PROGRAMMABLE CONTROLLERS

FP7 Thermocouple and RTD Input Units

User's Manual

Before beginning

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If physical defects caused by distribution are found, PEWEU will replace/repair the product free of charge. Exceptions include:

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* When physical defects are due to defective equipment other than the distributed product.
* When physical defects are due to modifications/repairs by someone other than PEWEU.
* When physical defects are due to natural disasters.

Warnings used in this manual

One or more of the following warnings may be used in this documentation:

DANGER	
⚠	Indicates a hazardous situation which, if not avoided, will result in death or serious injury.

WARNING	
⚠	Indicates a hazardous situation which, if not avoided, could result in serious or moderate injury.

CAUTION	
⚠	Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

NOTICE
Indicates a property damage message.

Scope of this manual

This manual covers:

- Unit functions
- Restrictions on unit combinations
- Installation, wiring, and operating instructions
- I/O allocation
- Configuration settings
- Time charts
- Conversion characteristics
- Optional settings for averaging, offset and gain adjustment, limit alarm, scale conversion, etc.
- Troubleshooting information
- An appendix with:

    – Hardware specifications
    – Unit memory addresses
    – Unit dimensions

Please refer to the FP Series Programming Manual or to the online help of Control FPWIN Pro for information on:

- System instructions
- Special internal flags
- Data registers
- System variables
- Memory area tables
- Programming examples

For documentation on other units used with the FP7, please refer to the hardware manual for that unit.

All manuals can be downloaded from the Panasonic Web site (http://www.panasonic-electric-works.com).

Safety measures

Operating environment

After installing the unit, make sure to use it within the range of the general specifications:

- Ambient temperature: 0°C to +55°C
- Ambient humidity: 10%–95% RH (at 25°C, non-condensing)
- Pollution degree: 2
- Do not use the unit in the following environments:

  - Direct sunlight
  - Sudden temperature changes causing condensation
  - Inflammable or corrosive gases
  - Excessive airborne dust, metal particles or salts
  - Benzine, paint thinner, alcohol or other organic solvents, or strong alkaline solutions such as ammonia or caustic soda
  - Vibration, shock, or direct drop of water
  - Influence from power transmission lines, high voltage equipment, power cables, power equipment, radio transmitters, or any other equipment that would generate high switching surges. Maintain at least 100mm of space between these devices and the unit.

Static electricity

Before touching the unit or equipment, always touch some grounded metal to discharge any static electricity you may have generated (especially in dry locations). The discharge of static electricity can damage parts and equipment.

Protection of power supply

- Use a twisted power supply wire.
- Insulate the wiring systems to the CPU, input/output devices, and mechanical power apparatus.
- An insulated power supply with an internal protective circuit should be used (FP power supply). The power supply for the CPU is a non-insulated circuit, so if an incorrect voltage is directly applied, the internal circuit may be damaged or destroyed.

- If using a power supply device without an internal protective circuit, always make sure power is supplied to the unit through a protective element such as a fuse.
- Be sure to supply power to a CPU and an expansion unit from the same power supply, and turn the power on and off simultaneously for both.

Power supply sequence

Make sure the power supply of the CPU turns off before the power supply for input and output. If the power supply for input and output is turned off first, the CPU will detect the input fluctuations and may begin an unexpected operation.

Before turning on the power

When turning on the power for the first time, be sure to take the precautions given below.

- During installation, check that there are no scraps of wiring, particularly conductive fragments, adhering to the unit.
- Verify that the power supply wiring, I/O wiring, and power supply voltage are all correct.
- Sufficiently tighten the installation and terminal screws.
- Set the operation mode selector to PROG mode.

Request concerning program storage

To prevent the accidental loss of programs, the user should consider the following measures:

- Backing up programs: To avoid accidentally losing programs, destroying files, or overwriting the contents of a file, use the backup or export functions of Control FPWIN Pro and store the files in a safe place. Additionally, you can print out the entire project documentation.
- Specifying passwords: The password setting is designed to avoid programs being accidentally overwritten. If the password is forgotten, however, it will be impossible to overwrite the program even if you want to. Also, if a password is forcibly bypassed, the program is deleted. Therefore, please note the password in a safe location.

Table of contents

Chapter 1

Overview

1.1 Features

The analog unit obtains temperature data using a thermocouple or resistance temperature detector (RTD) and converts the data internally into digital values.

- The thermocouple and RTD units have 8 channels to receive analog input data.
- The resolution of the temperature data is 0.1°C.
- Ten types of thermocouples (K, J, T, N, R, S, B, E, PLII, WRe5-26) and three types of RTDs (Pt100, JPt100, Pt1000) are supported for each channel.
- The voltage and current inputs of the thermocouple unit can be used in combination with a thermocouple input.
- Analog values are converted into digital data with up to 16 bits in a resolution range of 1/25000–1/62500.

Optional functions

Name	Description
Average processing	With average processing, count-based, time-based, or moving averages can be obtained from the analog input values. The average values are stored in the CPU's input area as digital values.
Offset/gain processing	Offset and gain adjustment can be used to correct offset or scaling errors. The offset and gain adjustments are made to the converted data before it is written to the CPU's input area.

Name	Description
Scale conversion	Use scale conversion to set an easy-to-use data range. The digital output values are scaled to values in the specified range between preset minimum and maximum values before they are written to the CPU's input area. This function is convenient if used for unit conversion. (Scale conversion is only available for the voltage and current inputs of AFP7TC8.)
Limit alarm	This function compares the acquired data with the specified upper and lower limits and turns the corresponding flags to TRUE when these limits are exceeded.
Maximum and minimum value hold	This function stores the maximum and minimum values of the acquired data in the unit memory area for each channel.
Disconnection detection	AFP7TC8: The disconnection detection flag turns to TRUE and the ERROR LED will light if the analog input value does not reach a certain threshold. Valid for thermocouple input and 1−5V and 4−20mA ranges only. AFP7RTD8: If the line at terminal A or both lines at terminal B and terminal b are disconnected, the digital output value is 30000.

1.2 Unit types

Name	Description		Product no.
Thermocouple unit	8 channels	Thermocouple input: K1, K2, J1, J2, T, N, R, S, B, E, PLII, WRe5-26 Voltage input: -10 to +10V, 0 to +5V, +1 to +5V, -100 to +100mV Current input: 0 to +20mA, 4 to +20mA	AFP7TC8
RTD unit	8 channels	Pt100-1, Pt100-2, JPt100-1, JPt100-2, Pt1000	AFP7RTD8

1.3 Basic operation

The processing of analog input data takes place in three steps:

1. Reception of analog signals

   The analog unit receives analog signals from the thermocouple, RTD, or external devices.

2. Analog to digital conversion

   The analog input values are converted to digital output values automatically and in sequence.

3. Storage of digital values

   A user program is needed to read the digital output values from the CPU's input area (WX).
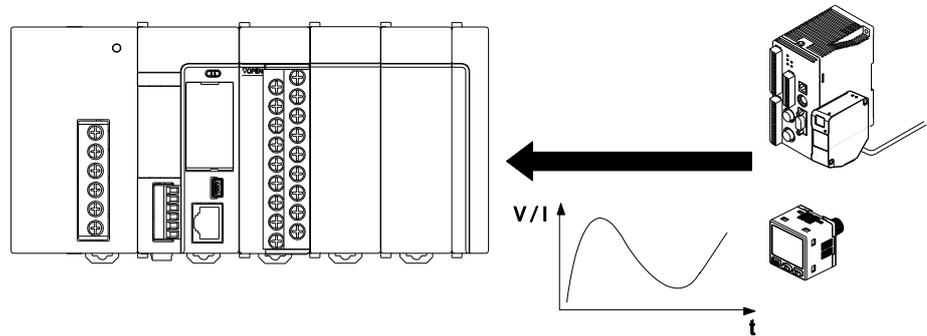
Unit configuration

The unit configuration, which is stored in the unit memory (UM), can be changed via the [Advanced] button in the "I/O map and unit configuration" dialog or by specifying the settings in a user program. The following items can be set:

- Power frequency
- Conversion time (AFP7TC8 only)
- Average processing (count-based, time-based, or moving average)
- Offset/gain processing
- Scale conversion (AFP7TC8 only)
- Limit alarm
- Maximum and minimum value hold
- Disconnection detection

1.4 Restrictions on unit combination

Current consumption

When designing the system, make sure the total current consumption of all units used together with the analog unit is within the capacity of the power supply. The unit has the following internal current consumption:

Name	Product no.	Current consumption
Thermocouple unit	AFP7TC8	≤80mA
RTD unit	AFP7RTD	≤65mA

Firmware version

The following CPU firmware versions are required for using the analog units:

Name	Version
CPU	Version 2.0 or later

1.5 Parts and functions
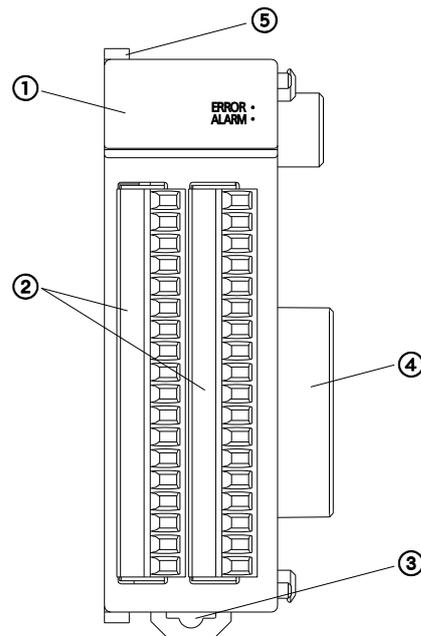
① Operation status LEDs – Display the current operation mode or the occurrence of an error.

LED	Color	Description
–	Blue	Lights when the CPU power is on.
ERROR	Red	Lights when the configuration settings are beyond the allowable range or A/D conversion is not possible.
ALARM	Red	Lights when a hardware error occurs.

② Analog input terminal block – Remove the terminal block to facilitate wiring. Crimp terminals for M3 can be used.

③ DIN rail attachment lever – Used for easy attachment to a DIN rail.

④ Expansion connector – Connects the unit to the internal circuit of I/O units and intelligent units.

⑤ Fixing hook – Used to fix expansion units.

Chapter 2

Wiring

2.1 Wiring the terminal block

Screw-type terminal blocks are used. The suitable wires are given below.
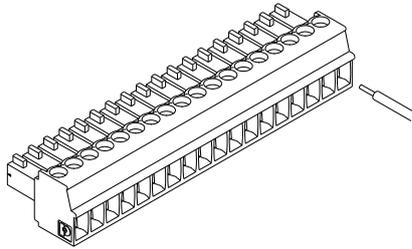
Suitable wire

No. of wires	Size	Cross-sectional area [mm^2]
1	AWG28−16	0.08−1.25
2	AWG28−20	0.08−0.5

Wiring method

Precautions

- 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 no wire is under stress.
- If the socket in the terminal block closes upon counter-clockwise rotation, the connection is wrong. Disconnect the wire, check the terminal hole, and then re-connect the wire.

OK
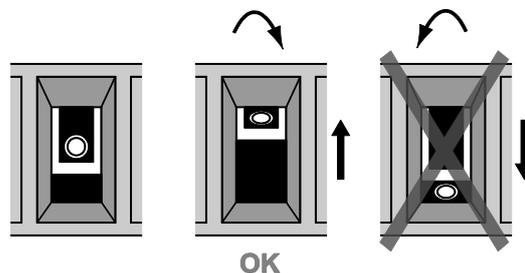
Procedure

1. Insert a screwdriver between terminal block and housing
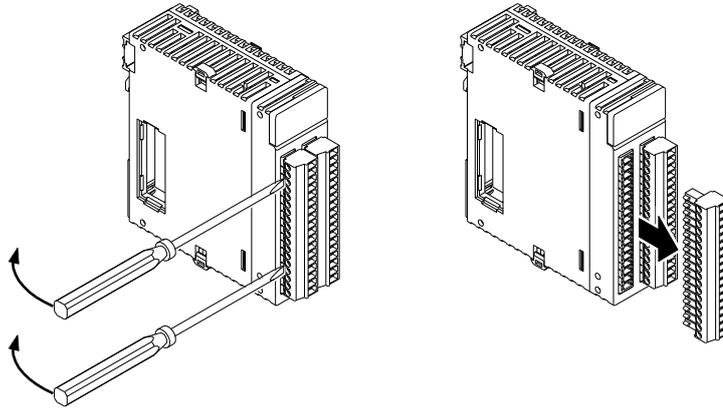
2. Remove the terminal block

3. Remove a portion of the wire's insulation

7mm
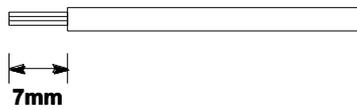
4. Insert the wire into the terminal block until it touches the back of the socket

5. Turn the screw clockwise to fix the wire in place
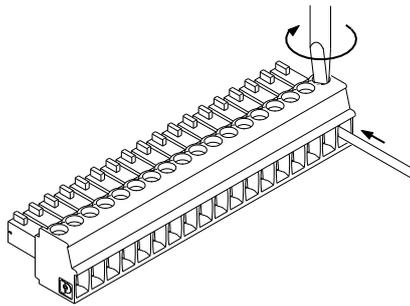
The tightening torque should be 0.22–0.25Nm or less.

