analog input range setting**

Specify to set the input range individually for each channel with the input range setting switch or to set the range which cannot be set with the range setting switch.

Reference:
- For the information on the table of shared memory area, <12.3 Table of Shared Memory Area>.
- For the information on the program example, <Chapter 7, 8 Sample Programs>.

5.2.2 Output Settings

No execution channel of analog output conversion processing setting
(Shared memory addresses: 22)
Can specify the channels not to execute the analog output processing.
Specify when you want to shorten the conversion processing time for unused output channels.

The items for the initial settings
- **Slot numbers to install analog output units**

Sets to K0 when installing in the slot number 0.

- **Execution channels of analog output conversion processing**

Specifies H11(H0011) to set ch0 and ch1 to execute and ch2 and ch3 not to execute the conversion processing.

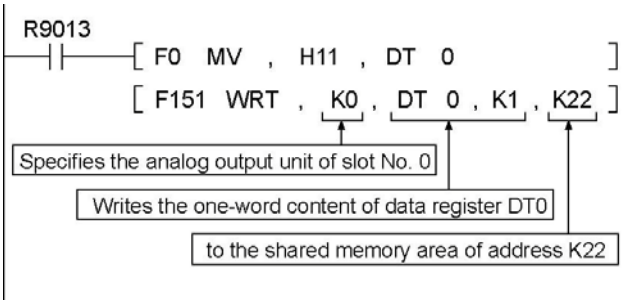
- **No. of data**

Specifies the number of words to be written in the shared memory.

- **Address of shared memory**

Specifies the address allocated for the no execution channel of analog output conversion processing setting.

Program example:



Optional settings (to be specified for each channel by programs if necessary)
- **Analog output hold setting**

Specifies either to hold or not hold analog output data when switching the CPU unit to the PROG. mode if necessary.
Carry out the following “analog output hold (any value) data setting” as well to set the output value at the desired value.

- **Analog output hold (any value) data setting**

Specifies to hold the analog output data at a desired value when switching the CPU unit to the PROG. mode if necessary.

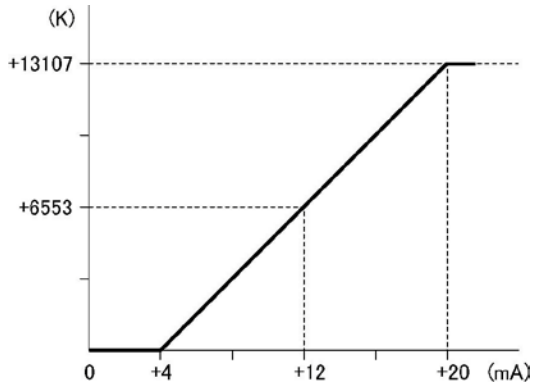
Reference:
- For the information on the table of shared memory area, <12.3 Table of Shared Memory Area>.
- For the information on the program example, <Chapter 9, 10 Sample Programs>.

Chapter 6

Analog I/O Conversion Characteristics

6.1 Analog Input Conversion Characteristics

6.1.1 Current Input Range: 4 to 20 mA



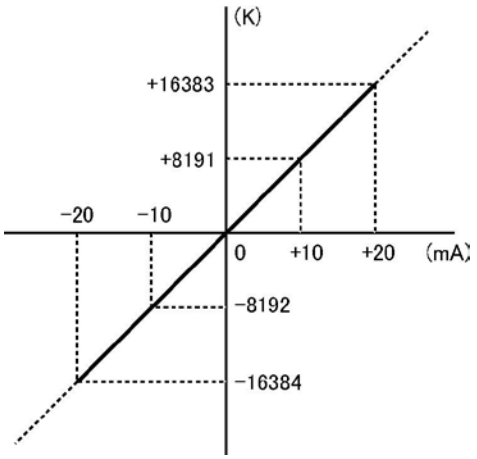
Input range: 4 to 20 mA

Analog input value (mA)	Digital converted value (K)
20	13107
16	9829
12	6553
8	3276
4	0

When exceeding the rated analog input range

Analog input value	Converted value
20 mA or more	+13107
4 mA or less	0

6.1.2 Current Input Range: -20 to +20 mA



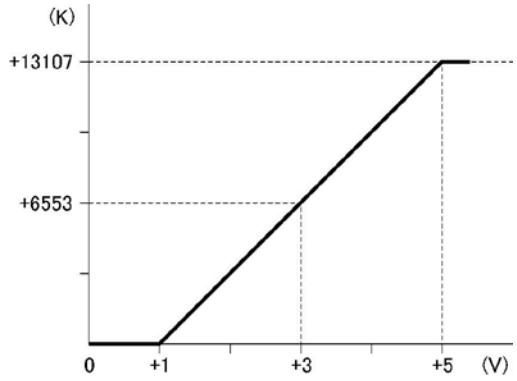
Input range: -20 to +20 mA

Analog input value (mA)	Digital converted value (K)
20	16383
15	12287
10	8191
5	4095
0	0
-5	-4096
-10	-8192
-15	-12288
-20	-16384

When exceeding the rated analog input range

Analog input value	Digital converted value
+20 mA or more	Conversion will be performed for the values of 16383 to 32767 or -16384 to -32768 even when outside of the allowable range, but the precision cannot be guaranteed.
-20 mA or less	

6.1.3 Voltage Input Range: 1 to 5 V



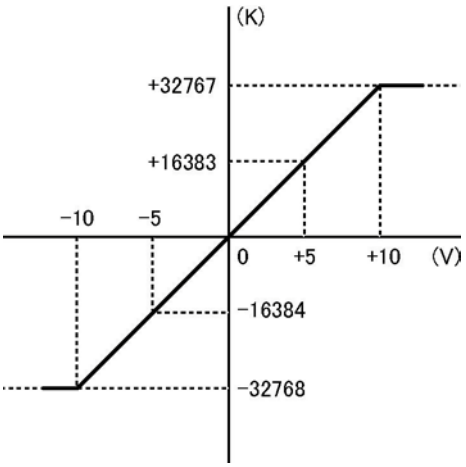
Input range: 1 to 5 V

Analog input value (mA)	Digital converted value (K)
5	13107
4	9829
3	6553
2	3276
1	0

When exceeding the rated analog input range

Analog input value	Converted value
5 V or more	+13107
1 V or less	0

6.1.4 Voltage Input Range: -10 to +10 V



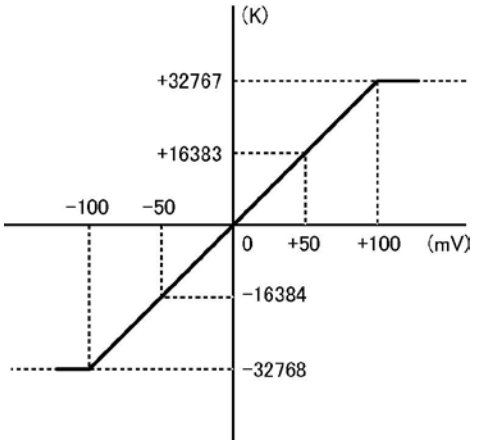
Input range: -10 to 10 V

Analog input value (mA)	Digital converted value (K)
10	32767
7.5	24575
5	16383
2.5	8191
0	0
-2.5	-8192
-5	-16384
-7.5	-24576
-10	-32768

When exceeding the rated analog input range

Analog input value	Converted value
+10 V or more	+32767
-10 V or less	-32768

6.1.5 Voltage Input Range: -100 to +100 mV



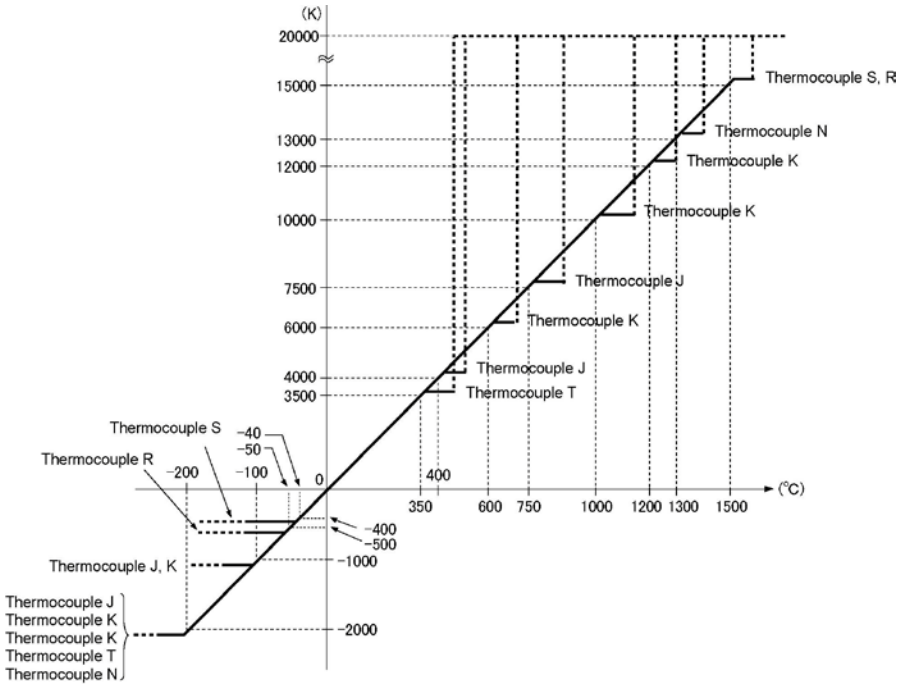
Input range: -100 to +100 mV

Analog input value (mA)	Digital converted value (K)
100	32767
75	24575
50	16383
25	8191
0	0
-25	-8192
-50	-16384
-75	-24576
-100	-32768

When exceeding the rated analog input range

Analog input value	Converted value
+100 mV or more	+32767
-100 mV or less	-32768

6.1.6 Thermocouple Input Range



When exceeding the rated analog input range
(Reference values which the precision is not guaranteed are indicated for the ranges up to ±15 °C.)

Range	Input value	Converted value
Thermocouple S	-55 °C or less Note)	-550
	+1515°C or more	+15150
Thermocouple J	-215 °C or less	-2150
	+765 °C or more	+7650
Thermocouple J	-115 °C or less	-1150
	+415 °C or more	+4150
Thermocouple K	-215 °C or less	-2150
	+1215 °C or more	+12150
Thermocouple K	-215 °C or less	-2150
	+1015 °C or more	+10150
Thermocouple K	-115 °C or less	-1150
	+615 °C or more	+6150
Thermocouple T	-215 °C or less	-2150
	+365 °C or more	+3650
Thermocouple R	-65 °C or less Note)	-650
	+1515 °C or more	+15150
Thermocouple N	-215 °C or less	-2150
	+1315 °C or more	+13150
Broken wire	-	+20000

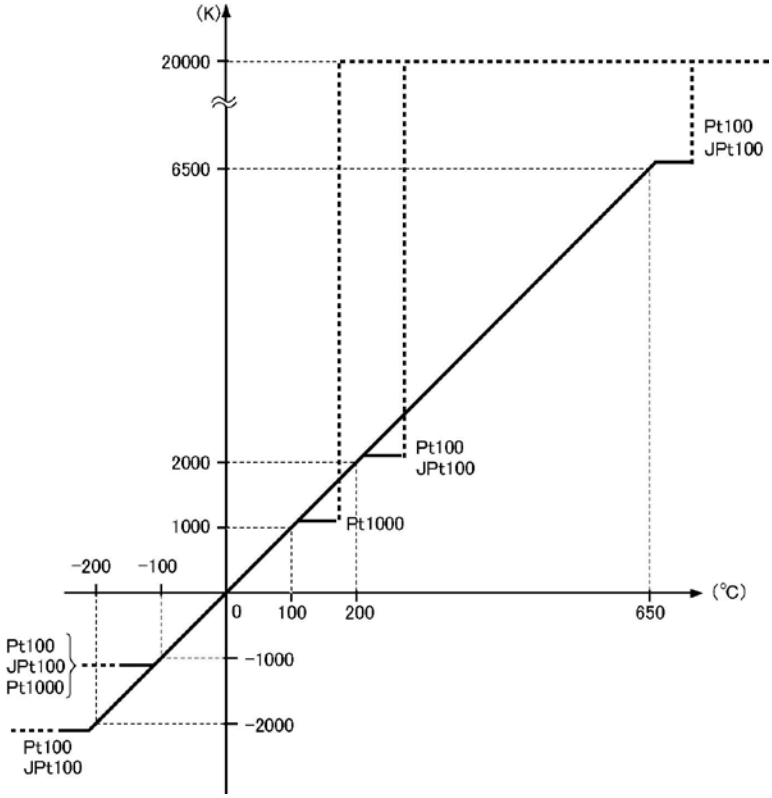
Note1) For the S and R ranges, conversion will be performed even if the input is outside of the ranges 0 to –55 °C and 0 to –65 °C, but the precision cannot be guaranteed.

Note2) If the input values exceed the upper limits, they will be converted to the above values, however, the temperatures get higher furthermore, the values will be the same value as the case of broken wire (i.e. 20000).

Reference:

For the information on broken wires, see <8.2.1 Broken Wire Detection for Analog Unit>.

6.1.7 R.T.D. (Resistance Thermometer Device) Input Range



When exceeding the rated analog input range
(Reference values which the precision is not guaranteed are indicated for the ranges up to ±15 °C.)

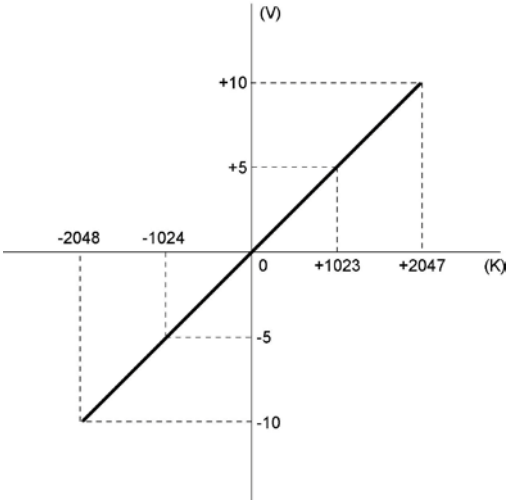
Range	Input value	Converted value
Pt100	-215 °C or less	-2150
	+665°C or more	+6650
Pt100	-115 °C or less	-1150
	+215 °C or more	+2150
JPt100	-215 °C or less	-2150
	+665 °C or more	+6650
JPt100	-115 °C or less	-1150
	+215 °C or more	+2150
Pt1000	-115 °C or less	-1150
	+115 °C or more	+1150
Broken wire	-	+20000

Note) If the input values exceed the upper limits, they will be converted to the above values, however, the temperatures get higher furthermore, the values will be the same value as the case of broken wire (i.e. 20000).

Reference:
For the information on broken wires, see <8.2.1 Broken Wire Detection for Analog Unit>.