6. Reattach the terminal block to the unit
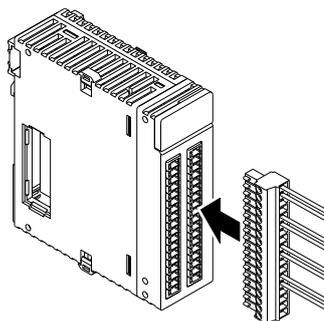
2.2 Connecting the analog inputs

Precautions

- Thermocouple input: Mind the polarity of the thermocouple when connecting the wires. When extending the signal line of the thermocouple, use its compensating lead wire. It is recommended to ground the unit using the shielded compensating lead wire.
- Current input/Voltage input: Use double-core twisted-pair shielded wires. We recommend grounding them. However, depending on the conditions of the external noise, it may be better not to ground the shielding.
- RTD input: Use thick copper wires having an insulation as specified by JIS C 3307 and JIS C 3401 to prevent large increases in electric resistance. It is recommended to ground the unit using the shielded compensating lead wire.
- Do not place the analog input wires close to power lines or load lines other than PLC wires, and do not bundle them with other wires.

2.2.1 Thermocouple input

Wiring and internal circuit diagram
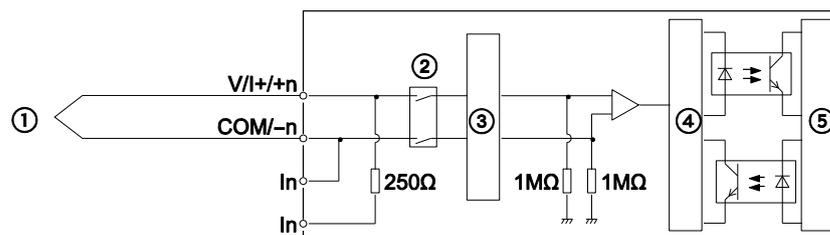
①	Thermocouple
②	PhotoMOS relay
③	Multiplexer
④	A/D conversion circuit
⑤	Internal circuit

Terminal layout
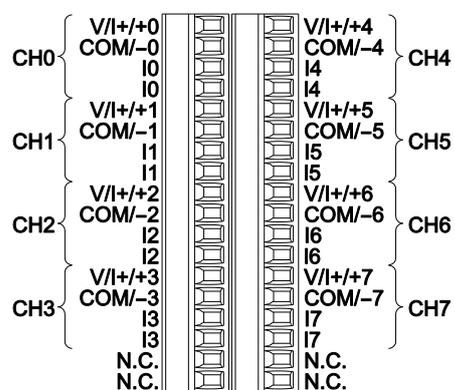
CH	Channel
V/I	Voltage/Current
COM	Common input
N.C.	Used by the system. Do not connect anything.

2.2.2 Voltage input

Wiring and internal circuit diagram
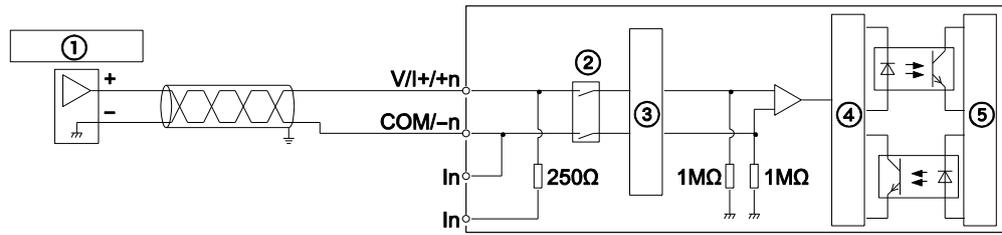
①	Input device
②	PhotoMOS relay
③	Multiplexer
④	A/D conversion circuit
⑤	Internal circuit

Terminal layout
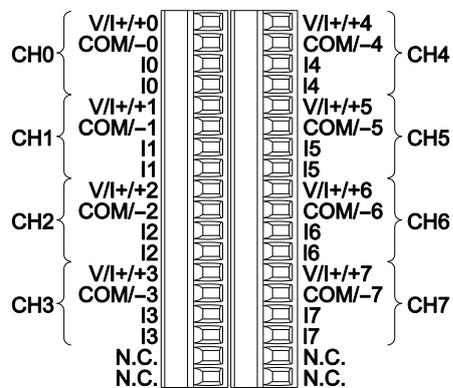
CH	Channel
V/I	Voltage/Current
COM	Common input
N.C.	Used by the system. Do not connect anything.

2.2.3 Current input

Wiring and internal circuit diagram
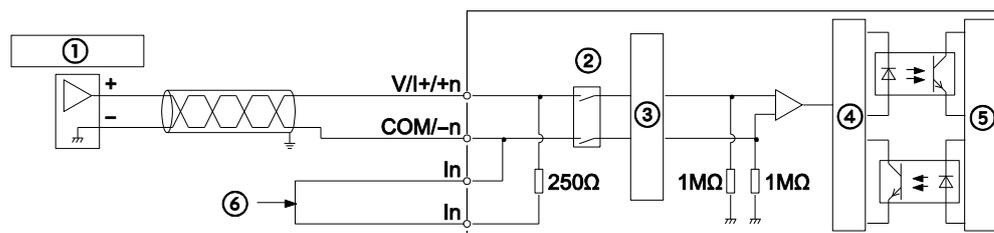
①	Input device
②	PhotoMOS relay
③	Multiplexer
④	A/D conversion circuit
⑤	Internal circuit
⑥	Connect the In terminals.

Terminal layout
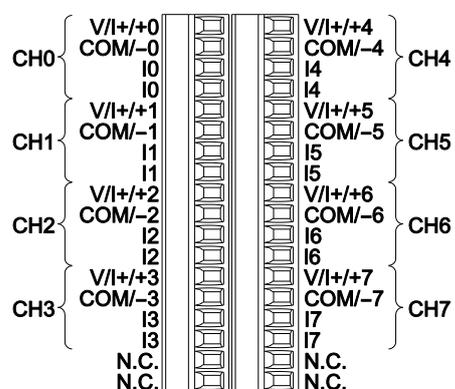
CH	Channel
V/I	Voltage/Current
COM	Common input
N.C.	Used by the system. Do not connect anything.

2.2.4   RTD input

Wiring and internal circuit diagram
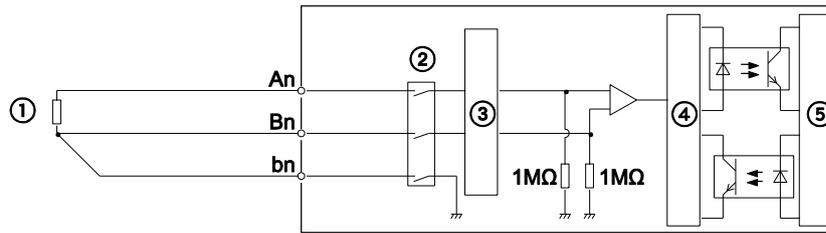
①	RTD input
②	PhotoMOS relay
③	Multiplexer
④	A/D conversion circuit
⑤	Internal circuit

Terminal layout
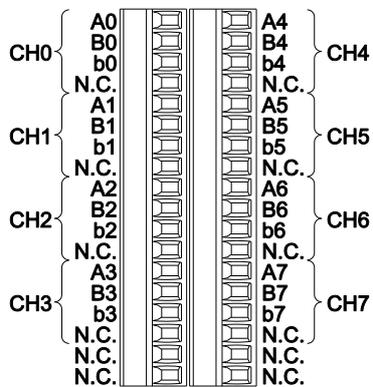
CH	Channel
N.C.	Used by the system. Do not connect anything.

Chapter 3

I/O allocation

3.1 General

Each unit attached to the CPU must be configured in an I/O map which is registered in the CPU. The current I/O map can be displayed in the "I/O map and unit configuration" dialog. It shows the slot numbers and starting word numbers of the CPU and its expansion units. I/O addresses are allocated based on the starting word number.

To display the current I/O map and starting word number of a unit in Control FPWIN Pro, proceed as follows:

Procedure

1. Open project
2. Double-click "PLC" in the navigator
3. Double-click "I/O map and unit configuration"
4. Double-click the desired slot number

Reference

Please refer to the CPU Hardware User's Manual for details on entering and uploading I/O maps.

3.2 Digital values and status flags

After A/D conversion, the digital output values are written to the CPU's input area (WX) and processed. Status flags are also allocated to the CPU's inputs.

The I/O addresses in the table show offset addresses. I/O addresses actually allocated are based on the first word number allocated to the unit. Example: If the first word address is 10, the address numbers for the digital output value and the error flag on channel 0 will be WX10 and X11F, respectively.

Channel 0–3

I/O addresses								Name
Channel 0		Channel 1		Channel 2		Channel 3		
WX0	X0–XF	WX2	X20–X2F	WX4	X40–X4F	WX6	X60–X6F	Digital output value (16 bits)[1]
WX1	X10	WX3	X30	WX5	X50	WX7	X70	Disconnection detection flag [2]
	X11		X31		X51		X71	High limit alarm flag [3]
	X12		X32		X52		X72	Low limit alarm flag [4]
	X13		X33		X53		X73	Limit alarm active flag [5]
	X14		X34		X54		X74	Not used
	X15		X35		X55		X75	Maximum/minimum hold active flag [6]
	X16–X1E		X36–X3E		X56–X5E		X76–X7E	Not used
	X1F		X3F		X5F		X7F	Error flag [7]

Channel 4–7

I/O addresses								Name
Channel 4		Channel 5		Channel 6		Channel 7		
WX8	X80–8XF	WX10	X100–X10F	WX4	X40–X4F	WX6	X60–X6F	Digital output value (16 bits)[1]
WX9	X90	WX11	X110	WX13	X130	WX15	X150	Disconnection detection flag [2]
	X91		X111		X131		X151	High limit alarm flag [3]
	X92		X112		X132		X152	Low limit alarm flag [4]
	X93		X113		X133		X153	Limit alarm active flag [5]
	X94		X114		X134		X154	Not used
	X95		X115		X135		X155	Maximum/minimum hold active flag [6]
	X96–X9E		X116–X11E		X136–X13E		X156–X15E	Not used
	X9F		X11F		X13F		X15F	Error flag [7]

[1] Digital output value

Memory area for digital values after conversion of the analog input values. If scale conversion has been set, the corresponding scaled values are stored here.

Thermocouple input:

Thermocouple	Temperature	Digital output value
K1	-100.0 to +600.0°C	-1000 to +6000
K2	-200.0 to +1000.0°C	-2000 to +10000
J1	-100.0 to +400.0°C	-1000 to +4000
J2	-200.0 to +750.0°C	-2000 to +7500
T	-270.0 to +400.0°C	-2700 to +4000
N	-270.0 to +1300.0°C	-2700 to +13000
R	0.0 to +1760.0°C	0 to +17600
S	0.0 to +1760.0°C	0 to +17600

Thermocouple	Temperature	Digital output value
B	0.0 to +1820.0°C	0 to +18200
E	-270.0 to +1000.0°C	-2700 to +10000
PLII	0.0 to +1390.0°C	0 to +13900
Wre5-26	0.0 to +2315.0°C	0 to +23150

Voltage input:

Voltage range	Digital output value
-10 to +10V	-31250 to +31250
0 to +5V	0 to +31250
+1 to +5V	0 to +25000
-100 to +100mV	-31250 to +31250

Current input:

Current range	Digital output value
0 to +20mA	0 to +31250
+4 to +20mA	0 to +25000

RTD input:

RTD	Temperature	Digital output value
Pt100-1	-100.0 to +200.0°C	-1000 to +2000
Pt100-2	-200.0 to +650.0°C	-2000 to +6500
JPt100-1	-100.0 to +200.0°C	-1000 to +2000
JPt100-2	-200.0 to +650.0°C	-2000 to +6500
Pt1000	-100.0 to +100.0°C	-1000 to +1000

[2] Disconnection detection flag

TRUE when a disconnection has been detected.

FALSE when the connection has been restored.

(Valid for thermocouple input and 1−5V and 4−20mA ranges only.)

[3] High limit alarm flag

TRUE when the digital output value exceeds the switch-on value for high limit alarm.

[4] Low limit alarm flag

TRUE when the digital output value drops below the switch-on value for low limit alarm.

[5] Limit alarm active flag

TRUE when the limit alarm function is active.

[6] Maximum/minimum hold active flag

TRUE when the maximum and minimum value hold function is active.

[7] Error flag

TRUE when an error has occurred.

3.3 Control flags

Control flags are allocated to the CPU's output area.

The I/O addresses in the table show offset addresses. I/O addresses actually allocated are based on the first word number allocated to the unit. Example: If the first word number is 10, the address numbers for the disconnection detection execution flag and the error flag reset flag on channel 0 will be Y100 and Y10F, respectively.

Channel 0–3

I/O addresses								Name
Channel 0		Channel 1		Channel 2		Channel 3		
WY0	Y0	WY1	Y10	WY2	Y20	WY3	Y30	Disconnection detection control flag [1]
	Y1–Y2		Y11–Y12		Y21–Y22		Y31–Y32	Not used
	Y3		Y13		Y23		Y33	Limit alarm control flag [2]
	Y4		Y14		Y24		Y34	Not used
	Y5		Y15		Y25		Y35	Maximum/minimum hold control flag [3]
	Y6–YE		Y16–Y1E		Y26–Y27		Y36–Y37	Not used
	YF		Y1F		Y2F		Y3F	Error reset flag [4]

Channel 4–7

I/O addresses								Name
Channel 4		Channel 5		Channel 6		Channel 7		
WY4	Y40	WY5	Y50	WY6	Y60	WY7	Y70	Disconnection detection control flag [1]
	Y41–Y42		Y51–Y52		Y61–Y62		Y71–Y72	Not used
	Y43		Y53		Y63		Y73	Limit alarm control flag [2]
	Y44		Y54		Y64		Y74	Not used
	Y45		Y55		Y65		Y75	Maximum/minimum hold control flag [3]
	Y46–Y4E		Y56–Y5E		Y66–Y67		Y76–Y77	Not used
	Y4F		Y5F		Y6F		Y7F	Error reset flag [4]

[1] Disconnection detection control flag

TRUE to execute the disconnection detection function.

FALSE to turn the disconnection detection flag (Xn0) to FALSE.

(Valid for 1–5V and 4–20mA ranges only.)

[2] Limit alarm control flag

TRUE to execute the limit alarm function.

FALSE to turn the high limit alarm flag (Xn1) and low limit alarm flag (Xn2) to FALSE.

[3] Maximum/minimum hold control flag

TRUE to execute the maximum/minimum hold function.

FALSE to turn the maximum/minimum hold active flag (Xn5) to FALSE.

[4] Error reset flag

TRUE to reset the error flag (XnF).

Chapter 4

Operation

4.1 Reading of analog input data

The processing of analog input data takes place in three steps:

1. Reception of analog signals

   The analog unit receives analog signals from the thermocouple, RTD, or external devices.

2. Analog to digital conversion

   The analog input values are converted to digital output values automatically and in sequence.

3. Storage of digital values

   A user program is needed to read the digital output values from the CPU's input area (WX).
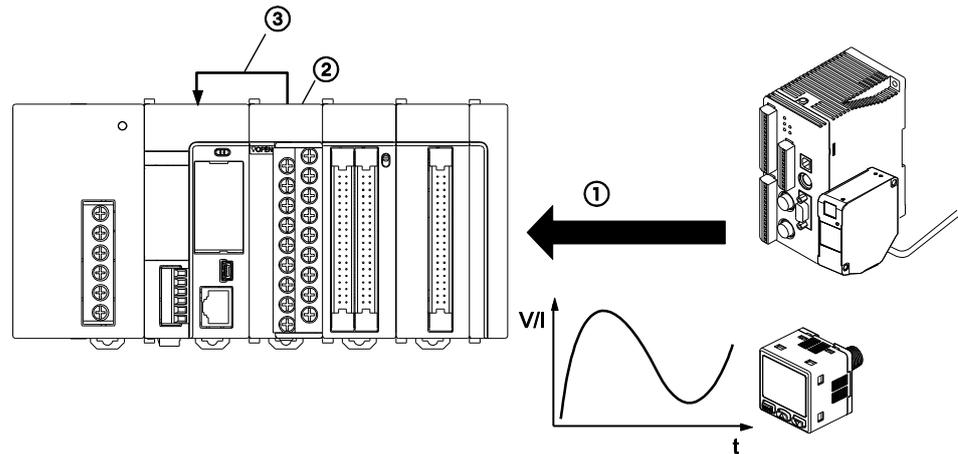
①	Analog signal
②	A/D conversion
③	Digital output value

Sample program

The digital output values from the analog unit are stored in the CPU's memory areas DIXWX0, DIXWX2, DIXWX4, and DIXWX6. They are read by channel and stored in four different variables.

POU Header

	Class	Identifier	Type	Initial
0	VAR_CONSTANT	iSlotNumber	INT	0
1	VAR	bReadInputValues	BOOL	FALSE
2	VAR	iInputChannel0	INT	0
3	VAR	iInputChannel1	INT	0
4	VAR	iInputChannel2	INT	0
5	VAR	iInputChannel3	INT	0

LD Body
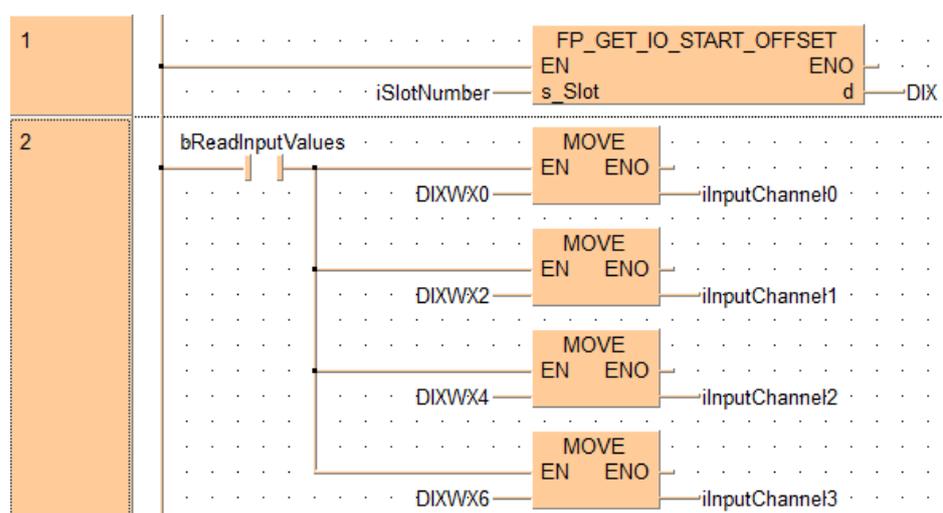
4.2 Conversion time

Conversion time varies with the selected configuration settings.

Conversion time

For AFP7TC8, each channel can be set to either normal mode (25ms/channel) or to high-speed mode (5ms/channel). A processing time of 25ms/channel or 5ms/channel is added to the conversion time.

No. of channels	Conversion time + processing time	
	Normal mode (25ms/channel)	High-speed mode (5ms/channel)
1	25ms+25ms	5ms+5ms
2	50ms+25ms	10ms+5ms
3	75ms+25ms	15ms+5ms
4	100ms+25ms	20ms+5ms
5	125ms+25ms	25ms+5ms
6	150ms+25ms	30ms+5ms
7	175ms+25ms	35ms+5ms
8	200ms+25ms	40ms+5ms

| Note | For AFP7RTD, only the normal mode (25ms/channel) is available. |

Power frequency

The thermocouple and RTD units use a digital filter to reduce power line noise. For AFP7TC8, this filter is only available in normal mode (25ms/channel). In the event of noise from the power line, we recommend to select normal mode and to set the frequency of your power line (50Hz or 60Hz) using the "Power frequency" setting.

Conversion processing

To speed up conversion, disable "Conversion processing" for all unused channels.

| Example | Conversion processing is enabled for 2 channels: |

- Order of conversion: channel 0→channel 1→channel 0→channel 1→…

- The conversion time for the disabled channels 2 to 7 is saved.

Time chart of A/D conversion

The digital output values from the analog unit are read by the CPU program at the CPU's I/O refresh time. A/D conversion in the analog unit and the CPU's processing cycles are not synchronized. Therefore, the latest digital output value will only be written into the CPU's operation memory when an I/O refresh is performed.

Example

Conversion processing is enabled for 4 channels:
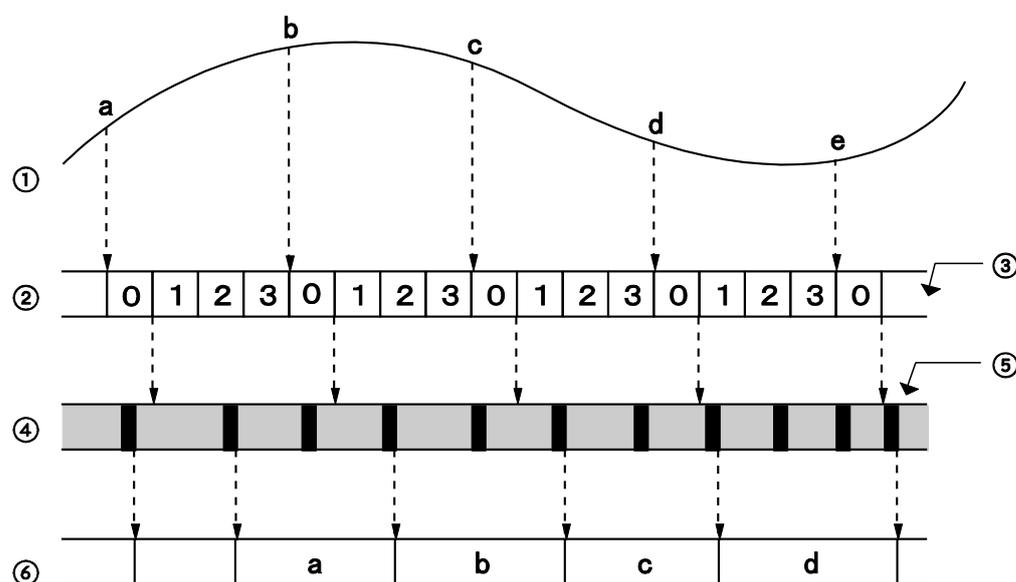
① Analog signal, channel 0 of analog unit
② Conversion processing
③ Order of conversion: channel 0→channel 1→channel 2→channel 3
④ CPU processing cycles
⑤ I/O refresh
⑥ Digital output value (from analog unit), channel 0 of CPU

Example

Conversion processing is enabled for 1 channel:
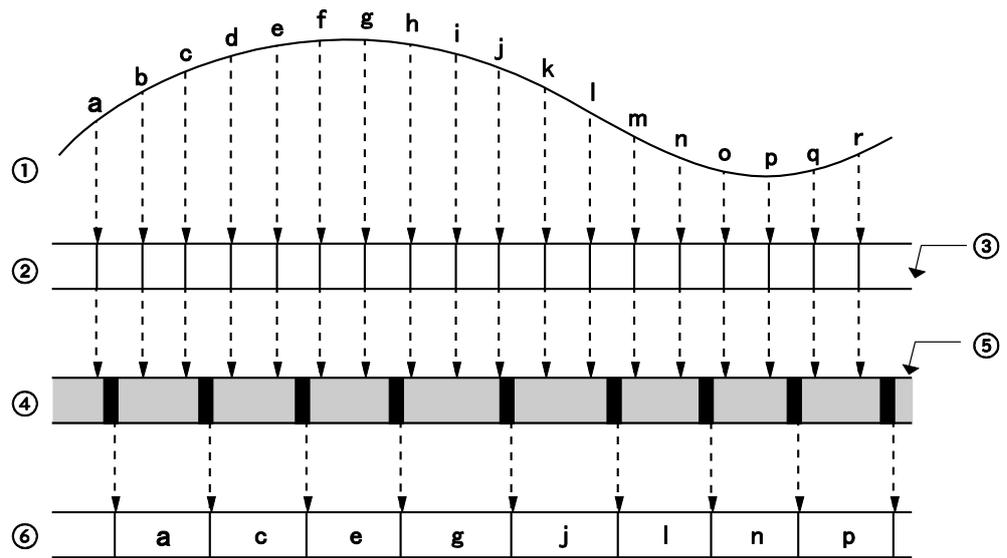
①	Analog signal, channel 0 of analog unit
②	Conversion processing
③	Conversion of channel 0 only
④	CPU processing cycles
⑤	I/O refresh
⑥	Digital output value (from analog unit), channel 0 of CPU