6.2 Analog Output Conversion Characteristics

6.2.1 Voltage Output Range: -10 to +10 V



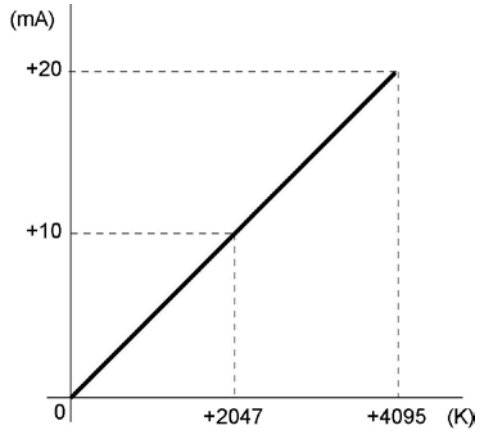
Output range: -10 to +10 V

Digital input value (K)	Analog output value (V)
2047	10
1535	7.5
1023	5
511	2.5
0	0
-512	-2.5
-1024	-5
-1536	-7.5
-2048	-10

When exceeding the rated digital input range

Digital input value	Analog output value
+2048 or more	Invariable (holds the output value that corresponds to the previous effective input value)
-2049 or less	Invariable (holds the output value that corresponds to the previous effective input value)

6.2.2 Current Output Range: 0 to 20 mA



Output range: 0 to 20 mA

Digital input value (K)	Analog output value (mA)
4095	20
3071	15
2047	10
1023	5
0	0

When exceeding the rated digital input range

Digital input value	Analog output value
+4096 or more	Invariable (holds the output value that corresponds to the previous effective input value)
-1 or less	Invariable (holds the output value that corresponds to the previous effective input value)

Chapter 7

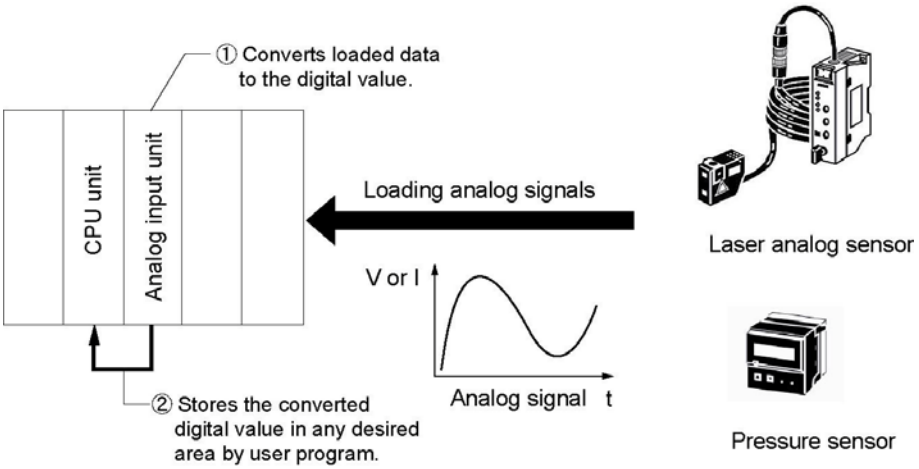
Basics of Analog Input

7.1 Reading the Analog Input Data

7.1.1 Reading the Analog Input Data

Basics of the analog input operation

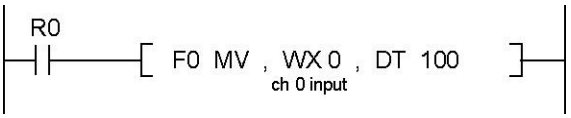
1) The data read into the input part are converted to the digital values within the analog unit successively.
   Note) The converted digital values differ depending on the range settings.
2) The converted digital values are stored in any desired area by the user program of the CPU unit reading appropriate input relay area WX.
   Note) The area numbers differ depending on the installation positions.



Program for reading the converted digital value.

Example:

For reading the value in the digital conversion data storage area WX0 for ch0 to arbitrary area “data register DT100”.



7.2 Timing for Reading Data

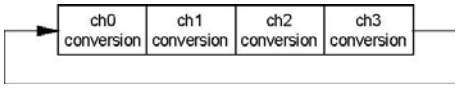
Input conversion processing time for input unit

Conversion time differs depending on the used ranges and number of channels.
The conversion time can be shorten for the number of channels where the conversion is not executed by using the execution/no execution setting.

When specified to execute the conversion for four channels

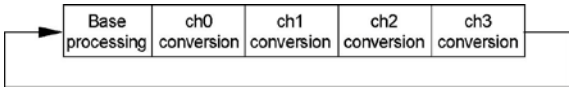
AFP2401 and AFP2402

Converts in order of ch0→ch1→ch2→ch3→ch0→ch1→ch2→ch3→….



AFP2400L

Converts in order of base processing→ch0→ch1→ch2→ch3→base processing→….

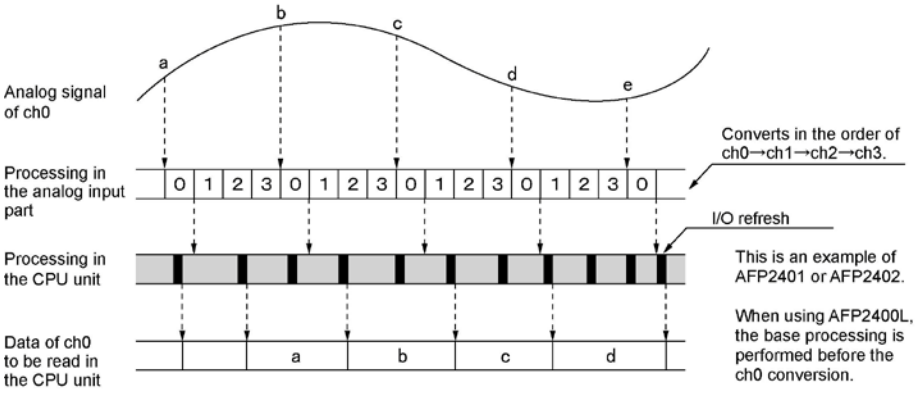


The base time is fixed at 400 μs regardless of the number of conversion channels.

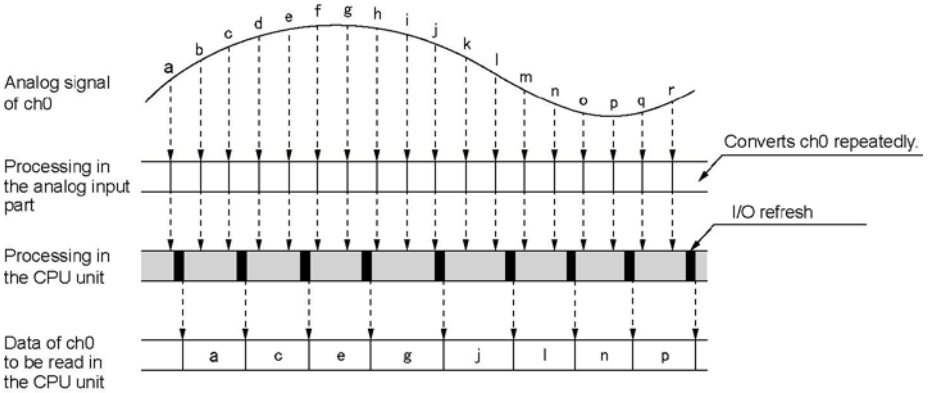
Timing for reading data in the CPU unit

- The digital value converted in the analog unit is read into the CPU unit at the time the I/O is refreshed.
- Since the conversion within the analog unit is not synchronized with the I/O refresh for the CPU unit, The latest data will be read into the memory for operation of the CPU unit at the time the I/O refresh is performed.

For four channels



For one channel

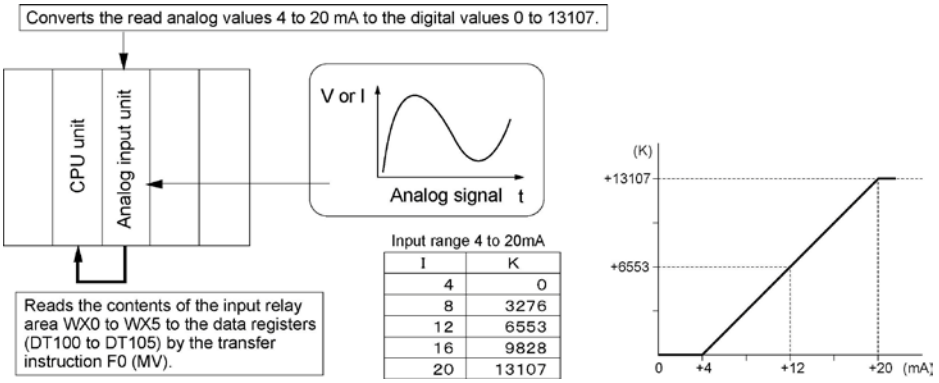


7.3 Sample Program

7.3.1 Basic Program (Analog Input Unit)

Program outline

Using ch0 to ch5 of the analog input unit, this program reads the analog input data to the data registers DT100 to DT105 using the preparation completion flag.



Settings

Item	Setting value for example program	Descriptions
Execution channel of analog input conversion processing	Ch0 to ch5: Set to execution (ch6 to ch7: Set to no execution)	Specify H1111 for shared memory address 16. Specify H11 for shared memory address 17.
I/O allocation	WX0	Analog input data for ch0
	WX1	Analog input data for ch1
	WX2	Analog input data for ch2
	WX3	Analog input data for ch3
	WX4	Analog input data for ch4
	WX5	Analog input data for ch5
Data register allocation	DT100	Input data read area for ch0
	DT101	Input data read area for ch1
	DT102	Input data read area for ch2
	DT103	Input data read area for ch3
	DT104	Input data read area for ch4
	DT105	Input data read area for ch5
Shared memory	Address 10	Preparation completion flag for ch0 to ch7
	Address 16	Execution/no execution of conversion processing setting for ch0 to ch3.
	Address 17	Execution/no execution of conversion processing setting for ch4 to ch7.

Key Point:

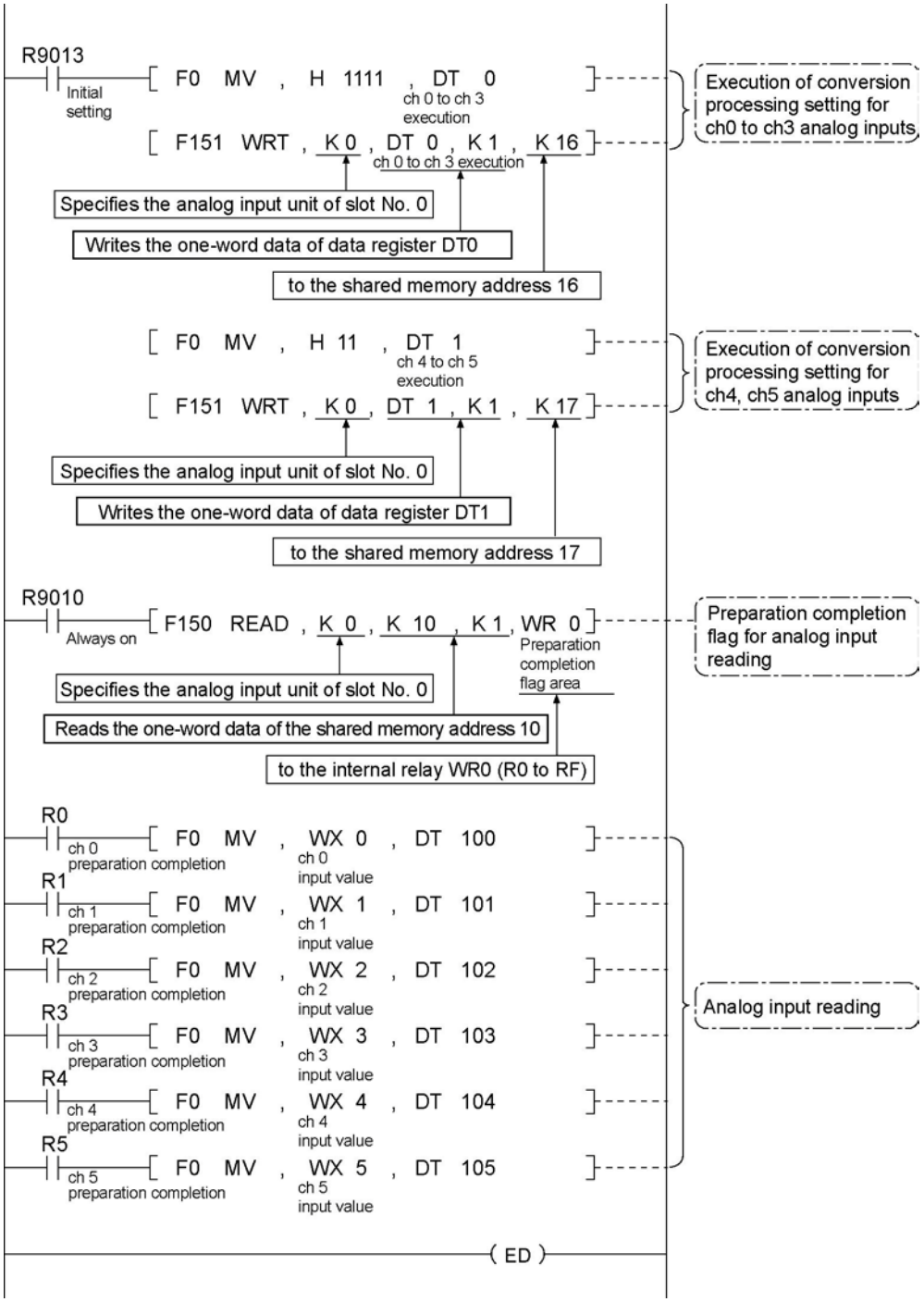
The preparation completion flag indicates that the conversion is ready for the analog unit when turning the power supply on. As data may be unstable values during the start-up of the power supply, make sure to confirm that this flag turns on, and then create a program to read the data. The time taken from the start-up of the power supply until the preparation completion flag turns on differs depending on the ranges.

Reference: <12.1 Table of Performance Specifications “Input conversion data setup time”>

Note:

- The ranges for the converted values differ depending on the used ranges.
- The number of input contacts and specified slot numbers differ depending on the installation positions of the units.

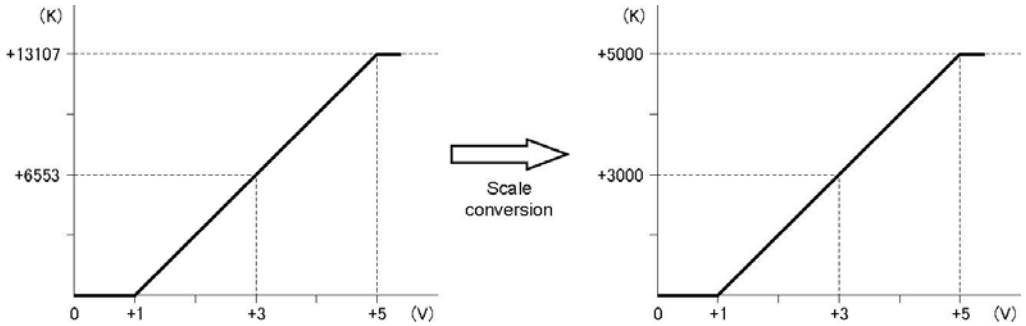
Sample program:



7.3.2 Scale Conversion Processing Program

Program outline

This program read the scale-converted analog data for ch0 and ch1 of the analog input unit to any data registers.