Chapter 5

Conversion characteristics

5.1 Temperature range

5.1.1 Thermocouple input (AFP7TC8)
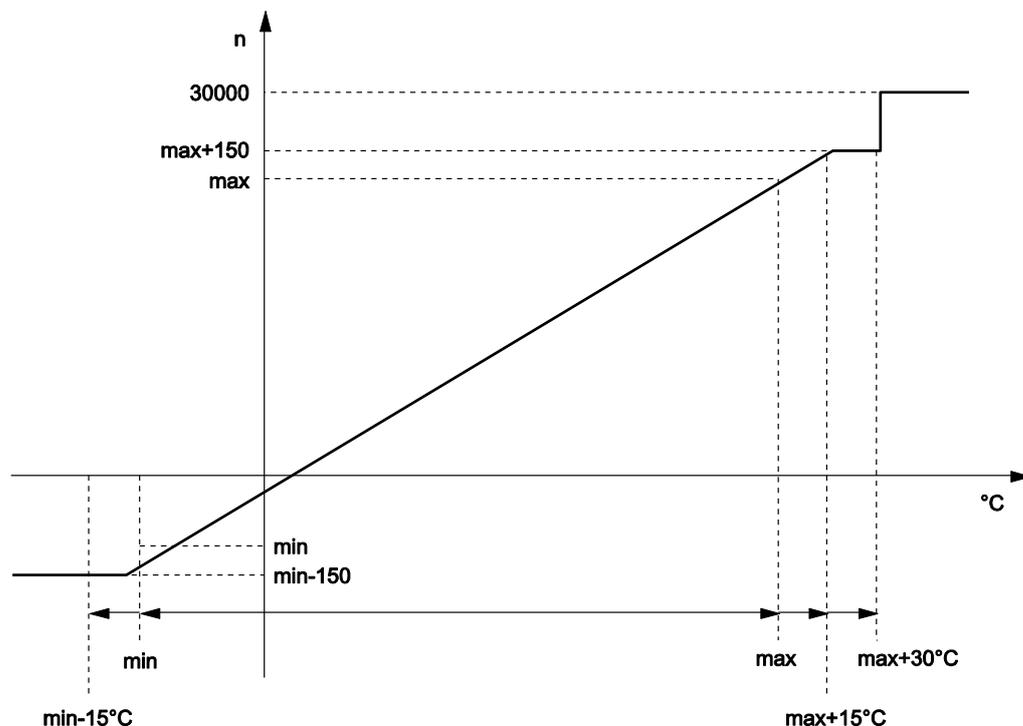
When exceeding the rated range

Accuracy of measurements ±15°C outside the rated range cannot be guaranteed.

If the upper limit of the range is exceeded by 30°C, the digital output value is 30000.

Thermocouple	Analog input value	Digital output value
K1	≤-115°C	-1150
	≥+615°C	+6150
K2	≤-215°C	-2150
	≥+1015°C	+10150
J1	≤-115°C	-1150
	≥+415°C	+4150
J2	≤-215°C	-2150

Thermocouple	Analog input value	Digital output value
	≥+765°C	+7650
T	≤-285°C	-2850
	≥+415°C	+4150
N	≤-285°C	-2850
	≥+1315°C	+13150
R	≤-15°C	-150
	≥+1775°C	+17750
S	≤-15°C	-150
	≥+1775°C	+17750
B	≤-15°C	-150
	≥+1835°C	+18350
E	≤-285°C	-2850
	≥+1015°C	+10150
PLII	≤-15°C	-150
	≥+1405°C	+14050
WRe5-26	≤-15°C	-150
	≥+2330°C	+23300
Wire broken	–	+30000

5.1.2   RTD input (AFP7RTD)
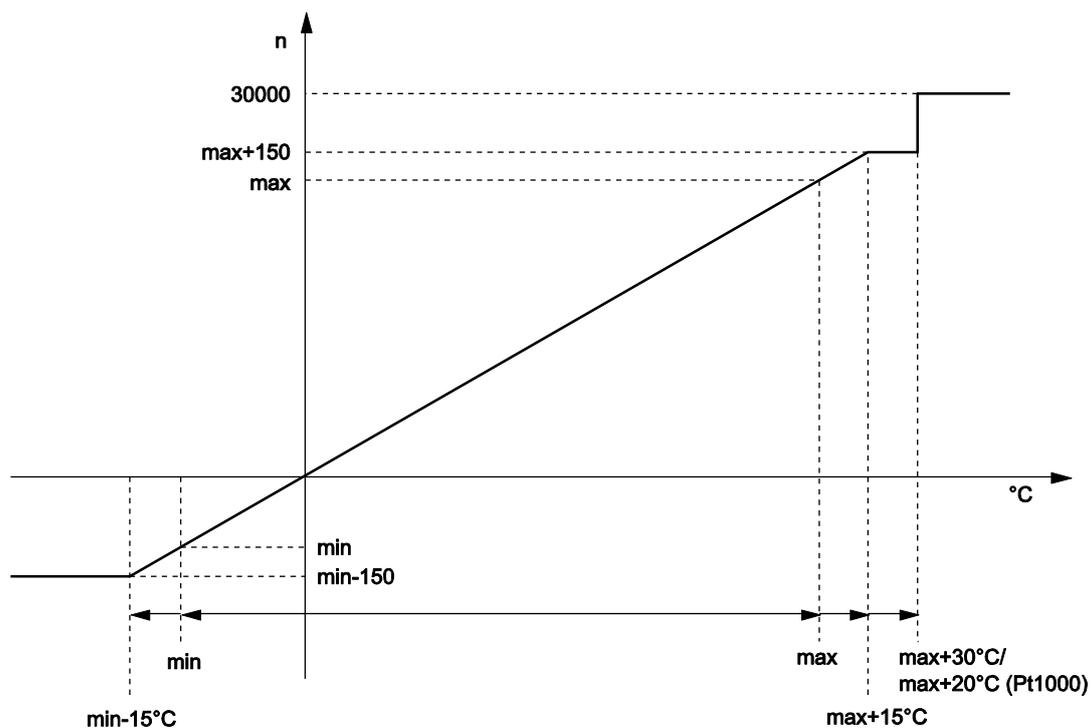
When exceeding the rated range

Accuracy of measurements ±15°C outside the rated range cannot be guaranteed.

If the upper limit of the range is exceeded by 30°C, the digital output value is 30000. For Pt1000, the upper limit must be exceeded by 20°C (max+20°C).

RTD	Analog input value	Digital output value
Pt100	≤-215°C	-2150
	≥+665°C	+6650
Pt100	≤-115°C	-1150
	≥+215°C	+2150
JPt100	≤-215°C	-2150
	≥+665°C	+6650
JPt100	≤-115°C	-1150
	≥+215°C	+2150
Pt1000	≤-115°C	-1150
	≥+115°C	+1150
Wire broken	–	+30000

5.2 Voltage range (AFP7TC8)

5.2.1 -10 to +10V (0.32mV, 1/62500)
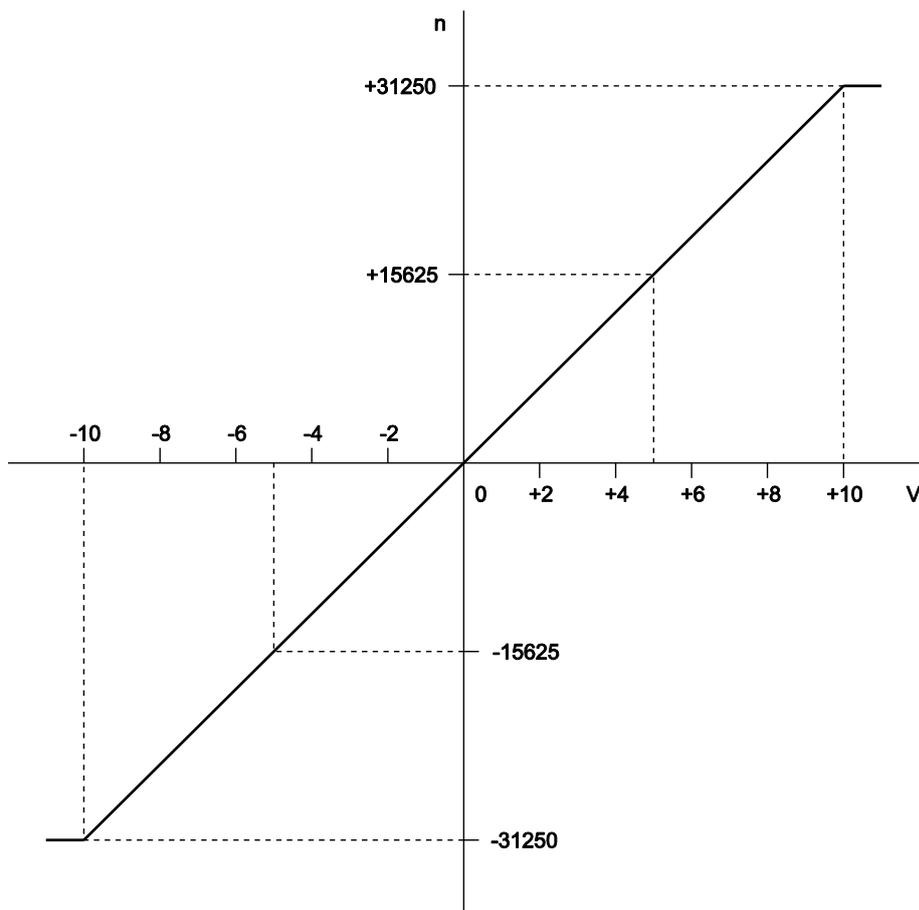
Analog input value (V)	Digital output value (n)
+10	+31250
+8	+25000
+6	+18750
+4	+12500
+2	+6250
0	0
-2	-6250
-4	-12500
-6	-18750
-8	-25000
-10	-31250

When exceeding the rated range

Analog input value (V)	Digital output value
≥+10V	+31250
≤-10V	-31250

5.2.2   0 to +5V (0.16mV, 1/31250)
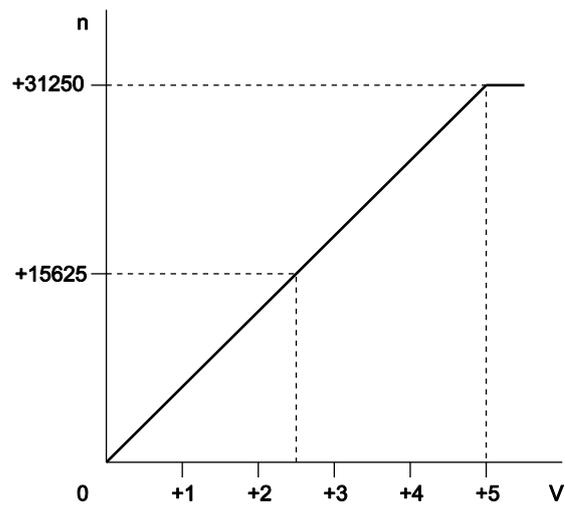
Analog input value (V)	Digital output value (n)
+5	+31250
+4	+25000
+3	+18750
+2	+12500
+1	+6250
0	0

When exceeding the rated range

Analog input value (V)	Digital output value
≥+5V	+31250
≤0V	0

5.2.3   1 to +5V (0.16mV, 1/25000)
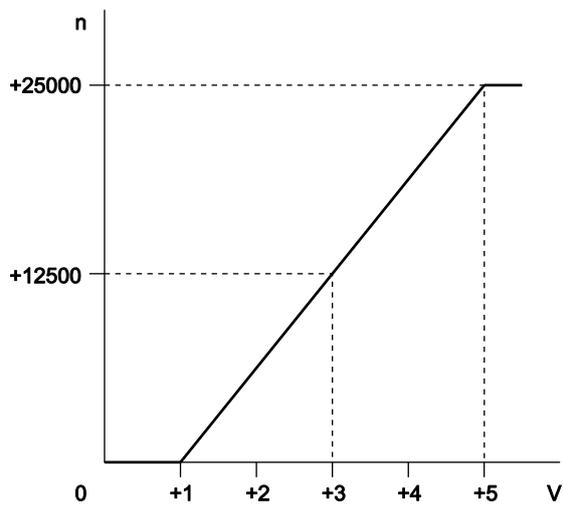
Analog input value (V)	Digital output value (n)
+5	+25000
+4	+18750
+3	+12500
+2	+6250
+1	0

When exceeding the rated range

Analog input value (V)	Digital output value
≥+5V	+25000
≤1V	0

5.2.4   -100 to +100mV (0.32mV, 1/62500)
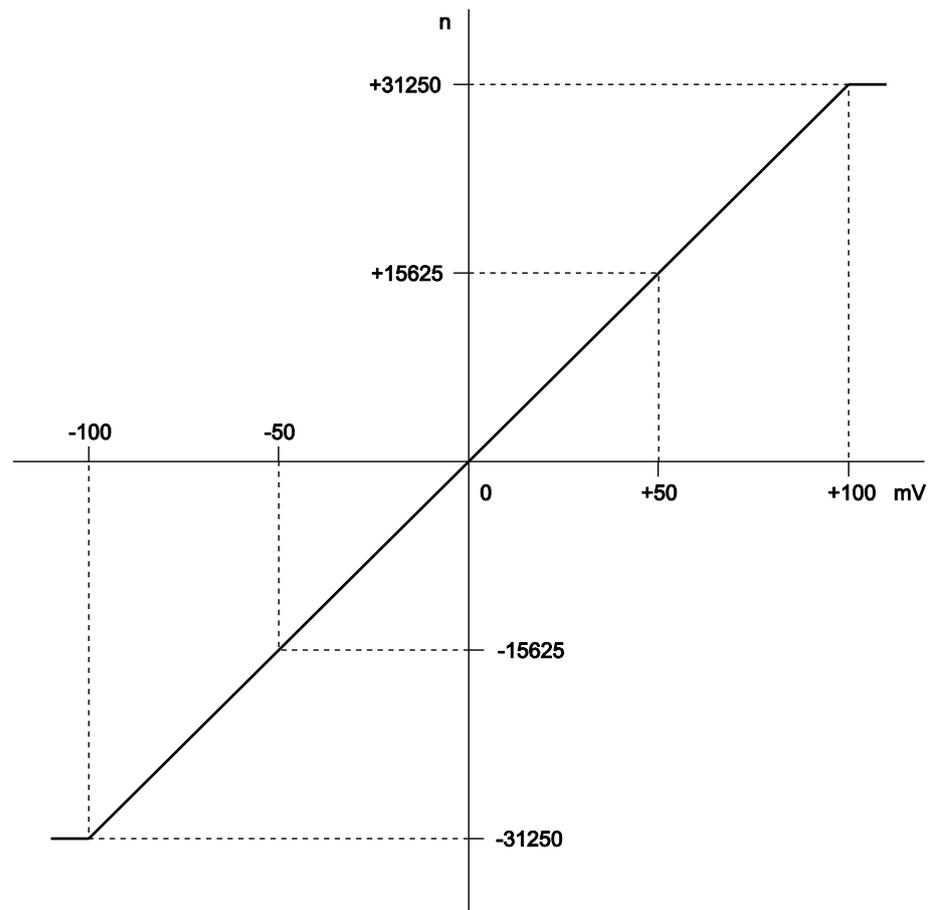
Analog input value (mV)	Digital output value (n)
+100	+31250
+80	+25000
+60	+18750
+40	+12500
+20	+6250
0	0
-20	-6250
-40	-12500
-60	-18750
-80	-25000
-100	-31250

When exceeding the rated range

Analog input value (mV)	Digital output value
≥+100mV	+31250
≤-100mV	-31250

5.3 Current range (AFP7TC8)

5.3.1   0 to +20mA (0.64µA, 1/31250)
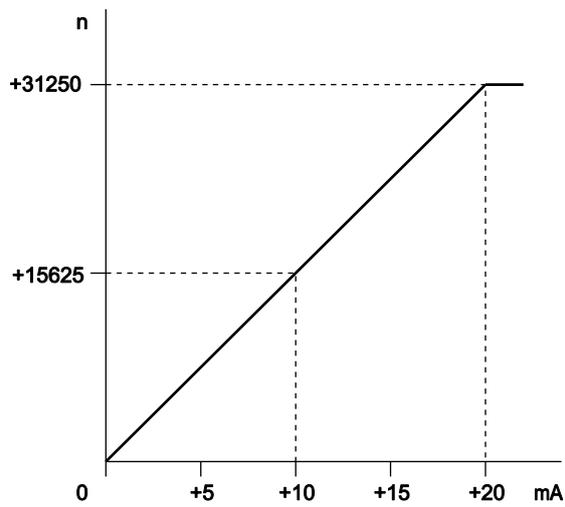
Analog input value (mA)	Digital output value (n)
+20	+31250
+16	+25000
+12	+18750
+8	+12500
+4	+6250
0	0

When exceeding the rated range

Analog input value (mA)	Digital output value
≥+20mA	+31250
≤0mA	0

5.3.2 +4 to +20mA (0.64µA, 1/25000)
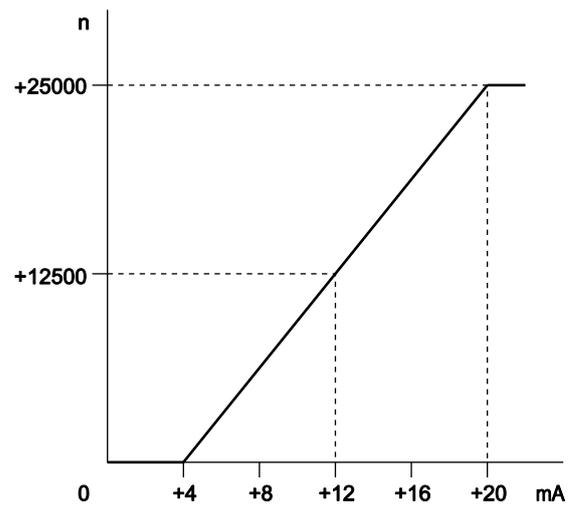
Analog input value (mA)	Digital output value (n)
+20	+25000
+16	+18750
+12	+12500
+8	+6250
+4	0

When exceeding the rated range

Analog input value (mA)	Digital output value
≥+20mA	+25000
≤+4mA	0

Chapter 6

Unit configuration

6.1 Advanced settings

After the unit has been entered in the I/O map, it can be configured in Control FPWIN Pro.

Procedure

1. Open project
2. Double-click "PLC" in the navigator
3. Double-click "I/O map and unit configuration"
4. Double-click the desired slot number
5. [Advanced]
6. Make the desired settings
7. [OK]

The settings will become effective when the project is downloaded to the PLC.

6.2 List of advanced configuration settings

AFP7TC8

General (common to all channels):

Item name	Data	Default setting
Power frequency	60Hz/50Hz	60Hz
Conversion time	25ms/5ms	25ms

Channel 0-7 (settings per channel)

Item name	Data	Default setting
Conversion processing	Enable/Disable	Enable
Range setting	-10V..+10V 0V..5V 1V..5V -100mV..+100mV 0mA..20mA 4mA..20mA K1(-100°C..600°C) K2(-200°C..1000°C) J1(-100°C..400°C) J2(-200°C..750°C) T(-270°C..400°C) N(-270°C..1300°C) R(0°C..1760°C) S(0°C..1760°C) B(0°C..1820°C) E(-270°C..1000°C) PLII(0°C..1390°C) WRe5-26(0°C..2315°C)	-10V..10V
Average processing	Disable/Count-based average/Time-based average/Moving average	Disable
Average count or time period	Count-based average: 2–60000 counts	8
	Time-based average: 200–60000ms	200
	Moving average: 3–64	8
Offset/gain processing	Disable/Enable	Disable
Offset value	-3000 to +3000	0
Gain value	+9000 to +11000	10000
Scale conversion [1]	Disable/Enable	Disable
Upper limit of scale	-30000 to +30000	10000
Lower limit of scale	-30000 to +30000	0
Limit alarm	Disable/Enable	Disable
High limit alarm switch-on value	-31250 to +31250	1000
High limit alarm switch-off value	-31250 to +31250	1000
Low limit alarm switch-on value	-31250 to +31250	0
Low limit alarm switch-off value	-31250 to +31250	0
Maximum and minimum value hold	Disable/Enable	Disable
Disconnection detection	Disable/Enable	Disable
Disconnection detection flag reset	Automatic/Manual	Automatic

[1] For voltage or current input only.

AFP7RTD

General (common to all channels):

Item name	Data	Default setting
Power frequency	60Hz/50Hz	60Hz

Channel 0-7 (settings per channel)

Item name	Data	Default setting
Conversion processing	Enable/Disable	Enable
Range setting	Pt100-1(-100°C..200°C) Pt100-2(-200°C..650°C) JPt100-1(-100°C..200°C) JPt100-2(-200°C..650°C) Pt1000-1(-100°C..100°C)	Pt100-1(-100°C..200°C)
Average processing	Disable/Count-based average/Time-based average/Moving average	Disable
Average count or time period	Count-based average: 2–60000 counts	8
	Time-based average: 200–60000ms	200
	Moving average: 3–64	8
Offset/gain processing	Disable/Enable	Disable
Offset value	-3000 to +3000	0
Gain value	+9000 to +11000	10000
Limit alarm	Disable/Enable	Disable
High limit alarm switch-on value	-31250 to +31250	1000
High limit alarm switch-off value	-31250 to +31250	1000
Low limit alarm switch-on value	-31250 to +31250	0
Low limit alarm switch-off value	-31250 to +31250	0
Maximum and minimum value hold	Disable/Enable	Disable

6.3 Average processing

With average processing, count-based, time-based, or moving averages can be obtained from the analog input values. The average values are stored in the CPU's input area as digital values.

6.3.1 Count-based average

If count-based average has been selected, a set number of analog input values are averaged and the average values are stored as digital values. If the number of analog input values acquired is less than the set number, the converted digital values will be stored without averaging.

Processing of analog measurement values

Example

The number of counts has been set to 5.
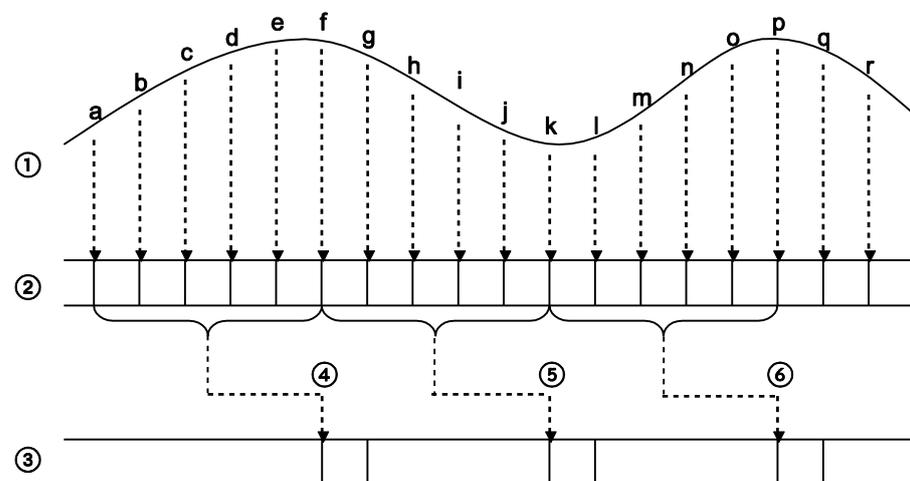
①	Analog signal
②	Analog input processing
③	Analog input values
④	Average of a–e
⑤	Average of f–j
⑥	Average of k–o

Configuration

Name	Default	Setting range
Average processing	Disable	Select "Count-based average"
Average count or time period	8	200–60000ms counts (specified with an unsigned integer)

6.3.2   Time-based average

If time-based average has been selected, the analog measurement values acquired during a set period of time are averaged and stored as digital values.

Processing of analog measurement values

Example

The time period has been set to 5ms.
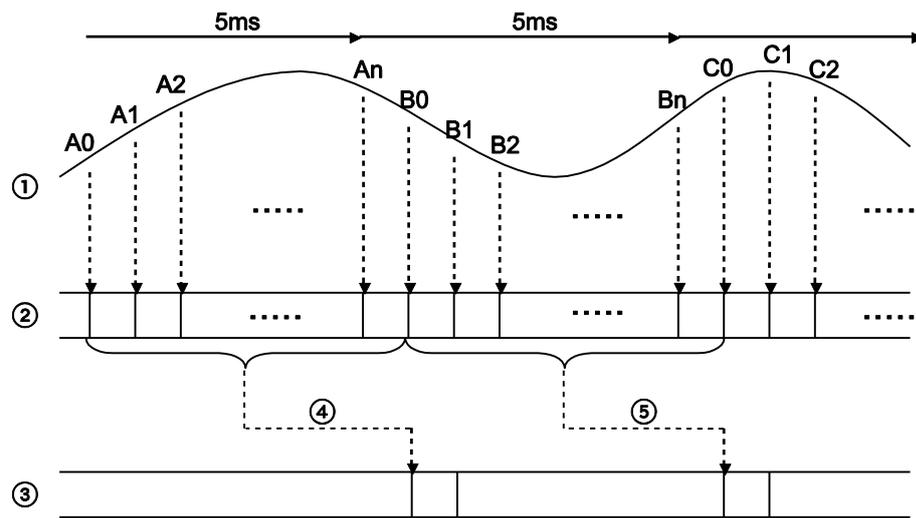
① Analog signal
② Analog input processing
③ Analog input values
④ Average of A0–An
⑤ Average of B0–Bn

Configuration

Name	Default	Setting range
Average processing	Disable	Select "Time-based average"
Average count or time period	200	Time: 200–60000ms (specified with an unsigned integer)

6.3.3 Moving average

If moving average has been selected, a series of averages are calculated of a shifting number of analog input values and stored as digital values.