Settings

Item	Setting value for example program	Descriptions
Execution channel of analog input conversion processing	Ch0 to ch1: Set to execution (ch2 to ch3: Set to no execution)	Specify H11 for shared memory address 16.
I/O allocation	WX0	Analog input data for ch0
	WX1	Analog input data for ch1
Data register allocation	DT100	Input data read area for ch0
	DT101 to DT102	Scale-conversion for ch0 (DT100x4000)
	DT103	Scale-conversion for ch0 (DT100x4000/13107)
	DT104	Scale-conversion for ch0 (DT103+1000)
	DT110	Input data read area for ch1
	DT111 to 112	Scale-conversion for ch1 (DT110x4000)
	DT113	Scale-conversion for ch1 (DT110x4000/13107)
	DT114	Scale-conversion for ch1 (DT113+1000)
Shared memory	Address 10	Preparation completion flag for ch0 to ch7
	Address 16	Execution/no execution of conversion processing setting for ch0 to ch3.

Key Point:

Scale-conversion

The converted values read from the analog unit are fractional numbers. Convert to round figures if necessary.

Example: For the range of 1 to 5 V

Converted values to be read from the analog unit: K0 to K13107

Sets the values to be converted: K1000 to K5000

Calculates the scale and the offset specified in the program replacing with the values to be converted in the conversion characteristics graph.

Note:

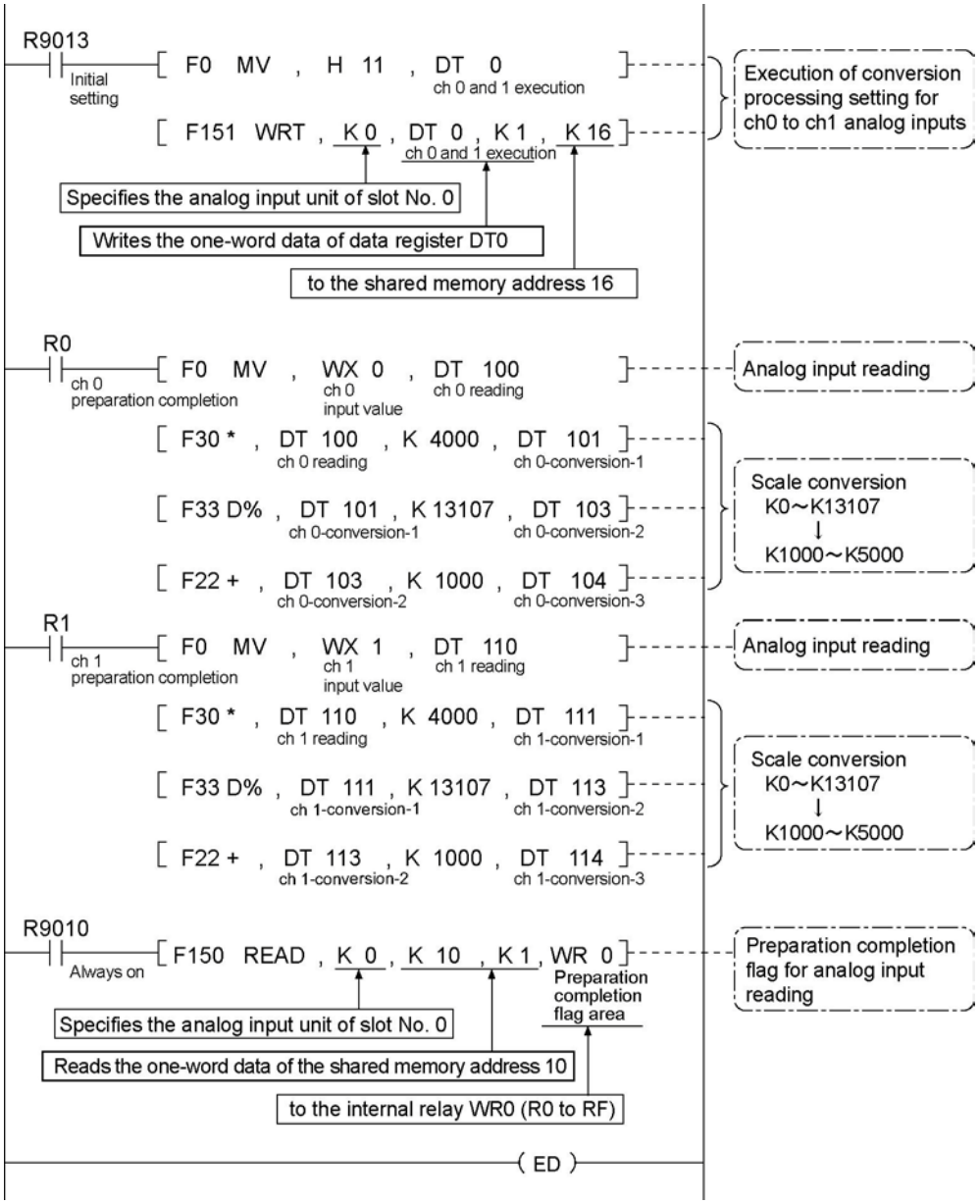
- The ranges for the converted values differ depending on the used ranges.
- The number of input contacts and specified slot numbers differ depending on the installation positions of the units.

Reference:

<chapter 6 Analog I/O Conversion Characteristics>

<4.2 I/O Allocation and Slot Numbers>

Sample program:



Chapter 8

Optional Settings for Analog Input

8.1 Average Processing Setting

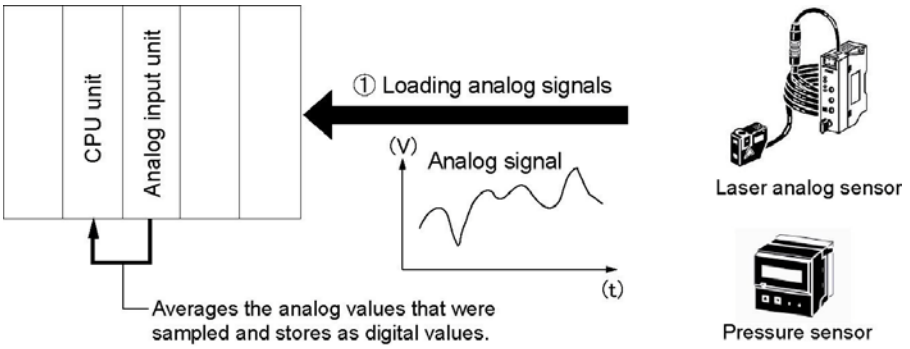
8.1.1 Average Processing for Analog Unit

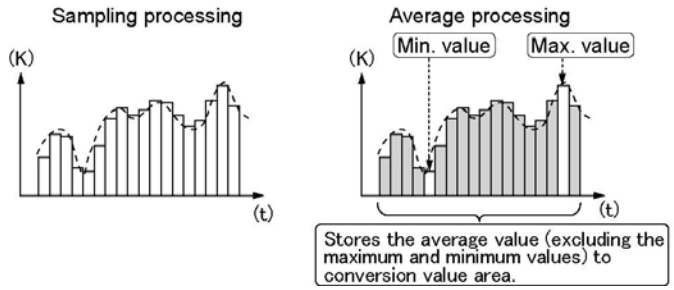
Average processing setting for analog input

Average processing is performed for the analog values read by sampling except the maximum value and minimum value, and stores them as digital values.

- Sets the number of averaging in the shared memory for each channel.
- Allowable number of times is in a range of 3 to 64 times.

Note) The digital values to be converted differ depending on the rages.
The slot numbers differ depending on the installation positions for the units.

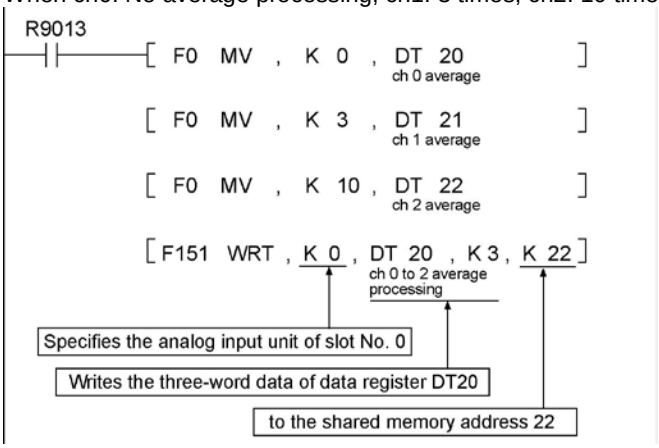




Program outline

The number of average processing times is specified for the shared memory address 22 to 29 by user program.

When ch0: No average processing, ch1: 3 times, ch2: 10 times

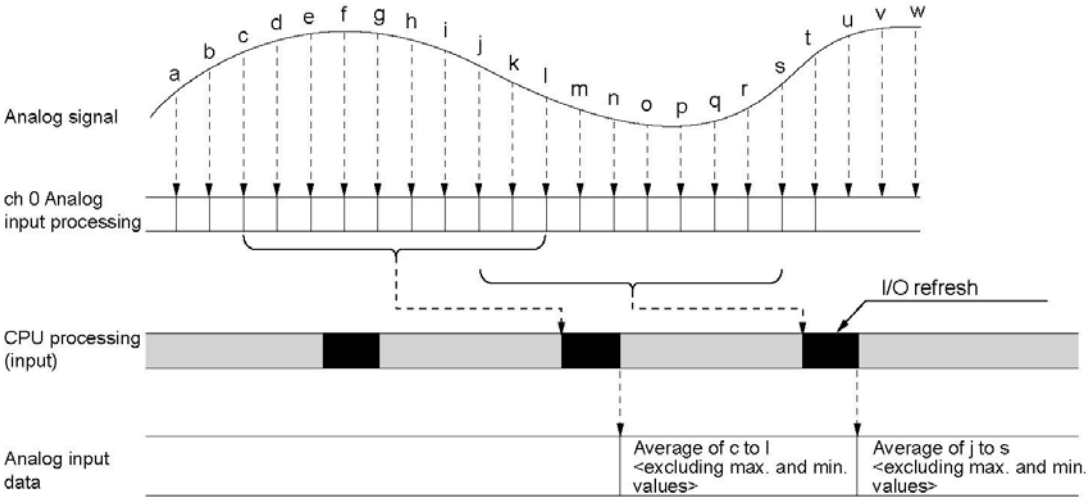


Timing for average processing

- The data to be read by sampling are converted successively.
  Note) The conversion time differs depending on the used number of channels and the setting ranges.
- Average processing is performed for the values going back for the specified number of times from the latest data except the maximum value and minimum value, and then the average value is output.

The change in the averaged data is as follows.

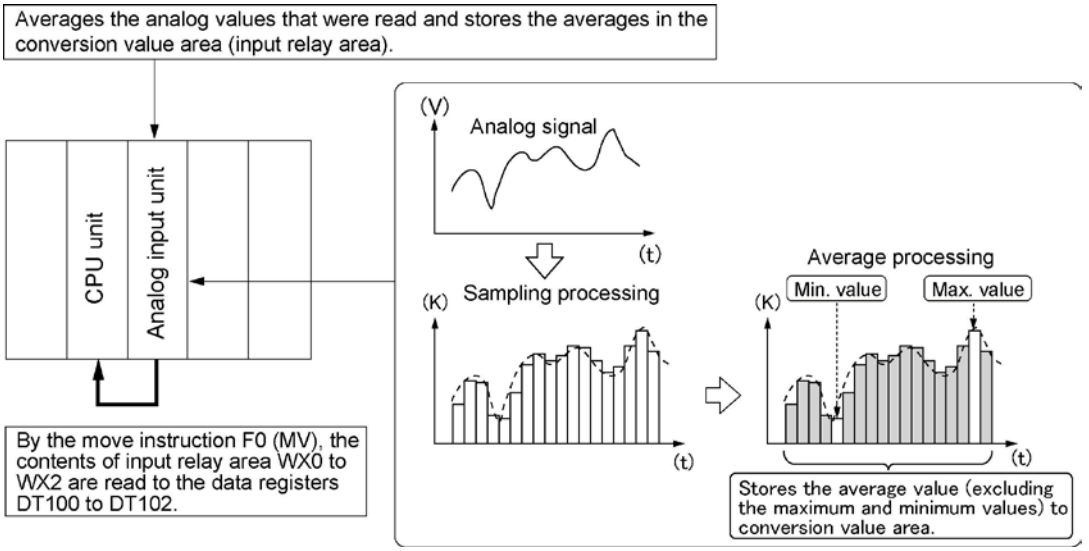
When the number of sampling times is 10:



8.1.2 Sample Program

Program outline

After averaging the analog input data for ch0 to ch2 for the analog input unit, the program reads the averages to the data registers DT100 to DT102 using the preparation completion flag.