Processing of analog measurement values

Example

The number of counts has been set to 15.
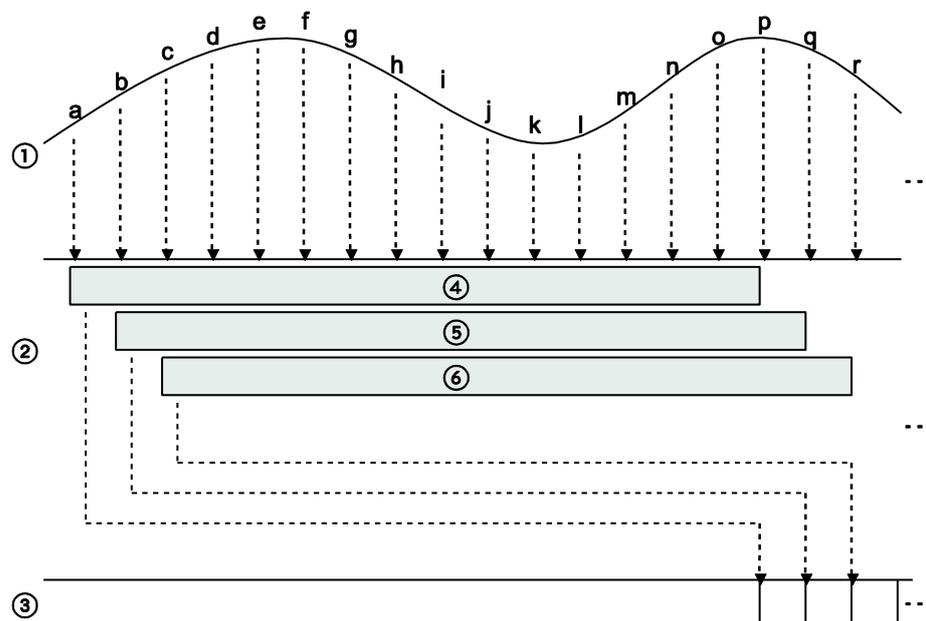
①	Analog signal
②	Analog input processing
③	Analog input values
④	Average of a–o
⑤	Average of b–p
⑥	Average of c–q

Configuration

Name	Default	Setting range
Average processing	Disable	Select "Moving average"
Average count or time period	8	3–64 counts (specified with an unsigned integer)

6.4 Offset and gain adjustment

Offset and gain adjustment can be used to correct offset or scaling errors. The offset and gain adjustments are made to the converted data before it is written to the CPU's input area.

| Analog in-put values | ⇨ | Offset ad-justment | ⇨ | Gain adjust-ment | ⇨ | Corrected digital output values |
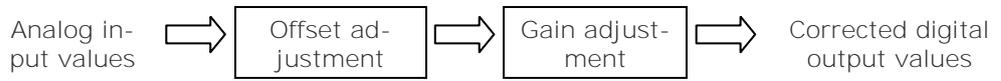
- The offset adjustment (zero-point adjustment) is used to remove the offset error between different components. If the digital output value is n=50 for an analog input value of 0V, select an offset value of 50 to correct the digital output value to n=0.
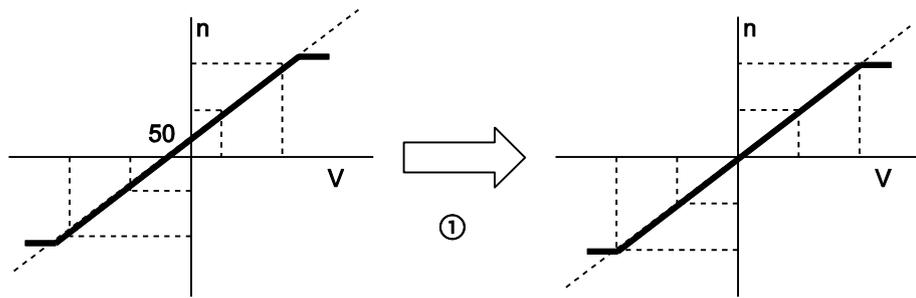
① Offset adjustment

- The gain value settings are used as a function to adjust small scale er- rors between different components. The gain value slope can be changed in a range of 0.9x–1.1x.
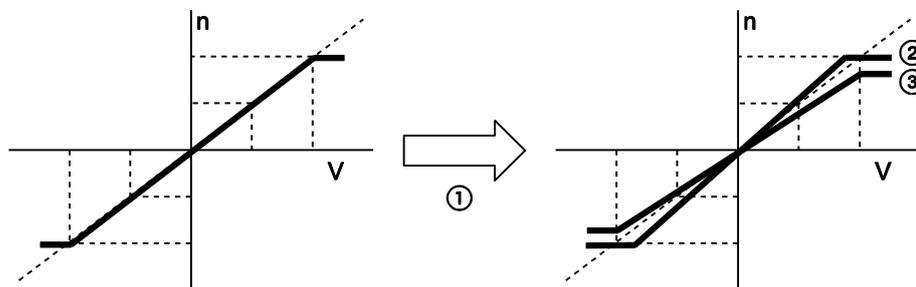
① Gain adjustment
② Gain 1.1x
③ Gain 0.9x

- Offset and gain processing is executed on a channel-by-channel basis.

Configuration

Name	Default	Setting range
Offset/gain processing	Disable	Select "Enable"
Offset value	0	To apply the setting, "Offset/gain processing" must be enabled. Setting range: -3000 to +3000 (specified with a signed integer)
Gain value	10000	To apply the setting, "Offset/gain processing" must be enabled. Setting range: +9000 to +11000 corresponding to a gain factor of 0.9x–1.1x (specified with a signed integer)

Note | The offset adjustment is applied to the unscaled value.

6.5 Scale conversion

Use scale conversion to set an easy-to-use data range. The digital output values are scaled to values in the specified range between preset minimum and maximum values before they are written to the CPU's input area. This function is convenient if used for unit conversion. Scale conversion is executed on a channel-by-channel basis.
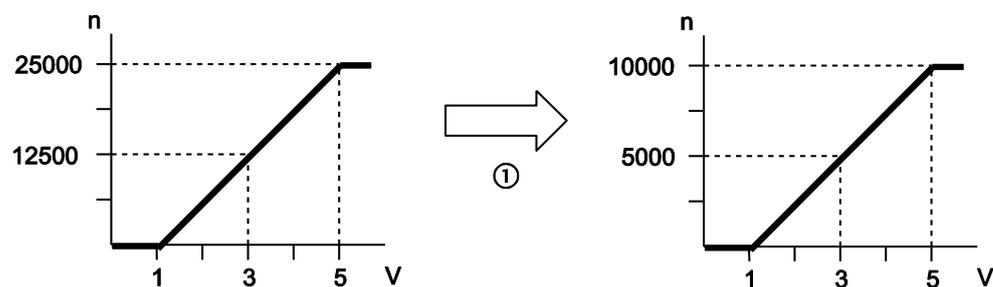
① Scale conversion

Configuration

Name	Default	Setting range
Scale conversion	Disable	Select "Enable"
Lower limit of scale	0	To apply the setting, "Scale conversion" must be enabled.
Upper limit of scale	10000	Setting range: -30000 to +30000 (specified with a signed integer)

Note

If data outside the lower or upper limit are acquired, scale conversion will be disabled and the lower or upper limit value will be written to the CPU's input area.

Scale conversion is only available for the voltage and current inputs of AFP7TC8.

6.6 Limit alarm

This function compares the acquired data with the specified upper and lower limits and turns the corresponding flags to TRUE when these limits are exceeded.

The high limit alarm flag turns to TRUE if the digital output value exceeds the switch-on value for high limit alarm. The low limit alarm flag turns to TRUE if the digital output value drops below the switch-on value for low limit alarm.

The limit alarm is set and executed on a channel-by-channel basis.

To use the function, you must enable "Limit alarm" in the "Analog unit settings" dialog and turn the limit alarm control flag to TRUE.

n	Digital output value
I	**Limit values**
①	High limit alarm switch-on value
②	High limit alarm switch-off value
③	Low limit alarm switch-off value
④	Low limit alarm switch-on value
II	**Control and status flags**
①	Limit alarm control flag
②	High limit alarm flag
③	Low limit alarm flag
④	Limit alarm active flag
III	**Operation sequence**
①	The limit alarm function is executed when the user program turns the limit alarm control flag to TRUE.
②	The high limit alarm flag turns to TRUE when the specified switch-on value for high limit alarm is reached.
③	The high limit alarm flag turns to FALSE when the specified switch-off value for high limit alarm is reached.
④	The low limit alarm flag turns to TRUE when the specified switch-on value for low limit alarm is reached.
⑤	All status flags turn to FALSE when the limit alarm control flag turns to FALSE and the limit alarm function is disabled. Therefore, the low limit alarm flag turns to FALSE before the switch-off value for low limit alarm is reached at ⑥.

For I/O addresses of control and status flags,

Configuration

Name	Default	Setting range
Limit alarm	Disable	Select "Enable"
High limit alarm switch-on value	1000	To apply the setting, "Limit alarm" must be enabled.
High limit alarm switch-off value	1000	Setting range: -31250 to +31250 (specified with a signed integer)
Low limit alarm switch-off value	0	
Low limit alarm switch-on value	0	

Note

When setting limit values, make sure the following is true:

- Low limit alarm switch-on value ≤ Low limit alarm switch-off value

- Low limit alarm switch-off value < High limit alarm switch-off value

- High limit alarm switch-off value ≤ High limit alarm switch-on value

Sample program

The limit alarm function is activated on channel 0 of the analog unit, and the desired output turns to TRUE when the specified upper or lower limit is detected. The output is specified using the function block FP_GET_UNIT_OFFSETS1. Please refer to the Control FPWIN Pro online help for detailed information.

POU Header

	Class	Identifier	Type	Initial
0	VAR_CONSTANT	iSlotNumber	INT	0
1	VAR	bSetLimitAlarmChannel0	BOOL	FALSE
2	VAR	bResetLimitAlarmChannel0	BOOL	FALSE
3	VAR	bHighLimitDetectedChannel0	BOOL	FALSE
4	VAR	bLowLimitDetectedChannel0	BOOL	FALSE

LD Body
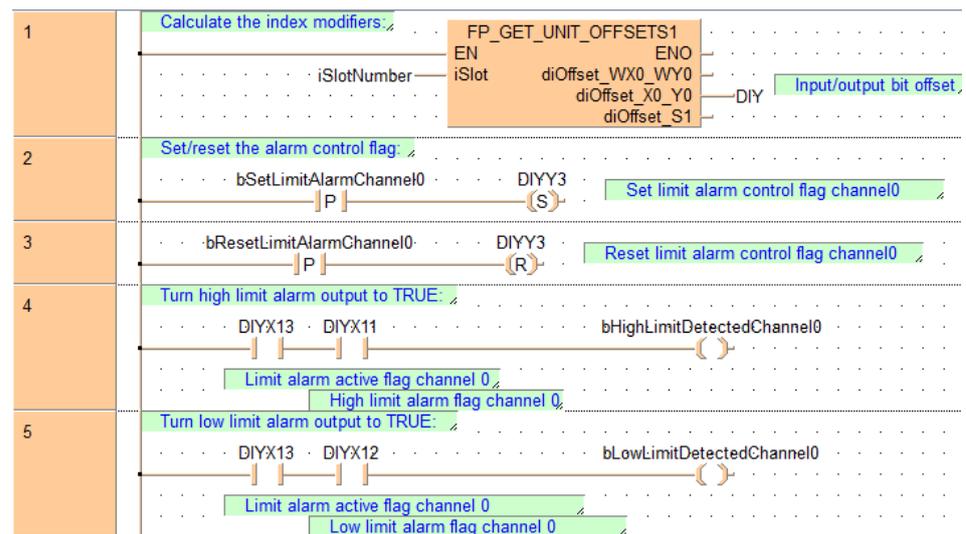
When bSetLimitAlarmChannel0 turns to TRUE, the limit alarm function on channel 0 is activated. When bResetLimitAlarmChannel0 turns to TRUE, the function is deactivated.

bHighLimitDetectedChannel0 turns to TRUE when the upper limit is reached. bLowLimitDetectedChannel0 turns to TRUE when the lower limit is reached.