Settings

Item	Setting value for example program	Descriptions
Execution channel of analog input conversion processing	Ch0 to ch2: Set to execution	Specify H111 for shared memory address 16.
I/O allocation	WX0	Analog input data for ch0
	WX1	Analog input data for ch1
	WX2	Analog input data for ch2
Data register allocation	DT100	Input data read area for ch0
	DT101	Input data read area for ch1
	DT102	Input data read area for ch2
Shared memory	Address 10	Preparation completion flag for ch0 to ch7
	Address 16	Execution/no execution of conversion processing setting for ch0 to ch3.
	Address 22	Average processing times setting for ch0
	Address 23	Average processing times setting for ch1
	Address 24	Average processing times setting for ch2

Key Point:

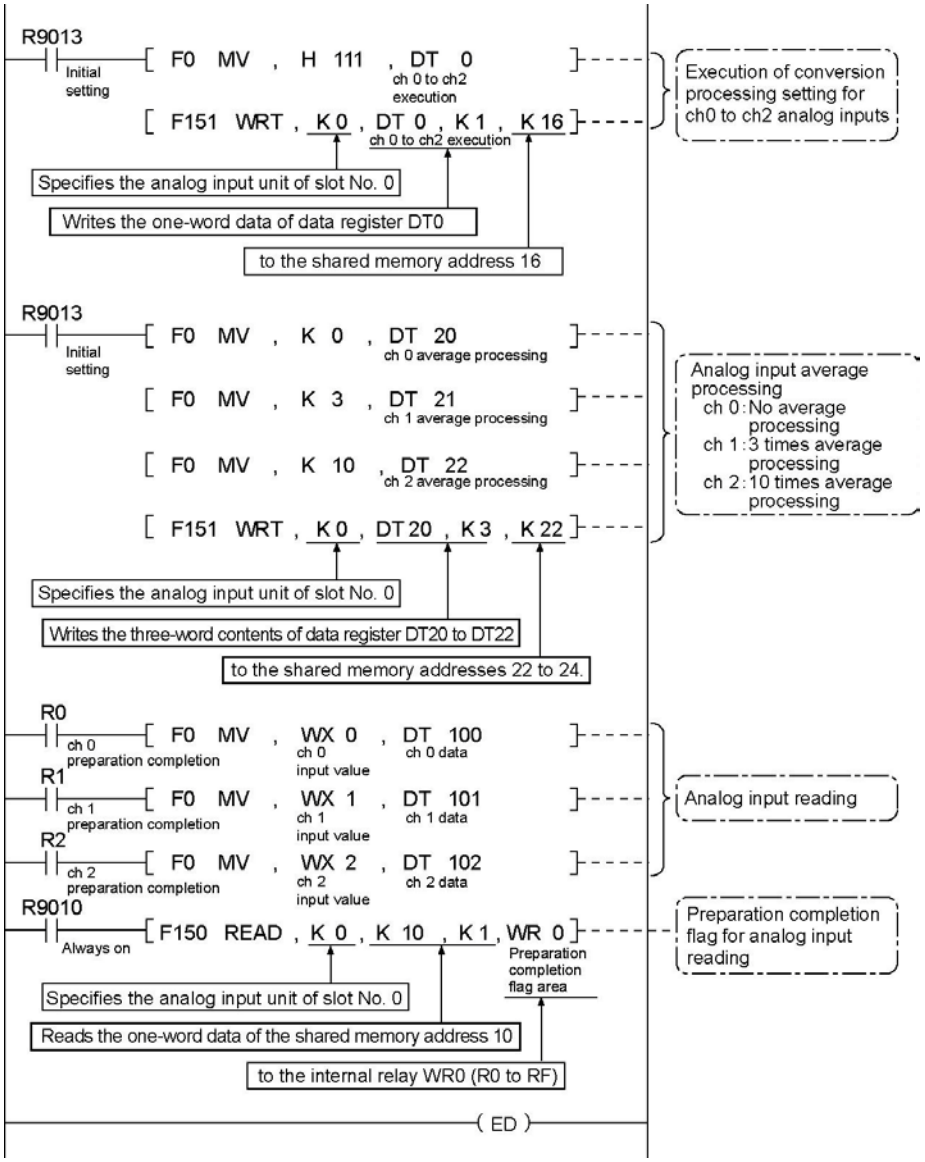
The average processing is performed in the analog unit by specifying the average processing times for the shared memory addresses 22 to 29.

Note:

- The ranges for the converted values differ depending on the used ranges.
- The number of input contacts and specified slot numbers differ depending on the installation positions of the units.
- Specify the average processing times within a range of K3 to K64.

Reference: <Chapter 6 Analog I/O Conversion Characteristics>
<4.2 I/O Allocation and Slot Numbers>

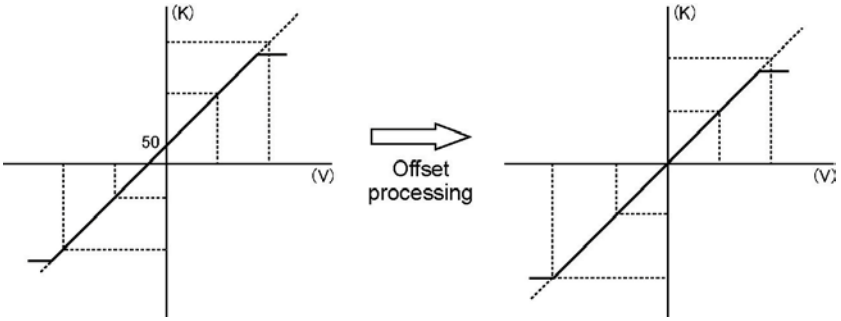
Sample program:



8.1.3 Offset Setting Program

Program outline

This program offsets the analog input data read from ch0 and ch1, and then reads it to the data registers DT100 to DT101.



Note) Offset setting for the above example

If the analog input value is 5V and the converted data is K50, the converted data is offset to 0 with the offset value K-50. In the sample program, the offset value K-50 for ch0 is read into the shared memory address 30 (offset changing setting for analog input ch0). Once the value is read, the analog input unit offsets with K-50 automatically.

Settings

Item	Setting value for example program	Descriptions
Execution channel of analog input conversion processing	Ch0 to ch1: Set to execution (ch2 to ch3): Set to no execution	Specify H11 for shared memory address 16.
I/O allocation	WX0	Analog input data for ch0
	WX1	Analog input data for ch1
Data register allocation	DT100	Input data read area for ch0
	DT101	Input data read area for ch1
Shared memory	Address 10	Preparation completion flag for ch0 to ch7
	Address 16	Execution/no execution of conversion processing setting for ch0 to ch3.
	Address 30	Offset changing setting for ch0 analog input
	Address 31	Offset changing setting for ch1 analog input

Key Point:

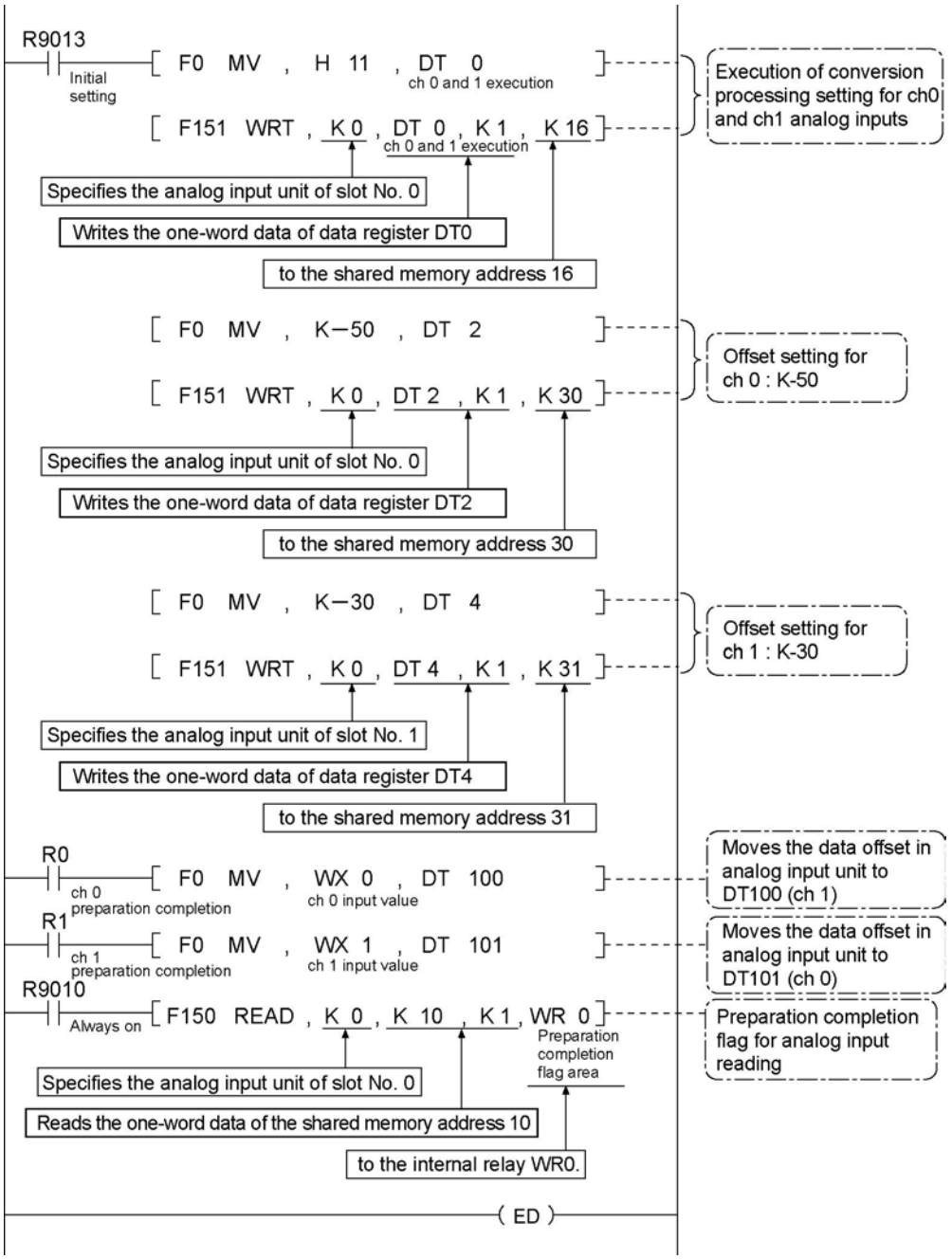
- The offset setting is to correct the deviation created when inputting standard analog input values <current/voltage/temperature>.
- The converted digital values can be offset in programs using the incremental or decremental instruction

Note:

- The ranges for the converted values differ depending on the used ranges.
- The number of input contacts and specified slot numbers differ depending on the installation positions of the units.
- Set offset values for each channel. The offsets may differ for each channel even if the analog input value are same.
- The conversion method and converted values for the area around the maximum and minimum values differs depending on the offset directions, so confirm the I/O conversion characteristics.

Reference: <Chapter 6 Analog I/O Conversion Characteristics>
<4.2 I/O Allocation and Slot Numbers>

Sample program:



8.2 Temperature Sensor Input Broken Wire Detection

8.2.1 Broken Wire Detection for Analog Unit

Temperature sensor broken wire detection for analog input

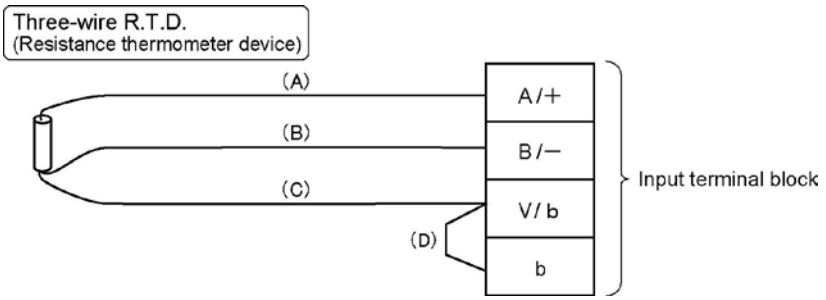
For the input channels of the thermocouple input range and R.T.D (resistance thermometer device) input range, you can detect broken wires in the input wiring of the temperature sensor for each channel using the broken-wire detection flag.

Once a broken wire detected, a relevant bit in the shared memory address 42 for the unit turns on, and the analog input data becomes 20000.

The shared memory address 42 is read and used by the user program as necessary.

Note:

For the broken wire detection in the three-wire resistance thermometer device input wiring, depending on which wire breaks as shown below, there are situations where the broken wire detection cannot be performed.



- Wire (A) connected to the A/+ terminal is broken: Broken wire detection is possible.
- Wire (B) and (C) connected to the B/- terminal and the V/b terminal are broken together: Broken wire detection is possible.

- Only wire (B) connected to the B/- terminal is broken: Broken wire detection is not possible.
- Only wire (D) connected to the b terminal is broken: Broken wire detection is not possible.

8.2.2 Sample Program

Program outline

The conditions on the input wiring of the temperature sensors (such as thermocouple or resistance thermometer device) for each channel are read to the internal relays R10 to R12 using the broken-wire detection flag for ch0 to ch2.

Settings

Item	Setting value for example program	Descriptions
Execution channel of analog input conversion processing	Ch0 to ch2: Set to execution	Specify H111 for shared memory address 16.
I/O allocation	WX0	Analog input data for ch0
	WX1	Analog input data for ch1
	WX2	Analog input data for ch2
Data register allocation	DT100	Input data read area for ch0
	DT101	Input data read area for ch1
	DT102	Input data read area for ch2
Internal relay allocation1	R10	Broken-wire detection flag for ch0
	R11	Broken-wire detection flag for ch1
	R12	Broken-wire detection flag for ch2
Shared memory	Address 10	Preparation completion flag for ch0 to ch3
	Address 16	Execution/no execution of conversion processing setting for ch0 to ch3.
	Address 42	Broken-wire detection flag for ch0 to ch7

Key Point:

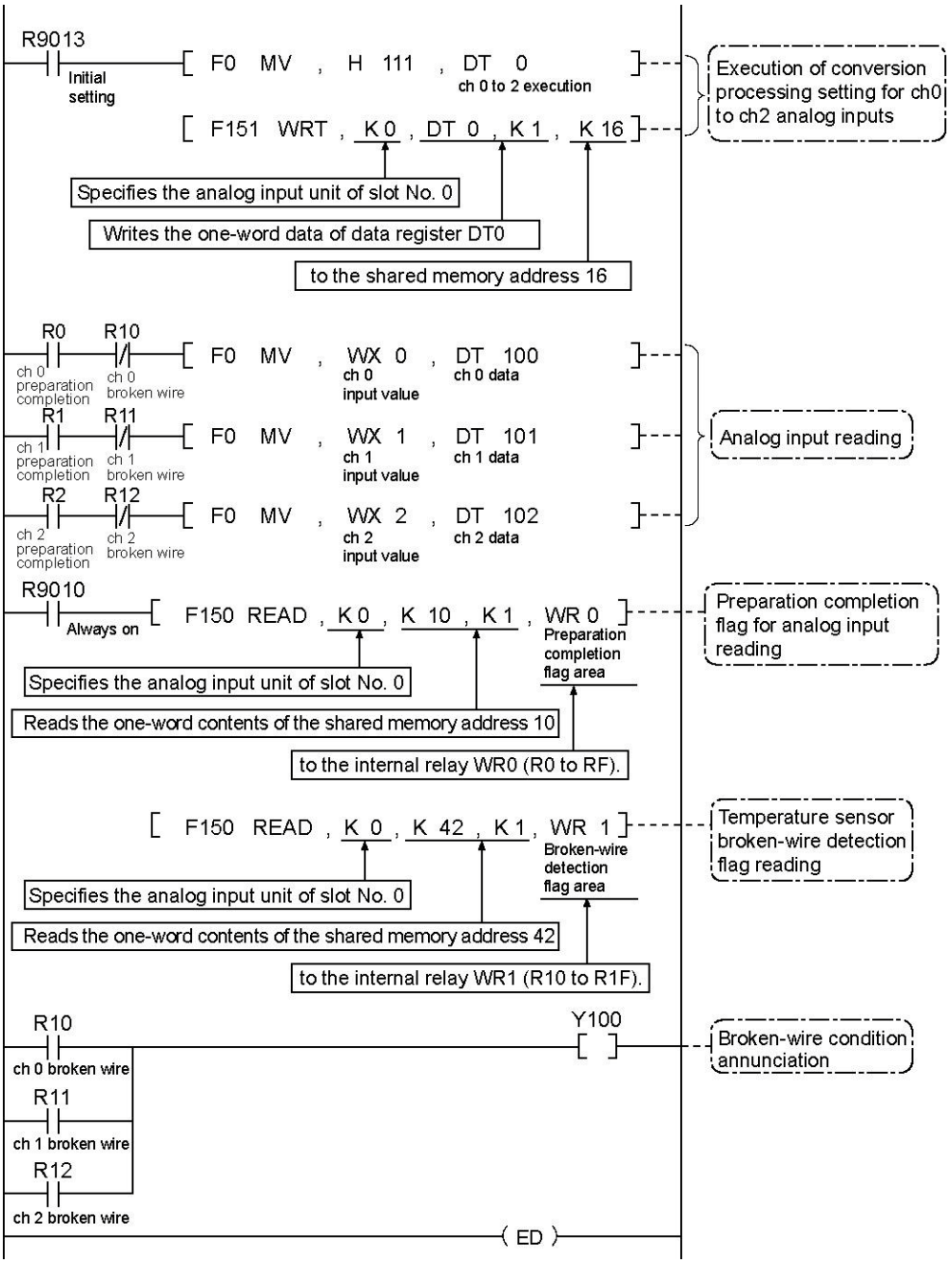
The broken-wire flags are stored in the shared memory address 42 for each channel.
At the same time, the analog input data becomes 20000.