6.7 Maximum and minimum value hold function

This function stores the maximum and minimum values of the acquired data in the unit memory area for each channel. See p. 75 for maximum and minimum value hold areas.

When the maximum/minimum hold control flag turns to TRUE, the current values will be stored as maximum and minimum values. These values will be refreshed continuously.

The maximum and minimum values will be held in the unit memory even when the control flag turns to FALSE or the CPU is switched to PROG mode.

The maximum and minimum values are held on a channel-by-channel basis.

To use the function, you must enable "Maximum and minimum value hold" in the "Analog unit settings" dialog and turn the maximum/minimum hold control flag to TRUE.
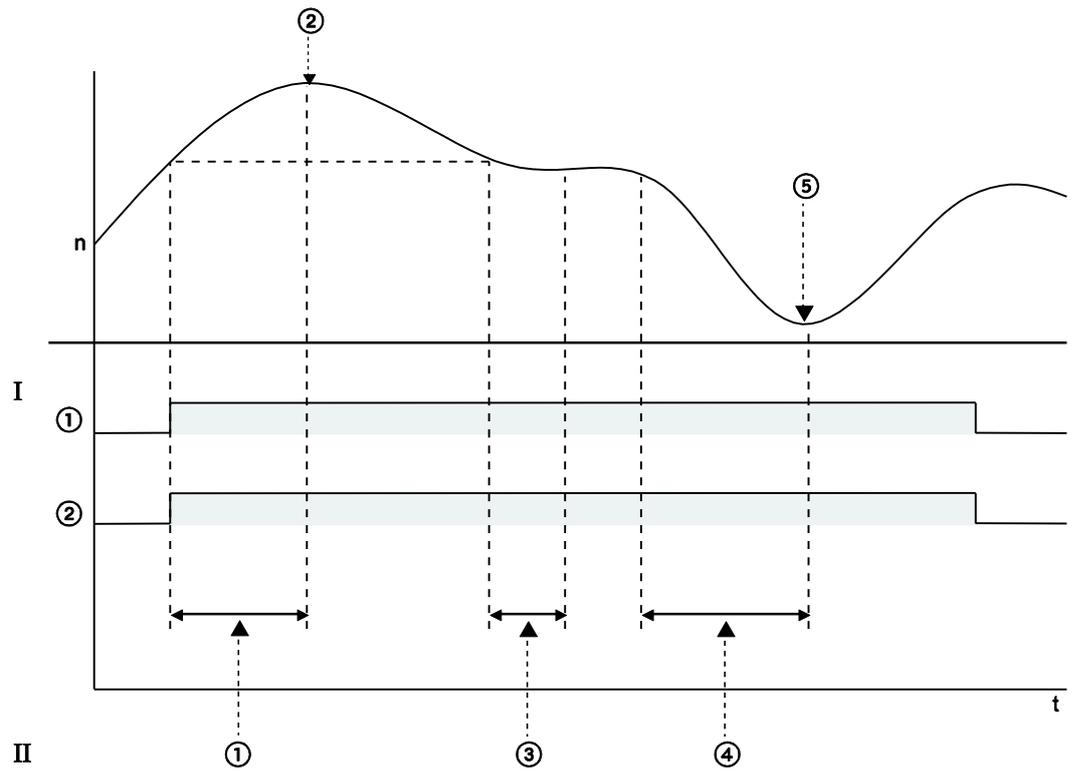
n	Digital output value
I	**Control and status flags**
①	Maximum/minimum hold control flag
②	Maximum/minimum hold active flag
II	**Operation sequence**
①	Maximum value is refreshed
②	Maximum value is held in unit memory
③	Minimum value is refreshed
④	
⑤	Minimum value is held in unit memory

Configuration

Name	Default	Setting range
Maximum and minimum value hold	Disable	Select "Enable"

Sample program

The maximum and minimum value hold function is executed on channel 0 of the analog unit in slot 1, and the maximum and minimum values will be copied from the specified unit memory areas. The output is specified using the function block FP_GET_UNIT_OFFSETS1. Please refer to the Control FPWIN Pro online help for detailed information.

POU Header

	Class	Identifier	Type	Initial
0	VAR_CONSTANT	iSlotNumber	INT	0
1	VAR	bSetLimitAlarmChannel0	BOOL	FALSE
2	VAR	bResetLimitAlarmChannel0	BOOL	FALSE
3	VAR	bHighLimitDetectedChannel0	BOOL	FALSE
4	VAR	bLowLimitDetectedChannel0	BOOL	FALSE

LD Body
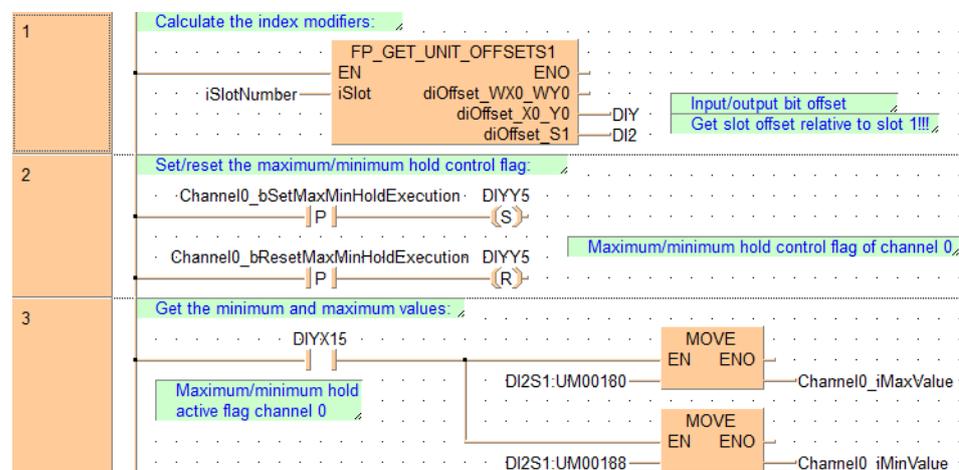
When Channel0_bSetMaxMinHoldExecution is TRUE, the maximum and minimum value hold function is activated. When Channel0_bResetMaxMinHoldExecution is TRUE, the maximum and minimum value hold function is deactivated.

When the maximum and minimum hold active flag for channel 0 is TRUE, the maximum and minimum values on channel 0 are read from the unit memory of the unit in slot 1 and copied to the variables Channel0_iMaxValue and Channel0_iMinValue.

6.8 Disconnection detection

AFP7TC8

The disconnection detection flag turns to TRUE and the ERROR LED will light if the analog input value does not reach a certain threshold.

Threshold for a voltage range of +1 to +5V: ≤0.7V

Threshold for a current range of +4 to +20mA: ≤2.8mA

If the input data exceeds the above values while the disconnection detection control flag is TRUE, the disconnection detection flag will turn to FALSE automatically, provided that "Disconnection detection flag reset" has been set to "Automatic". If "Manual" has been selected, the flag will be set to FALSE by turning the disconnection detection control flag to FALSE in the user program.

To use the function, you must enable "Disconnection detection" in the "Analog unit settings" dialog and turn the disconnection detection control flag to TRUE.

Disconnection detection is performed on a channel-by-channel basis.

Automatic reset of disconnection detection flag

①	Analog input value
②	Threshold
③	Disconnection detection control flag
④	Disconnection detection flag
⑤	In automatic mode, the disconnection detection flag will automatically turn FALSE when the threshold is reached again.

Manual reset of disconnection detection flag

①	Analog input value
②	Threshold
③	Disconnection detection control flag
④	Disconnection detection flag
⑤	In manual mode, the disconnection detection flag will not automatically turn FALSE when the threshold is reached again.
⑥	The disconnection detection flag turns to FALSE when the disconnection detection control flag turns to FALSE.

Configuration (for automatic reset)

Name	Default	Setting range
Disconnection detection	Disable	Select "Enable"
Disconnection detection reset	Automatic	Select "Automatic"

Sample program

The disconnection detection is activated on channel 0. The disconnection detection flag turns to TRUE if a disconnection has been detected.

POU Header

	Class	Identifier	Type	Initial
0	VAR_CONSTANT	iSlotNumber	INT	0
1	VAR	Channel0_bSetDisconnectionDetection	BOOL	FALSE
2	VAR	Channel0_bResetDisconnectionDetection	BOOL	FALSE
3	VAR	bIsDisconnectionDetected	BOOL	FALSE

LD Body
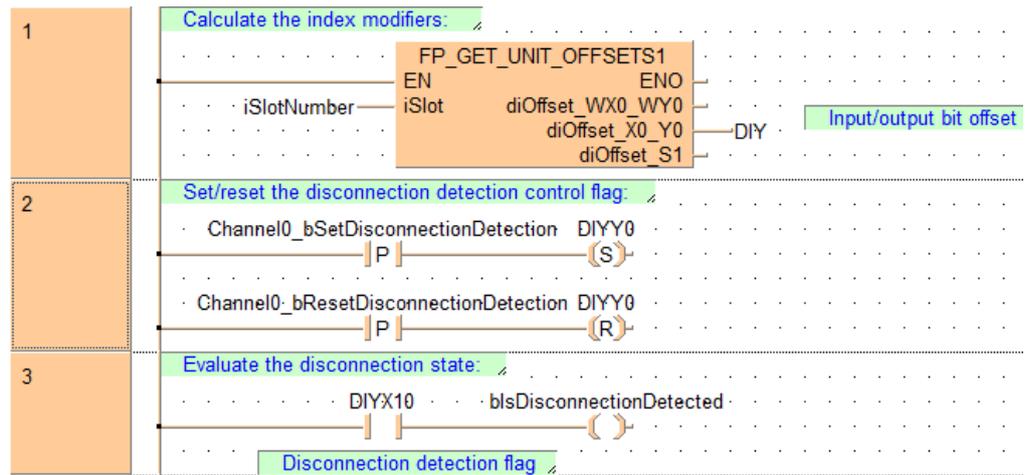
When Channel0_bSetDisconnectionDetection turns to TRUE, the disconnection detection function on channel 0 is activated. When Channel0_bResetDisconnectionDetection turns to TRUE, the disconnection detection function on channel 0 is deactivated.

When a disconnection is detected on channel 0, the disconnection detection flag turns to TRUE and the variable bIsDisconnectionDetected is set to TRUE.

| Note | Disconnection detection is only performed for a voltage range of +1 to +5V or a current range of +4 to +20mA. |

AFP7RTD

If the line at terminal A or both lines at terminal B and terminal b are disconnected, the digital output value is 30000. If only one of the lines at terminal B or b is disconnected, this is not considered a disconnection. With AFP7RTD8, the disconnection detection flag and the disconnection detection control flag cannot be used.
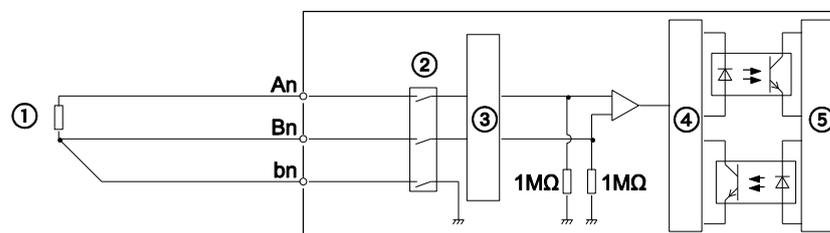
①	RTD input
②	PhotoMOS relay
③	Multiplexer
④	A/D conversion circuit
⑤	Internal circuit
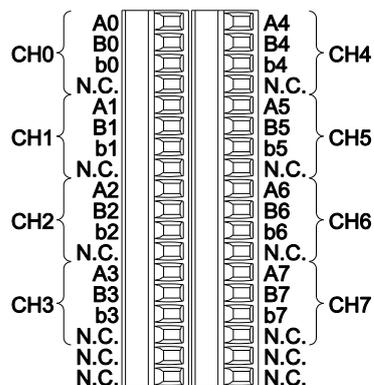
CH	Channel
N.C.	Used by the system. Do not connect anything.

6.9 Configuration by program

With the analog unit it is possible to make configuration settings by user program. Please refer to the appendix for the bit settings of each parameter (see p. 71).

To change the configuration, make the desired bit settings in the unit memory of the corresponding parameter and write "16#55AA" to unit memory UM00028.

After the configuration has been updated, unit memory UM00028 will be set to 0.