Note:

- The ranges for the converted values differ depending on the used ranges.
- The number of input contacts and specified slot numbers differ depending on the installation positions of the units.

Reference: <Chapter 6 Analog I/O Conversion Characteristics>
<4.2 I/O Allocation and Slot Numbers>

Sample program:



Chapter 9

Basics of Analog Output

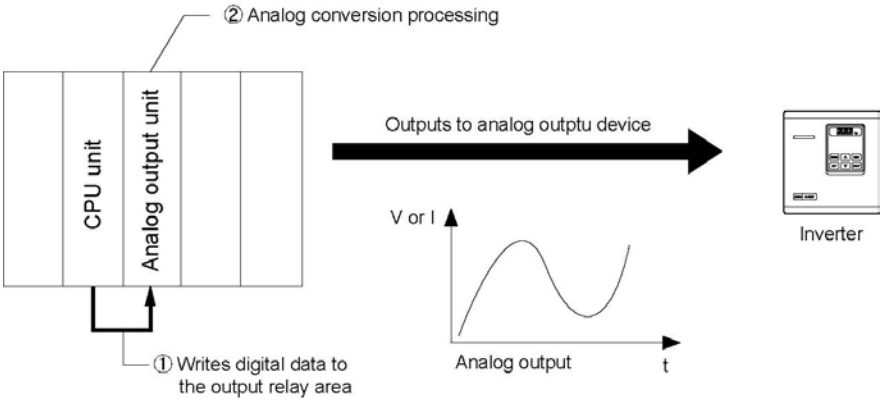
9.1 Writing the Analog Output Data

Basics of the analog output operation

1) Writes data into the relevant output relay area WY using the user program of the CPU unit to obtain analog output.

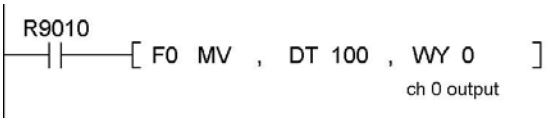
Note) The converted analog values differ depending on the range settings.
The specified slot numbers differ depending on the installation position of the units.

2) The digital data written in the analog unit are converted to the analog values within the analog unit successively.



Program outline

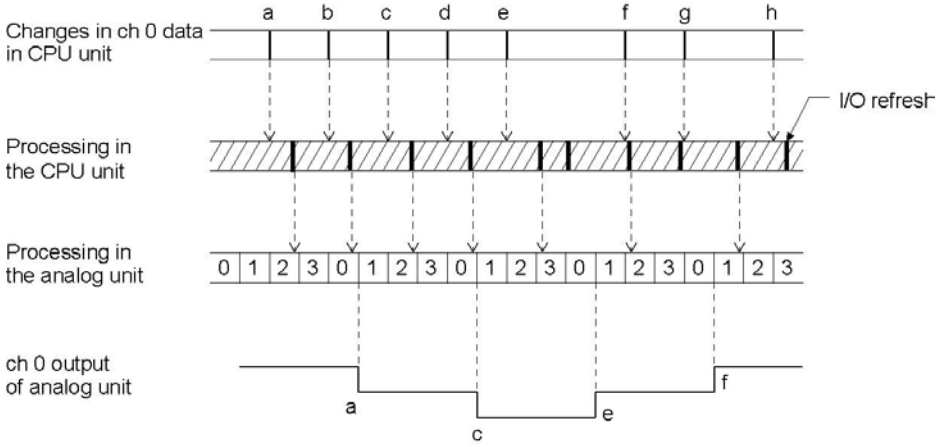
When writing the data in DT100 into the output relay area WY0 for ch0



Timing for analog output from analog unit

- Data is written into the analog unit as a data in the output relay area at the time the I/O for the CPU unit is refreshed.
- Since the conversion within the analog unit is not synchronized with the operation of the CPU unit, the latest data written from the CPU unit will be converted to the analog value and output.

The time taken for the analog unit to convert digital data differs depending on the used number of channels and the used ranges.

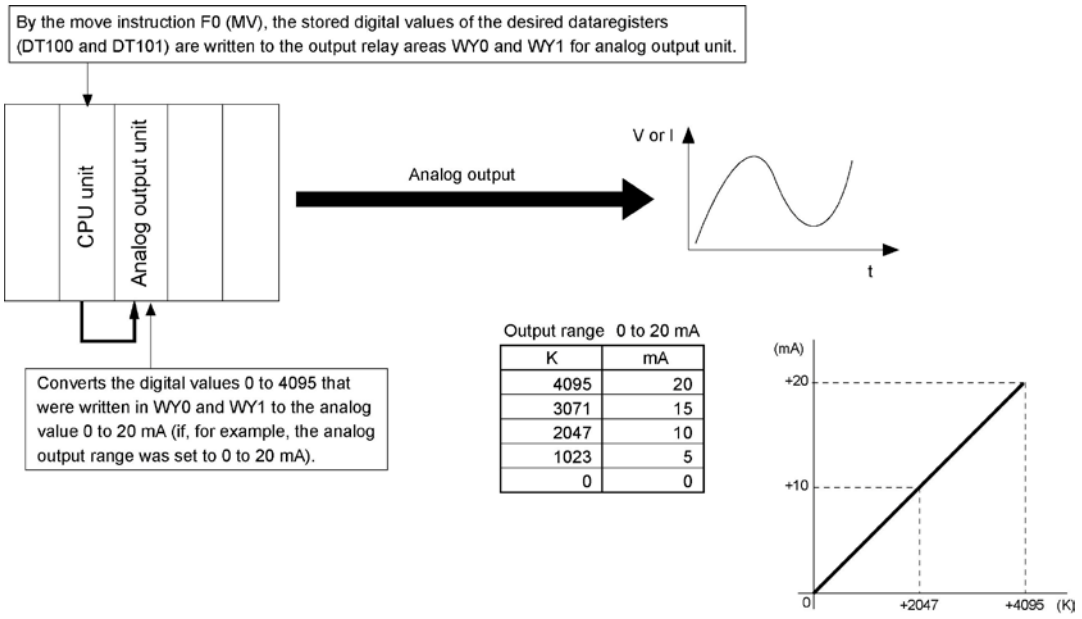


9.2 Sample Program

9.2.1 Basic Program (Analog Output Unit)

Program outline

This program writes the output data stored in data registers DT100 and DT101 to the output relay areas WY0 and WY1, which correspond to the output channels ch0 and ch1 of the analog output unit set for the execution of conversion processing.



Settings

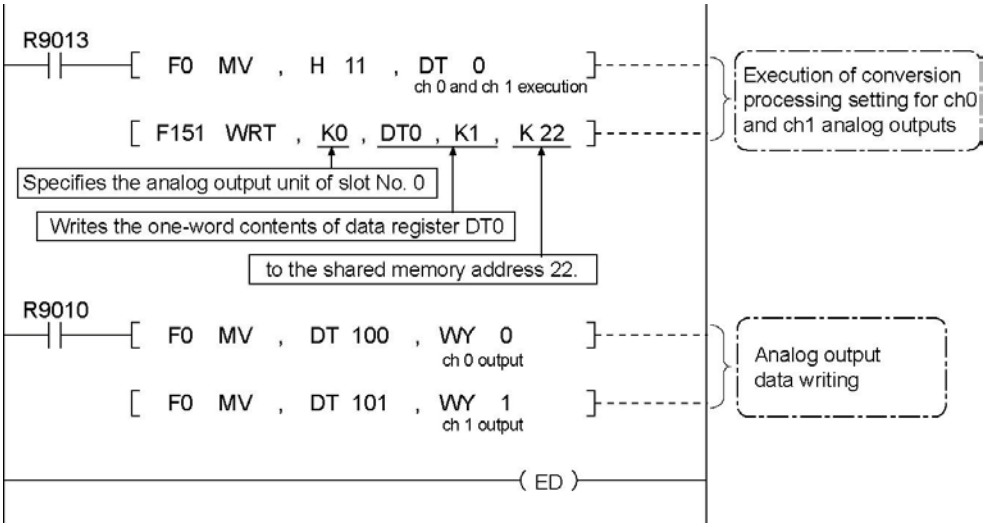
Item	Setting value for example program	Descriptions
Execution channel of analog input conversion processing	Ch0 to ch1: Set to execution (ch2 to ch3: Set to no execution)	Specify H11 for shared memory address 22.
I/O allocation	WY0	Digital output data for ch0
	WY1	Digital output data for ch1
Data register allocation	DT100	Output data write area for ch0
	DT101	Output data write area for ch1
	Address 22	Execution/no execution of conversion processing setting for ch0 to ch3.

Note:

- Written digital values and output values differ depending on the used ranges.
- The number of input contacts and specified slot numbers differ depending on the installation positions of the units.

Reference: <Chapter 6 Analog I/O Conversion Characteristics>
<4.2 I/O Allocation and Slot Numbers>

Sample program:



Chapter 10

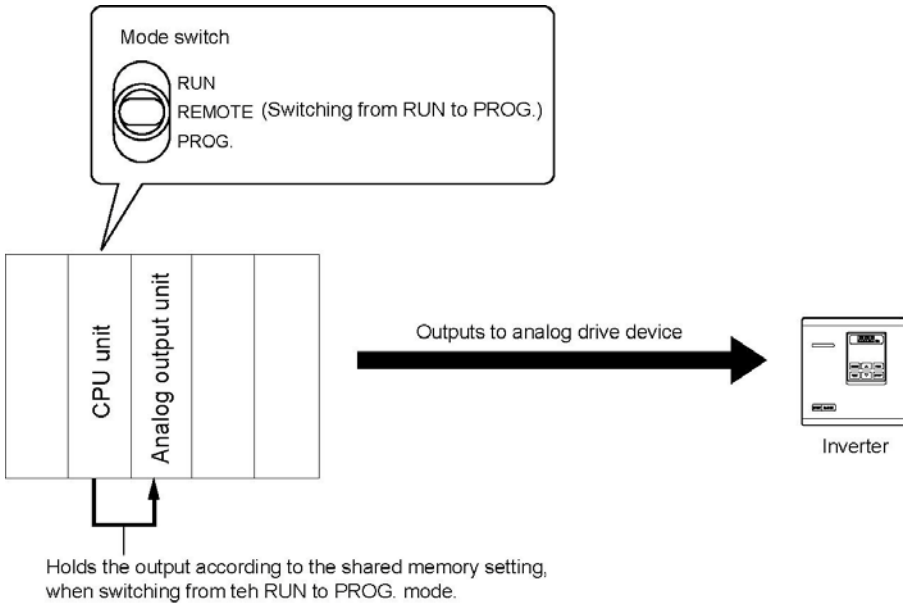
Optional Settings for Analog Output

10.1 Analog Output Hold Setting

Analog output hold function

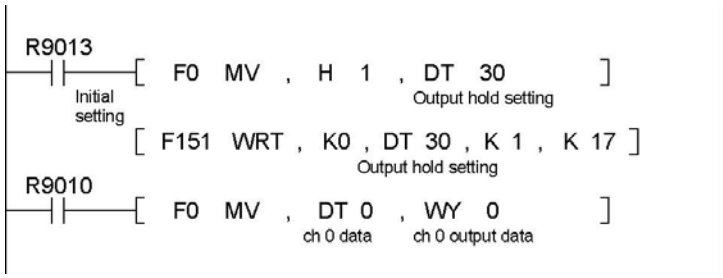
- When switching from the RUN mode to the PROG. mode, this program holds the analog output.
- Specify the output hold setting in the shared memory area for each channel.
- Any value can be set for the output data.

Note) The converted digital values differ depending on the used ranges.
The specified area number differs depending on the installation position.



Program outline

When setting the shared memory address 17 to “H1”, and holding the output at the final value in the RUN mode.



Note:

When the analog output hold setting is not performed, the output in the PROG. mode will be the output (0 V or 0 mA) equivalent to the digital value K0.

10.2 Sample Program

10.2.1 Final Value of Run Mode

Program outline

When switching from the RUN mode to the PROG. mode, this program holds the analog output at **the final value of the RUN mode** according to the shared memory setting. Then the program writes the data stored in data register DT0 to the output relay area WY0 of output channel ch0.

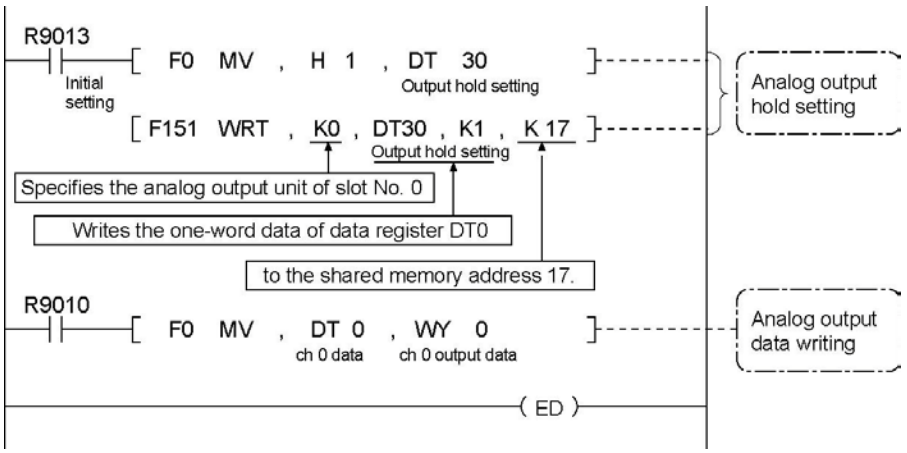
Final value of RUN mode:

During the RUN mode, the analog output value corresponding to the last digital data written.

Settings

Item	Setting value for example program	Descriptions
I/O allocation	WY0	Digital output data
Data register allocation	DT0	Output data write area for ch0
	DT30	Area specified in output hold setting
Shared memory	Address 17	Analog output hold setting H0: Non-hold H1: Hold (holds analog output at final value of RUN mode)

Sample program



Key Point:

If “H1” is set for the shared memory address 17, the program holds the analog output value when switching the RUN mode to PROG. mode.

When the analog output hold setting is not performed, a value equivalent to the digital value K0 (0 V or 0 mA) is output.

Note:

- The written digital values and output values differ depending on the used ranges.
- The number of input contacts and specified slot numbers differ depending on the installation positions of the units.

Reference: <Chapter 6 Analog I/O Conversion Characteristics>
<4.2 I/O Allocation and Slot Numbers>

10.2.2 Output Hold (Any Value) Setting (Analog Output Unit)

Program outline

When switching from the RUN mode to the PROG. mode, this program holds the analog output at any desired value according to the shared memory settings. Then the program writes the data stored in data registers DT100 to DT102 to the output relay areas WY0 to WY2 of output channels ch0 to ch2.

Settings

Item	Setting value for example program	Descriptions
I/O allocation	WY0	Digital output data for ch0
	WY1	Digital output data for ch1
	WY2	Digital output data for ch2
Data register allocation	DT100	Output data write area for ch0
	DT101	Output data write area for ch1
	DT102	Output data write area for ch2
Shared memory	Address 17	Analog output hold setting H0: Non-hold H1: Hold (holds analog output at any desired value)
	Address 18 to 20	Analog output hold data (any value) setting Sets output hold digital value in constant number for ch0 to ch2

 **Key Point:**

If “H1” is set for the shared memory address 17, the program holds the analog output value when switching the RUN mode to PROG. mode.

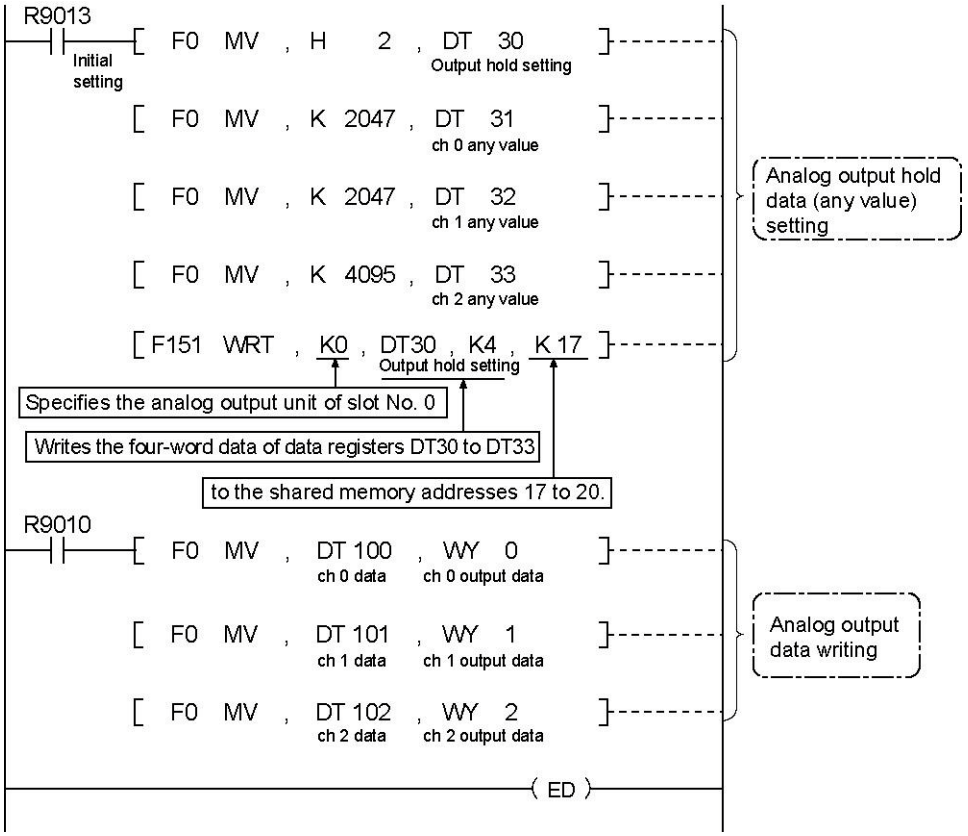
When the analog output hold setting is not performed, a value equivalent to the digital value K0 (0 V or 0 mA) is output.

 **Note:**

- The written digital values and output values differ depending on the used ranges.
- The number of input contacts and specified slot numbers differ depending on the installation positions of the units.

 **Reference:** <Chapter 6 Analog I/O Conversion Characteristics>
<4.2 I/O Allocation and Slot Numbers>

Sample program



Chapter 11

Troubleshooting

11.1 Troubleshooting (Analog Input)

11.1.1 Analog Input Value Cannot be Read

- Check the I/O allocation for the analog units.
- Check that the shared memory addresses 16 and 17 are not set to H0000.
- Check the terminal block wiring.
- Check the range settings.

11.1.2 Analog Input Conversion Value is Unsteady

- Make sure that you are using shielded twisted-pair wiring and that the shielding the properly connected.
- Make sure that the analog signal wires are not connected to AC wires or power wires.
- Check that there is no devices which create radiated noise, such as power lines, power cables, high-capacity relays or inverters near the analog unit.

11.1.3 Proper Current Input Conversion Value Cannot be Obtained

- Check the terminal block wiring.
- Check output devices.

11.1.4 Proper conversion Value Cannot be Obtained During Thermocouple Connection

- Check the type of the thermocouple and the range setting of the analog unit.
- Check the polarity of the thermocouple.
- Make sure that no wind directly hit the analog input unit.
- Check that the wiring between the thermocouple and the analog input unit is not relayed with wirings other than thermocouples or thermocouple compensating lead wire.

11.1.5 Proper conversion Value Cannot be Obtained During R.T.D. Connection

- Check the wiring and cycle the power supply.

11.2 Troubleshooting (Analog Output)

11.2.1 Analog Output Value is Unsteady

- Make sure that the shielding on the input device is grounded.
- Depending on the conditions of the external noise, it may be better to leave the shielding open.
- Check the program.

11.2.2 Analog Output Value Does Not Change

- Make sure that the FP2 CPU unit is in RUN mode.
- Check the I/O allocation for the analog units.
- Check the terminal block wiring.
- For current output, make sure that the impedance of the output load device is 350Ω or less.
- Make sure that the output does not short-circuit.
- Make sure that the input digital value is in a range of 0 to 4095 for current output, and –2048 to +2047 for voltage output.
- Check the set of the range setting switch (dip switch).

Chapter 12

Specifications

12.1 Table of Specifications

General specifications (Common)

<table>
<tr><th>Item</th><th colspan="3">Description</th></tr>
<tr><td rowspan="5">Ambient temperature</td><td colspan="3">0 to 55 °C
Use the FP2 analog output unit (FP2-DA4) within the ranges given below.</td></tr>
<tr><td>Output range</td><td colspan="2">Ambient operating temperature</td></tr>
<tr><td rowspan="3">Current output range
(0 to 20 mA)</td><td>When using 4 channels</td><td>0 to 45 °C</td></tr>
<tr><td>When using 3 channels</td><td>0 to 50 °C</td></tr>
<tr><td>When using 1 or 2 channels</td><td>0 to 55 °C</td></tr>
<tr><td>Voltage output range
(-10 to +10 V)</td><td>When using 1 to 4 channels</td><td>0 to 55 °C</td></tr>
<tr><td>Storage temperature</td><td colspan="3">-20 to 70 °C</td></tr>
<tr><td>Ambient humidity</td><td colspan="3">30 to 85% RH (at 25 °C non-condensing)</td></tr>
<tr><td>Storage humidity</td><td colspan="3">30 to 85% RH (at 25 °C non-condensing)</td></tr>
<tr><td rowspan="4">Breakdown voltage</td><td colspan="3">500 V AC, 1 minute between all analog input terminals and earth
500 V AC, 1 minute between all analog output terminals and earth</td></tr>
<tr><td colspan="3">1500 V AC, 1 minute between all analog input terminals and AC external terminal (excluding earth terminal)
1500 V AC, 1 minute between all analog output terminals and AC external terminal (excluding earth terminal)</td></tr>
<tr><td colspan="3">200 V AC, 1minute between analog input terminal channels (for FP2-AD8X only)
-Isolated between insulation voltage range and thermocouple range only.
-When using R.T.D. range, not isolated between all other ranges.</td></tr>
<tr><td colspan="3">Cutoff current: 10 mA, excluding protective varistor and capacitor</td></tr>
<tr><td rowspan="2">Insulation resistance</td><td colspan="3">100 MΩ or more between all analog input terminals and earth
100 MΩ or more between all analog output terminals and earth
(measured with a 500 V DC megger testing)</td></tr>
<tr><td colspan="3">100 MΩ or more between all analog input terminals and AC external terminal (excluding earth terminal)
100 MΩ or more between all analog output terminals and AC external terminal (excluding earth terminal)
(measured with a 500 V DC megger testing)</td></tr>
<tr><td>Vibration resistance</td><td colspan="3">10 to 55 Hz, 1 cycle/min, double amplitude of 0.75 mm, 10 min on X, Y and Z directions</td></tr>
<tr><td>Shock resistance</td><td colspan="3">98 m/s^2 or more, 4 times on X, Y and Z directions</td></tr>
<tr><td>Noise immunity</td><td colspan="3">1500 Vp-p with pulse widths 50 ns and 1 µs (with noise simulator)
(Applied to the power unit)</td></tr>
<tr><td>Operating conditions</td><td colspan="3">Free from corrosive gases and excessive dust</td></tr>
<tr><td>Weight</td><td colspan="3">Approx. 160 g (FP2-AD8VI, AD8X, RTD), approx. 160 g (FP2-DA4)</td></tr>
</table>

Analog input specifications (FP2-AD8VI AFP2400L)

Item	Description		
No. of input points	8 channels/unit		
Input range (resolution)	Voltage	-10 to +10 V (1/65536)	
		1 to 5 V (1/13107)	
	Current	-20 to +20 mA (1/32768)	
		4 to 20 mA (1/13107)	
Conversion speed	Voltage input	500 µs/channel (base time 400 µs) Note2)	
	Current input		
Overall accuracy	±1.0% F.S. or less (at 0 to 55 °C) Note1)		
Input impedance	Voltage input	1 MΩ or more	
	Current input	250 Ω	
Absolute maximum input	-10 to +10 V range	-15 to +15 V	
	1 to 5V range		
	-20 to +20 mA range	-30 to +30 mA	
	4 to 20 mA range		
Insulation method	Between analog input terminal and FP2 internal circuits: Optical coupler insulation, DC/DC converter insulation		
	Between analog input channels: Not insulated		
Digital output processing	Averaging	Can be set in a range of 3 to 64 times/each channel (moving average excluding max. and min. values)	
	Offset setting	Can be set in a range of K-2048 to +2047/each channel	
Input range change method	All channels: By range setting switch		
	Each channel: By shared memory setting		
Conversion execution processing channels setting	Each channel: By shared memory setting		
Input conversion data setup time	**(After FP2 system power has been turned on)**		
	Input range	**FP2-AD8VI**	
	Voltage input range (all channels together)	Approx. 430 ms	
	Current input range (all channels together)	Approx. 430 ms	

Note1) The full scale (F.S.) for each of analog input voltage 1 to 5 V and current 4 to 20 mA is ±10 V and ±20 mA respectively.

Note2) This is the preprocessing time which is necessary for carrying out the A/D conversion. The time is fixed at 400 µs regardless of the number of channels.

 **Reference:** <12.2 Table of Shared Memory Area>

Analog input specifications (FP2-AD8X AFP2401)

Item	Description		
No. of input points	8 channels/unit Note5)		
Input range (resolution)	Voltage	-10 to +10 V (1/65536)	
		1 to 5 V (1/13107)	
		-100 to +100 mV (1/65536)	
	Thermocouple	S: 0 to +1500 °C (0.1 °C)	
		J: -200 to +750 °C (0.1 °C)	
		J: -100 to +400 °C (0.1 °C) Note1)	
		K: -200 to +1200 °C (0.1 °C) Note1)	
		K: -200 to +1000 °C (0.1 °C)	
		K: -100 to +600 °C (0.1 °C) Note1)	
		T: -200 to +350 °C (0.1 °C)	
		R: 0 to +1500 °C (0.1 °C)	
		N: -200 to +1300 °C (0.1 °C) Note1)	
	R.T.D.	Pt100: -200 to +650 °C (0.1 °C)	
		Pt100: -100 to +200 °C (0.1 °C) Note1)	
		JPt100: -200 to +650 °C (0.1 °C) Note1)	
		JPt100: -100 to +200 °C (0.1 °C) Note1)	
		Pt1000: -100 to +100 °C (0.1 °C)	
Conversion speed	Voltage input	500 µs/channel (Not isolated), 5 ms/ch (Isolated) Note4)	
	Thermocouple input	20 ms/channel Note2) Note4) (22 ms/channel and 300ms/ channel can be selected by shared memory 39. Note6))	
	R.T.D. input	20 ms/channel Note2) Note4) (22 ms/channel and 300ms/ channel can be selected by shared memory 39. Note6))	
Overall accuracy	±0.3% F.S.or less (at 0 to 55 °C), ±0.1% F.S.or less (at25 °C) (Voltage range only)Note3) (Reference junction compensation accuracy: ±1.0°C)		
Input impedance	Voltage input		Approx. 150 kΩ or more
	Thermocouple input		1 MΩ or more
	R.T.D input		Approx. 51kΩ
Absolute maximum input	-10 to +10 V range		-12 to +12 V
	1 to 5V range		
	-100 to +100 mV range		-150 to +150 mV
Insulation method	Between analog input terminal and FP2 internal circuits: Optical coupler insulation, DC/DC converter insulation Between input channels: Optical MOS relay insulation (in channel isolation range)		
Digital output processing	Averaging	Can be set in a range of 3 to 64 times/each channel (moving average excluding max. and min. values)	
	Offset setting	Can be set in a range of K-2048 to +2047/each channel	
Broken wire detection	Only thermocouple range or R.T.D. input range/each channel		
Input range change method	All channels: By range setting switch		
	Each channel: By shared memory setting		
Conversion execution processing channels setting	Each channel: By shared memory setting		
Permission resistance of input wire	R.T.D. input		30 Ω or less (when the ohmic values for 3 wires are the same)
Input conversion data setup time	**(After FP2 system power has been turned on)**		
	Input range (all channels together)		**FP2-AD8X**
	Non insulation Voltage input range		500 ms
	Insulation voltage input range		4500 ms
	Thermocouple input range		4500 ms
	R.T.D. input range		4500 ms

Note1) Can be specified by the shared memory setting only.

Note2) When using the thermocouple or R.T.D. range, sampling is performed 10 times within the conversion time for 20 ms to average 8 sampling data by excluding the maximum value and minimum value.

Note3) The full scale (F.S.) for analog input voltage 1 to 5 V is ±10 V.
The full scale (F.S.) for thermocouple range is –200 to +1000°C.
The total precision for the thermocouple R at 0 to 500 °C is ±0.5% F.S. or less (at 0 to 55 °C).
The full scale (F.S.) for R.T.D is –200 to +650 °C .

Note4) **Reference:** For the information on conversion cycle time, see <12.3 Analog I/O Conversion Cycle Time>.

Note5) As there is a case that the measured data is unstable, the conversion execution processing channels setting should be specified for unused channels.

Reference: <12.2.1 Shared Memory of Analog Input Unit>

Note6) If the commercial frequency noise at 50 Hz has an effect, it is recommendable to use the conversion speed of 22 ms. If it is used in the environment where any noise at 50Hz or 60hz has an effect, it is recommendable to use the conversion speed of 300 ms.

Analog input specifications (FP2-RTD AFP2402)

Item	Description		
No. of input points	8 channels/unit Note5)		
Input range (resolution)	R.T.D.	Pt100: -200 to +650 °C (0.1 °C)	
		Pt100: -100 to +200 °C (0.1 °C) Note1)	
		JPt100: -200 to +650 °C (0.1 °C) Note1)	
		JPt100: -100 to +200 °C (0.1 °C) Note1)	
		Pt1000: -100 to +100 °C (0.1 °C)	
Conversion speed	R.T.D. input	20 ms/channel Note2) Note4) (22 ms/channel and 300ms/channel can be selected by shared memory 39. Note6)	
Overall accuracy	±0.3% F.S. or less (at 0 to 55 °C) Note3)		
Insulation method	Between analog input terminal and FP2 internal circuits: Optical coupler insulation, DC/DC converter insulation		
Digital output processing	Averaging	Can be set in a range of 3 to 64 times/each channel (moving average excluding max. and min. values)	
	Offset setting	Can be set in a range of K-2048 to +2047/each channel	
Broken wire detection	Each channel		
Input range change method	All channels: By range setting switch		
	Each channel: By shared memory setting		
Conversion execution processing channels setting	Each channel: By shared memory setting		
Permission resistance of input wire	R.T.D. input	30 Ω or less (when the ohmic values for 3 wires are the same)	
Input conversion data setup time	**(After FP2 system power has been turned on)**		
	Input range		**FP2-RTD**
	R.T.D. input range		4500 ms

Note1) Can be specified by the shared memory setting only.

Note2) When using the thermocouple or R.T.D. range, sampling is performed 10 times within the conversion time for 20 ms to average 8 sampling data by excluding the maximum value and minimum value.

Note3) The full scale (F.S.) for analog input is –200 to +650°C.

Note4) **Reference:** For the information on conversion cycle time, see <12.3 Analog I/O Conversion Cycle Time>.

Note5) As there is a case that the measured data is unstable, the conversion execution processing channels setting should be specified for unused channels.

Reference: <12.2.1 Shared Memory of Analog Input Unit>

Note6) If the commercial frequency noise at 50 Hz has an effect, it is recommendable to use the conversion speed of 22 ms. If it is used in the environment where any noise at 50Hz or 60hz has an effect, it is recommendable to use the conversion speed of 300 ms.

Analog output specifications (FP2-DA4 AFP2410)

Item	Description	
No. of output points	4 channels Note1)	
Output range (digital input)	Voltage	-10 to +10 V (K-2048 to K2047)
	Current	0 to 20 mA (K0 to K4095)
Resolution	1/4096	
Conversion speed	500 µs/channel Note2)	
Overall accuracy	Within ±1.0% F.S. or less (at0 to 55 °C)	
Output impedance	Voltage output	0.5 Ω or less
Maximum output current	Voltage output	5 mA
Allowable output load resistance	Current output	300 Ω or less
Insulation method	Between analog output terminal and FP2 internal circuits: Optical coupler insulation, DC/DC converter insulation	
	Between analog output channels: Not isolated	
Analog output hold	Hold/non hold setting by shared memory setting	

Note1) For the FP2 analog output unit (FP2-DA4), there are restrictions regarding the ambient temperature that depend on how many channels are used. Use according to the restrictions listed in “Ambient temperature” of “section 12.1 General Specifications”.

Note2) For information on the conversion cycle time when using multiple channels

 **Reference**: <12.4 Analog I/O Conversion Cycle Time>

12.1.1 Table of Input/Output Contact Allocation

Analog input unit

Channel		FP2 I/O number
Analog input	**ch0**	WX(n): X(n)0 to X(n)F
	ch1	WX(n+1): X(n+1)0 to X(n+1)F
	ch2	WX(n+2): X(n+2)0 to X(n+2)F
	ch3	WX(n+3): X(n+3)0 to X(n+3)F
	ch4	WX(n+4): X(n+4)0 to X(n+4)F
	ch5	WX(n+5): X(n+5)0 to X(n+5)F
	ch6	WX(n+6): X(n+6)0 to X(n+6)F
	ch7	WX(n+7): X(n+7)0 to X(n+7)F

Analog output unit

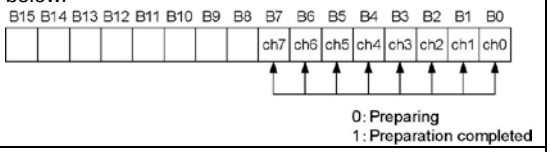
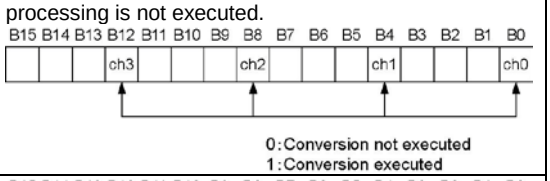
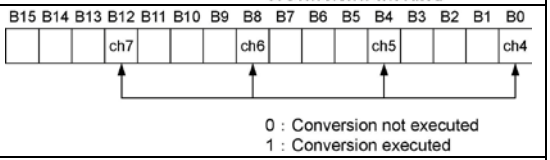
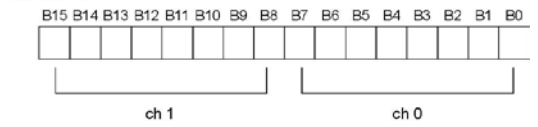
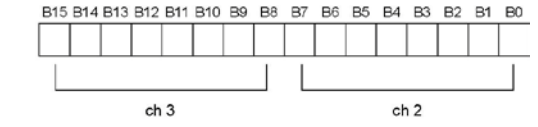
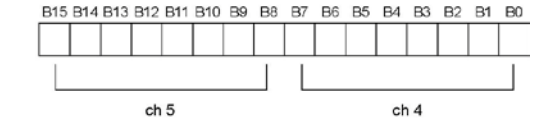
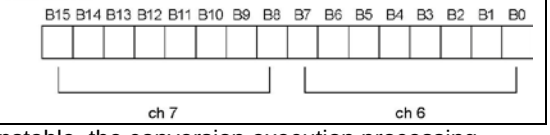
Channel		FP2 I/O number
Analog output	**ch0**	WY(n): Y(n)0 to Y(n)F
	ch1	WY(n+1): Y(n+1)0 to Y(n+1)F
	ch2	WY(n+2): Y(n+2)0 to Y(n+2)F
	ch3	WY(n+3): Y(n+3)0 to Y(n+3)F

 **Note:**

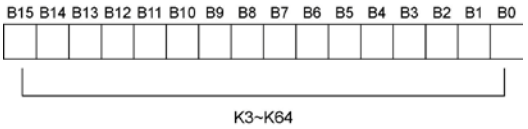
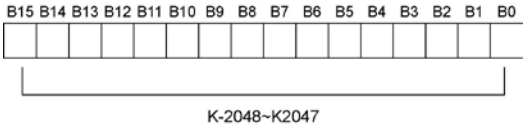
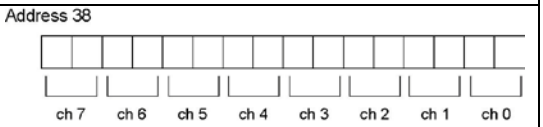
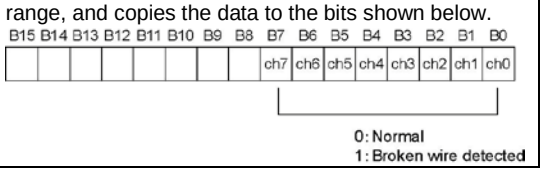
- The I/O number shown by an “n” in the table above is determined according to the installed slot position and the I/O allocation for other units.
- Both input and output are handled by increments of 16 bits per channel.
- Even if the number of used channels is specified low in the setting of the shared memory, the number of I/O allocation does not change.

12.2 Table of Shared Memory Area

12.2.1 Shared Memory of Analog Input Unit

Address	Name	Initial value	Descriptions
10	**Preparation completion flag for analog input ch0 to ch7**	H0000	After the power is turned on and the first conversion is completed, the input channel where the conversion data preparation is completed affects the bits shown below. 
16	**No execution of conversion processing setting for analog input ch0 to ch3** Note1)	H1111	Specifies the input channel where conversion processing is not executed. 
17	**No execution of conversion processing setting for analog input ch4 to ch7** Note1)	H1111	
18	**Range setting for analog input ch0 and 1**	HFFFF	When setting the input range independently for each input channel, after setting the range setting switch to “Enable setting by software”, the codes for the range settings shown below are set. Address 18 
19	**Range setting for analog input ch2 and 3**	HFFFF	Address 19 
20	**Range setting for analog input ch4 and 5**	HFFFF	Address 20 
21	**Range setting for analog input ch6 and 7**	HFFFF	Address 21 

Note1) As there is a case that the measured data is unstable, the conversion execution processing channels setting should be specified for unused channels.

Address	Name	Initial value	Descriptions
22	**Average times setting for analog input ch0**	K1	Sets the number of times for average processing for each channel that executes average processing. (range: 3 to 64 times)  K3 to K64 is set: Average processing is performed for specified times. K0 to K2 is set: No average processing; general sampling processing. Note) When specified average times are changed during the processing, the data which has been stored by then will be deleted, and the program will start storing data from the start.
23	**Average times setting for analog input ch1**	K1	
24	**Average times setting for analog input ch2**	K1	
25	**Average times setting for analog input ch3**	K1	
26	**Average times setting for analog input ch4**	K1	
27	**Average times setting for analog input ch5**	K1	
28	**Average times setting for analog input ch6**	K1	
29	**Average times setting for analog input ch7**	K1	
30	**Offset changing setting for analog input ch0**	K0	Sets the offset data for each channel that executes offset changing. (range: -2048 to +2047) 
31	**Offset changing setting for analog input ch1**	K0	
32	**Offset changing setting for analog input ch2**	K0	
33	**Offset changing setting for analog input ch3**	K0	
34	**Offset changing setting for analog input ch4**	K0	
35	**Offset changing setting for analog input ch5**	K0	
36	**Offset changing setting for analog input ch6**	K0	
37	**Offset changing setting for analog input ch7**	K0	
38	**Data update flag (Only for FP2-AD8X, FP2-RTD)**	H0000	 After writing the converted data in the shared memory, adds 1. 00→01→10→11→00→
39	**Conversion speed switch (Thermocouple, R.T.D.) (Only for FP2-AD8X, FP2-RTD)**	K0	K0: 20 ms K1: 22 ms (Select it when the 50Hz frequency noise has an effect.) K4:300ms(Select it when being effected by a noise.)(supported from Ver.1.2)
42	**Broken wire detection flag for temperature sensor input**	H0000	Detects broken wires in the input wiring only for each input channel that is set for the thermocouple input range or R.T.D. (resistance thermometer device) input range, and copies the data to the bits shown below. 

Note:

- Do not perform reading and writing with shared memory addresses other than those listed above.
- The shared memory addresses are all preset when the power is turned from off to on (they return to the initial values).

Address	Conditions
10	When the PROG. mode changes to the RUN mode, all preparation completion flags for all channels turn on as the setting has been done to execute conversion for all channels. Once the no execution setting has been specified for each channel, the applied bits in address 10 are in preparation. If setting the range setting switch to “Enable setting by software”, the analog input preparation completion flag for the address 10 does not turn on as the conversion will not be performed until completing the range setting.
10, 38, 42	Writing by user program is not available. Reading is always available.
16, 17, 22 to 37,39	After changing the mode from the PROG to the RUN mode, writing by program is available any number of times.
18 to 21	Writing by user program is available only once after the RUN mode. Reading is always available.

Table of input range setting code

FP2-AD8VI (AFP2400L) **A: Available N/A: Not available**

Input	Type	Measurement range	Isolator	DIPSW setting	Input range setting code
Voltage	±10 V	-10 to +10 V	Not isolated between channels	A	H01
	1 to 5 V	1 to 5 V	Not isolated between channels	A	H07
Current	±20 mA	-20 to 20 mA	Not isolated between channels	A	H01
	4 to 20 mA	4 to 20 mA	Not isolated between channels	A	H07

FP2-AD8X (AFP2401) **A: Available N/A: Not available**

Input	Type	Measurement range	Isolator	DIPSW setting	Input range setting code
Voltage	±10 V	-10 to +10 V	Not isolated between channels	A	H01
			Isolated between channels	N/A	H02
	1 to 5 V	1 to 5 V	Not isolated between channels	A	H07
			Isolated between channels	N/A	H08
	±100 mV	-100 to +100 mV	Not isolated between channels	A	H04
			Isolated between channels	N/A	H05
Thermo-couple	S	0 to +1500 °C	Isolated between channels	A	H10
	J	-200 to +750 °C	Isolated between channels	A	H0D
	J	-100 to 400 °C	Isolated between channels	N/A	H1D
	K	-200 to +1000 °C	Isolated between channels	A	H0E
	K	-200 to 1200 °C	Isolated between channels	N/A	H1E
	K	-100 to 600 °C	Isolated between channels	N/A	H2E
	T	-200 to +350 °C	Isolated between channels	A	H11
	R	0 to +1500 °C	Isolated between channels	A	H0F
	N	-200 to 1300 °C	Isolated between channels	N/A	H0A
R. T. D.	Pt100	-200 to +650 °C	Not isolated between channels	A	H12
	Pt100	-100 to +200 °C	Not isolated between channels	N/A	H22
	JPt100	-200 to +650 °C	Not isolated between channels	N/A	H32
	JPt100	-100 to +200 °C	Not isolated between channels	N/A	H42
	Pt1000	-100 to +100 °C	Not isolated between channels	A	H13

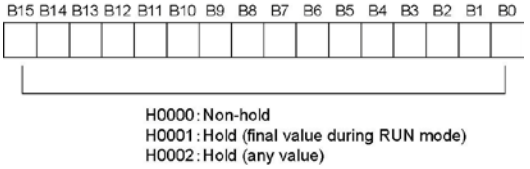
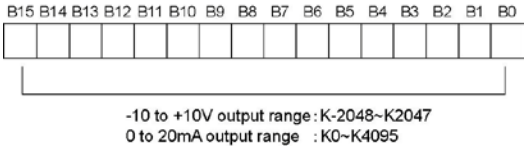
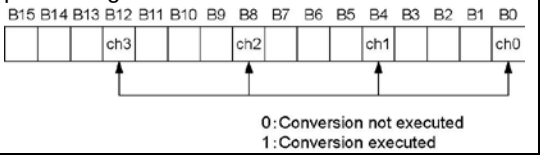
Note) For FP2-AD8X, it is possible to switch between “Isolated between channels” and “Not isolated between channels” depending on the ranges. (Photo MOS relay insulation)

FP2-RTD (AFP2402) **A: Available N/A: Not available**

Input	Type	Measurement range	Isolator	DIPSW setting	Input range setting code
R. T. D.	Pt100	-200 to +650 °C	Not isolated between channels	A	H12
	Pt100	-100 to +200 °C	Not isolated between channels	N/A	H22
	JPt100	-200 to +650 °C	Not isolated between channels	N/A	H32
	JPt100	-100 to +200 °C	Not isolated between channels	N/A	H42
	Pt1000	-100 to +100 °C	Not isolated between channels	A	H13

Note:
If specifying values other than the above setting codes, the conversion does not performed properly. Do not set to those values.

Shared Memory of Analog Output Unit

Address	Name	Initial value	Descriptions
17	**Output hold setting for analog output ch0 to ch3**	H0000 (non-hold)	Sets either the non-hold, hold (final value during RUN mode), or hold (any value) for the analog output during the FP2 CPU unit PROG. mode.  If a value different from those above is set, then non-hold is set.
18	**Output hold (any value) data setting for analog output ch0**	K0000	When an desired output is set for the hold setting of the address 17, the analog output value is held corresponding to the data set at this address.  If a value different from those above is set, then the set value becomes disabled, and the final output value before moving to the PROG. mode is held.
19	**Output hold (any value) data setting for analog output ch1**	K0000	
20	**Output hold (any value) data setting for analog output ch2**	K0000	
21	**Output hold (any value) data setting for analog output ch3**	K0000	
22	**No execution of conversion processing setting for analog output ch0 to ch3**	H1111	Specifies the output channel where conversion processing is not executed. 

Note:

- Do not perform reading and writing with shared memory addresses other than those listed above.
- The shared memory addresses are all preset when the power is turned from off to on (they return to the initial values).

Address	Conditions
17 to 22	After changing the mode from the PROG to the RUN mode, writing by program is available any number of times.

12.3 Analog I/O Conversion Cycle Time

When setting the range for each analog I/O channel, the analog I/O conversion cycle time can be calculated by the formula below.

- **Analog input conversion cycle time (FP2-AD8VI)**

Conversion cycle time
=conversion speed (0.5 ms) x number of input channels used + base time (0.4 ms)
(number of input channels set for execution of conversion processing)

- **Analog input conversion cycle time (FP2-AD8X,FP2-RTD)**

Conversion cycle time
=conversion speed x number of input channels used
(number of input channels set for execution of conversion processing)

Note1) The total time of all channels set for execution of conversion processing.
Note2) When the thermocouple range and the R.T.D. range are mixed, the conversion cycle time for the voltage range will get longer.

- **Analog output conversion cycle time (FP2-DA4)**

Conversion cycle time
=conversion speed (0.5 ms) x number of output channels used
(number of output channels set for execution of conversion processing)

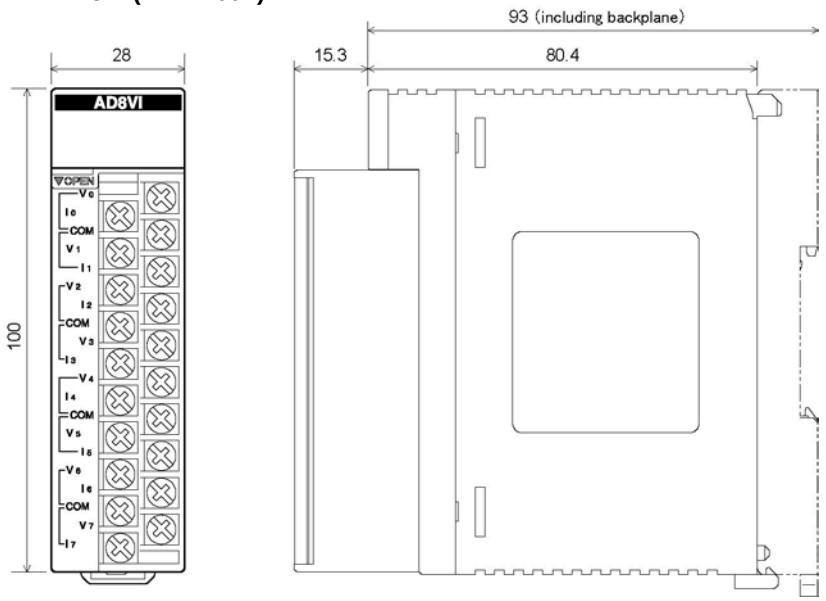
Chapter 13

Dimensions, Sample Programs and others

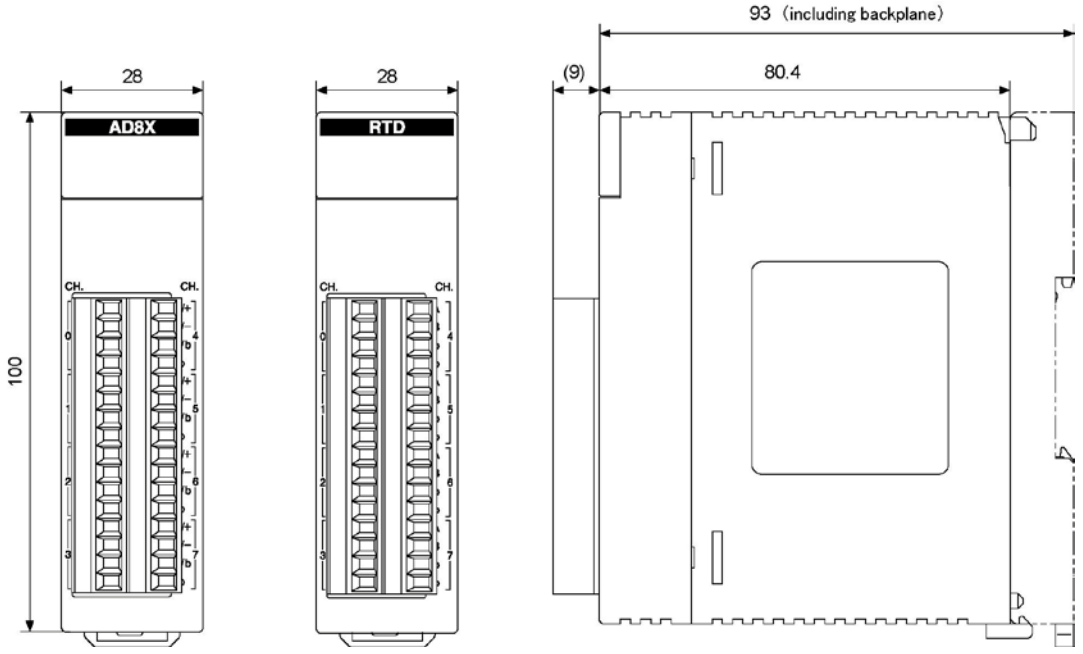
13.1 Dimensions

13.1.1 Analog Input Unit

FP2-AD8VI (AFP2400L)

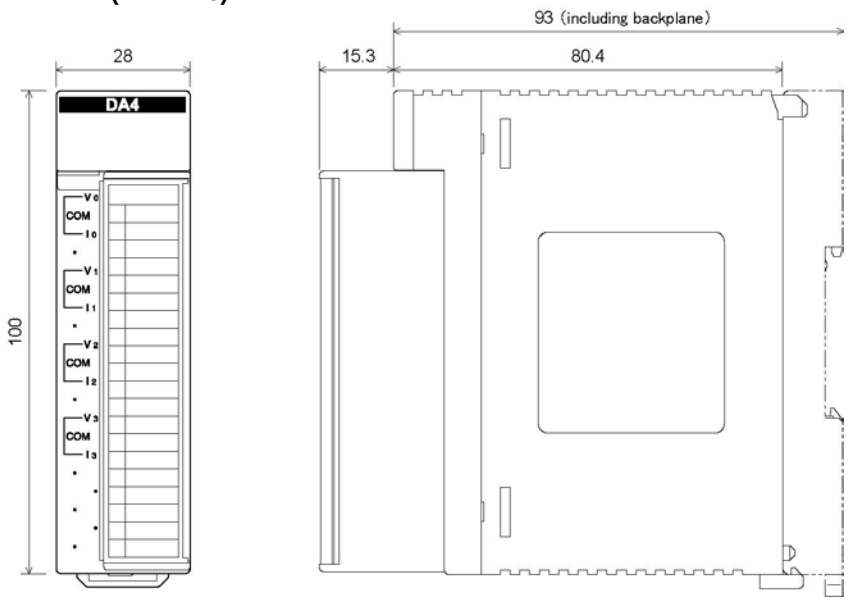


FP2-AD8X (AFP2401), FP2-RTD (AFP2402)



13.1.2 Analog Output Unit

FP2-DA4 (AFP2410)

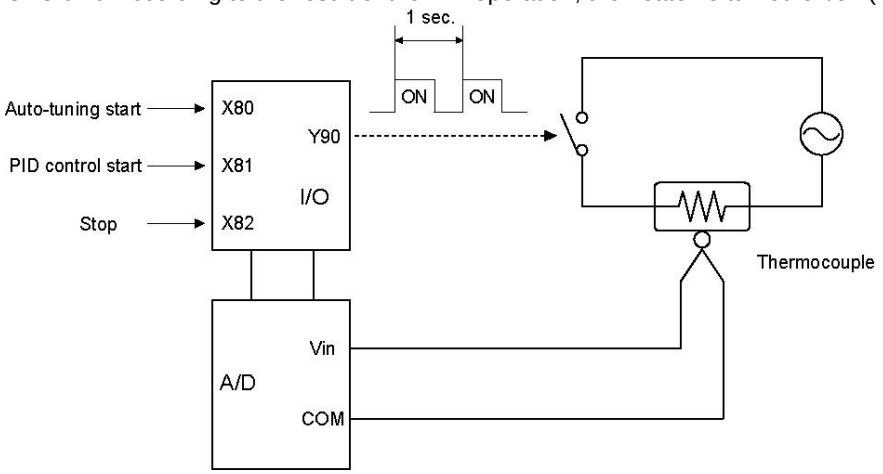


13.2 Sample Programs

13.2.1 Temperature Control by PID Operation

Program outline

Reads the temperature data to be obtained in the analog unit, and executes the IPD operation in the CPU unit. According to the result of the PID operation, the heater is turned on/off (PWM output).



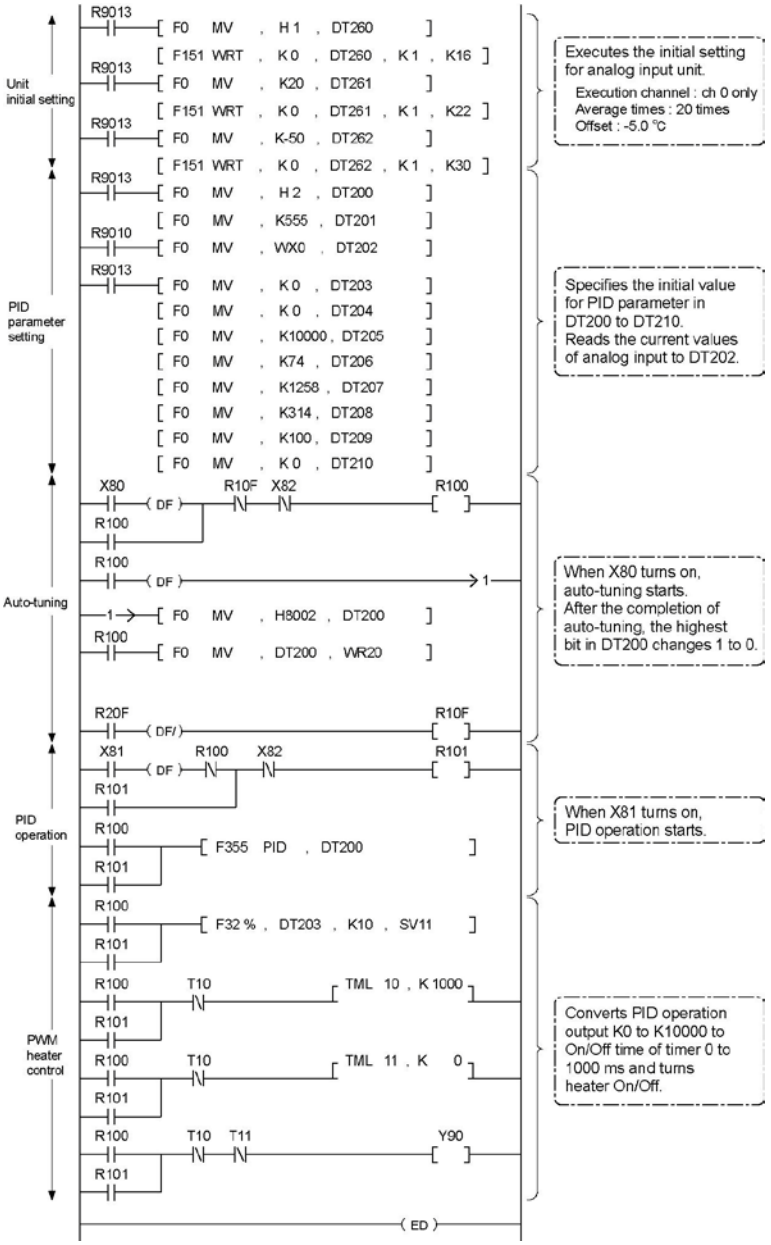
I/O allocation

I/O number	Descriptions
X80	Auto-tuning start
X81	PID control start
X82	Control stop
Y90	Heater on/off

Data register allocation

Setting type	Data register No.	Allocation	Example program setting
Setting area work area for PID operation	DT200	Control mode	Select PID control, auto-tuning operation. Specify auto-tuning. Select I-PD mode, reverse action.
	DT201	Target value	Specify temperature.
	DT202	Measured value	Read analog input value WX0.
	DT203	PID output	Stores the operation result in K0 to K10000. <0.00% to 100.00%>
	DT204	Lower value	Specify 0.00%.
	DT205	Upper value	Specify 100.00%.
	DT206	Proportional gain	Rewrites setting values after automatic tuning when specifying auto-tuning.
	DT207	Integral time	
	DT208	Derivative time	
	DT209	Operation interval	
	DT210	Progress of tuning	
	DT211 to DT229	Used as work area by the system during PID operation	
Analog unit settings	DT260	Execution channel setting	ch0: Specify H1
	DT261	Average times setting	20 times: Specify 20
	DT262	Offset	-5.0: Specify –K50

Sample program



Note:

The ranges for the digital values to be read and the digital values specified for output differ depending on the used ranges.

The number of I/O contacts and specified slots differ depending on the installation position of units.

Reference:

<Chapter 6 Analog I/O Conversion Characteristics>

<4.2 I/O Allocation and Slot Numbers>

For the details and precaution for PID operation instruction F355, see <FP Series Programming Manual>.

Record of changes

Manual No.	Date	Description of changes
ARCT1F397E	AUG.2004	First edition
ARCT1F397E-1	JAN.2005	2nd edition
ARCT1F397E-2	JUN.2005	3rd edition
ARCT1F397E-3	JUN.2006	4th edition
ARCT1F397E-4	NOV.2008	5th edition - Change of Corporate name
ARCT1F397E-5	JUN.2011	6th edition - Change of Corporate name - Error correction
ARCT1F397E-6	JUL.2013	7th edition - Change of Corporate name

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