Sample program

Make the following settings by user program:

- Range setting, channel 0: K1(-100°C..600°C)
- Range setting, channel 1: K1(-100°C..600°C)
- Conversion processing, channel 2−3: Disable

POU Header

	Class	Identifier	Type	Initial
0	VAR_CONSTANT	iSlotNumber	INT	0
1	VAR	bConfigure	BOOL	FALSE
2	VAR	bConfigurationUpdateInProgress	BOOL	FALSE
3	VAR	bConfigurationUpdateComplete	BOOL	FALSE
4	VAR	bReadAnalogInputData	BOOL	FALSE
5	VAR	iChannel0InputData	INT	0
6	VAR	iChannel1InputData	INT	0

LD Body
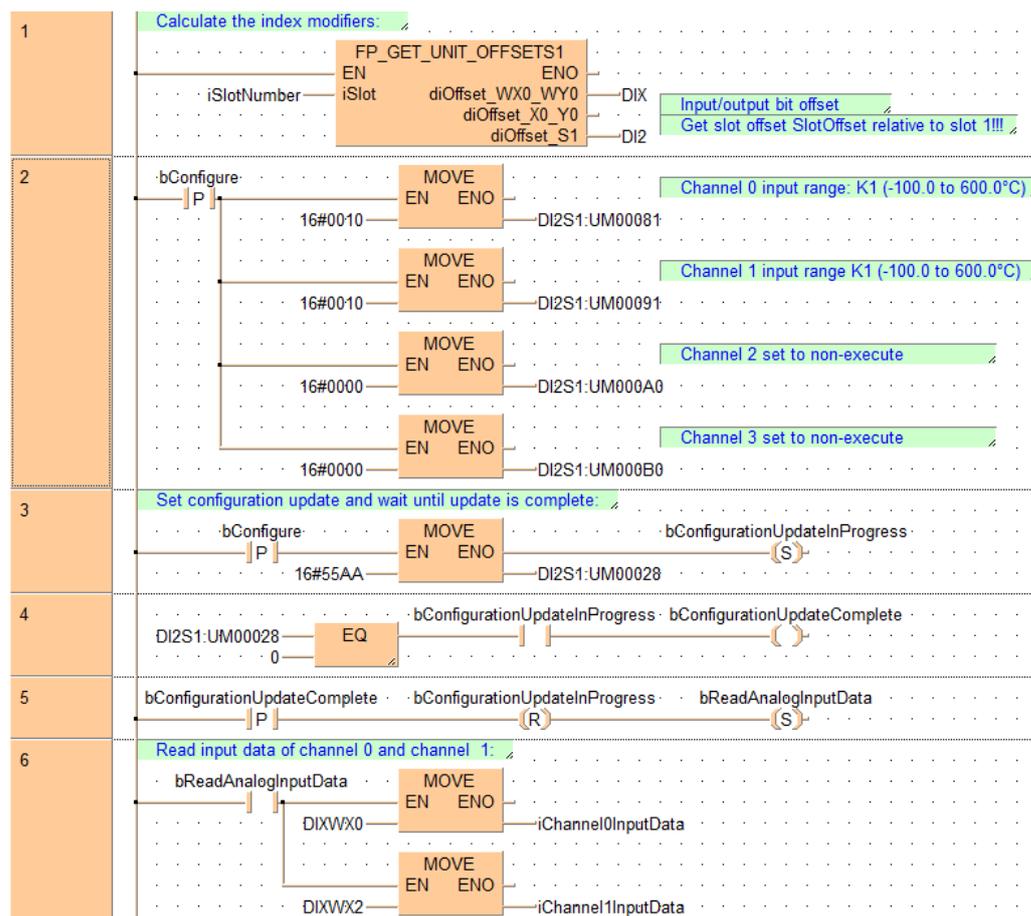
When bConfigure turns to TRUE and 16#55AA is written to unit memory UM00028, the configuration is updated. When the update is complete, 0 is written to UM00028 and writing of the output data starts.

Chapter 7

Troubleshooting

7.1 Failure in reading analog input data

If an error occurs during the reading of analog input data:

- Check that I/O allocations are correct.
- Check the connections of the terminal block.
- Check the configuration settings.

7.2 Unstable analog input value

If the analog input value is unstable:

- Use twisted pair wires and check that the wire is properly shielded.
- Check that the analog input wires are not placed close to power lines or high-tension lines or bundled with the lines.
- Check that there are no power lines, high-voltage lines, high-capacity relays, or noise-generating equipment, such as inverters, close to the analog unit.
- Check that the voltage or current range setting is set correctly.

7.3 Incorrect digital output values with current input

If no correct digital output values can be obtained with the current input:

- Check the connections of the terminal block.
- Check the connections of the input device.
- Check that the range setting has been set to current input.

Chapter 8

Specifications

8.1 General specifications

Item	Description	
Ambient temperature	0 to +55°C	
Storage temperature	-40 to +70°C	
Ambient humidity	10%–95% RH (at 25°C, non-condensing)	
Storage humidity	10%–95% RH (at 25°C, non-condensing)	
Breakdown voltage Cutoff current: 5mA (factory setting)	Input terminals/Output terminals ↔ Power supply terminal/Function earth of CPU	500V AC for 1min
	Between analog input channels	200V AC for 1min
Insulation resistance (measured with a 500V DC megger)	Input terminals/Output terminals ↔ Power supply terminal/Function earth of CPU	100MΩ (measured with a 500V DC megger)
Vibration resistance [1]	5–8.4Hz, amplitude of 3.5mm 8.4–150Hz, constant acceleration of $9.8m/s^2$ 10min on 3 axes (in X, Y, and Z direction), 10 sweeps (1 octave/min)	
Shock resistance [1]	$\geq 147m/s^2$, 3 times on 3 axes (in X, Y, and Z direction)	
Noise immunity (Power supply terminal of CPU)	1000Vp-p, with pulse widths 50ns and 1μs (based on in-house measurements)	
Operation conditions	Free from corrosive gases and excessive dust	
Conformity to CE Directives	EMC: EN 61131-2	
Overvoltage category	II	
Pollution degree	2	

[1] Based on JIS B 3502 and IEC 61131-2.

8.2 Performance specifications

AFP7TC8

Item		Description
Inputs		8 channels
Input range (Resolution)	Voltage	-10 to +10V DC (1/62500) 0 to +5V DC (1/31250) +1 to +5V DC (1/25000) [1] -100 to +100mV DC (1/62500)
	Current	0 to +20mA (1/31250) +4 to +20mA (1/25000) [2]
	Thermocouple	K1: -100.0 to 600.0°C/K2: -200.0 to 1000.0°C J1: -100.0 to 400.0°C/J2: -200.0 to 750.0°C T: -270.0 to 400.0°C N: -270.0 to 1300.0°C R: 0.0 to 1760.0°C S: 0.0 to 1760.0°C B: 0.0 to 1820.0°C E: -270.0 to 1000.0°C PLII: 0.0 to 1390.0°C WRe5-26: 0.0 to 2315.0°C
Conversion time		High-speed mode: 5ms/channel+5ms (processing time) Normal mode: 25ms/channel+25ms (processing time)
Display accuracy [3]		At +25°C: Max. ±0.1% F.S. in normal mode At 0°C to +55°C: Max. ±0.3% F.S. in normal or high-speed mode
Accuracy of reference junction compensation (Thermocouple)		±1.0°C
Input impedance	Voltage	≈1MΩ
	Current	≈250Ω
Absolute maximum input	Voltage	-15 to +15V
	Current	-30 to +30mA
Insulation method		Input terminals ↔ Internal circuit: • Optical coupler • Insulated DC-DC converter Between channels: PhotoMOS relay
Channel deactivation		To speed up conversion, disable "Conversion processing" for all unused channels.
Input range selection		Settings per channel
Average processing	Count-based average	Setting range: 2–60000 counts
	Time-based average	Setting range: 200–60000ms
	Moving average	Setting range: 3–64 counts
Offset/gain processing	Offset value	Setting range: -3000 to +3000
	Gain value	Setting range: +9000 to +11000 (90%–110%)
Scale conversion (Voltage/Current)		Setting range: -30000 to +30000
Limit alarm		Available
Maximum and minimum value hold		Available
Disconnection detection		Available for a voltage range of +1 to +5V or a current range of +4 to +20mA Available for all thermocouple types

Item	Description
Weight	145g
Current consumption	≤80mA

[1] Full scale (F.S.) for accuracy specifications is 0 to +5V.

[2] Full scale (F.S.) for accuracy specifications is 0 to +20mA.

[3] Supply power for 30 minutes or more after power-on if highly accurate measurements are required. Sudden temperature changes in the unit may temporarily affect accuracy. Keep the unit out of the direct air flow from devices such as a cooling fan in a control panel.

Note   The unit configuration, which is stored in the unit memory (UM), can be changed via the [Advanced] button in the "I/O map and unit configuration" dialog or by specifying the settings in a user program.

Display accuracy (AFP7TC8)

Thermo-couple	Input range [1]	Normal mode (25ms/channel)		High-speed mode (5ms/channel)
		Ambient temperature 25°C	Ambient temperature 0–55°C	Ambient temperature 0–55°C
K1	-100.0 to 600.0°C	0.1%	±0.3%	±0.30%
K2	-200.0 to 1000.0°C	±0.1%	±0.3%	±0.30%
J1	-100.0 to 400.0°C	±0.1%	±0.3%	±0.30%
J2	-200.0 to 750.0°C	±0.1%	±0.3%	±0.30%
T	-270.0 to -200.0°C	[2]	[2]	[2]
	-200.0 to 0.0°C	±0.15%	±0.3%	±0.30%
	0.0 to 400.0°C	±0.1%	±0.3%	±0.30%
N	-270.0 to -200.0°C	[2]	[2]	[2]
	-200.0 to 0.0°C	±0.15%	±0.3%	±0.30%
	0.0 to 1300.0°C	±0.1%	±0.3%	±0.30%
R	0.0 to 300.0°C	±0.15%	±0.3%	±1.00%
	300.0 to 1760.0°C	±0.1%	±0.3%	±0.30%
S	0.0 to 300.0°C	±0.15%	±0.3%	±1.00%
	300.0 to 1760.0°C	±0.1%	±0.3%	±0.30%
B	0.0 to 400.0°C	[2]	[2]	[2]
	400.0 to 800.0°C	±0.15%	±0.3%	±1.00%
	800.0 to 1820.0°C	±0.1%	±0.3%	±0.30%
E	-270.0 to -200.0°C	[2]	[2]	[2]
	-200.0 to 0.0°C	±0.15%	±0.3%	±1.00%
	0.0 to 1000.0°C	±0.1%	±0.3%	±0.30%
PLII	0.0 to 1390.0°C	±0.1%	±0.3%	±0.30%
WRe5-26	0.0 to 2315.0°C	±0.1%	±0.3%	±0.30%

[1] Accuracy of measurements ±15°C outside the rated range cannot be guaranteed.

[2] Temperature measurement is possible, but accuracy cannot be guaranteed.

AFP7RTD

Item	Description
Inputs	8 channels
Input range (Resolution: 0.1°C)	Pt100 (1): -100.0 to 200.0°C Pt100 (2): -200.0 to 650.0°C JPt100 (1): -100.0 to 200.0°C JPt100 (2): -200.0 to 650.0°C Pt1000: -100.0 to 100.0°C
Conversion time	25ms/channel+25ms (processing time)
Total accuracy [1]	Max. ±0.1% F.S. at +25°C Max. ±0.3% F.S. at 0°C to +55°C
Allowable signal source resistance	RTD input: 30Ω (3-wire balance)
Insulation method	Input terminals ↔ Internal circuit: • Optical coupler • Insulated DC-DC converter Between channels: PhotoMOS relay
Channel deactivation	To speed up conversion, disable "Conversion processing" for all unused channels.
Input range selection	Settings per channel

Average processing	Count-based average	Setting range: 2–60000 counts
	Time-based average	Setting range: 200–60000ms
	Moving average	Setting range: 3–64 counts
Offset/gain processing	Offset value	Setting range: -3000 to +3000
	Gain value	Setting range: +9000 to +11000 (90%–110%)

Limit alarm	Available
Maximum and minimum value hold	Available
Disconnection detection	Available
Weight	145g
Current consumption	≤65mA

[1] Supply power for 30 minutes or more after power-on if highly accurate measurements are required.

Note   The unit configuration, which is stored in the unit memory (UM), can be changed via the [Advanced] button in the "I/O map and unit configuration" dialog or by specifying the settings in a user program.

8.3 I/O allocation

8.3.1 Digital values and status flags

After A/D conversion, the digital output values are written to the CPU's input area (WX) and processed. Status flags are also allocated to the CPU's inputs.

The I/O addresses in the table show offset addresses. I/O addresses actually allocated are based on the first word number allocated to the unit. Example: If the first word address is 10, the address numbers for the digital output value and the error flag on channel 0 will be WX10 and X11F, respectively.

Channel 0–3

I/O addresses								Name
Channel 0		**Channel 1**		**Channel 2**		**Channel 3**		
WX0	X0–XF	WX2	X20–X2F	WX4	X40–X4F	WX6	X60–X6F	Digital output value (16 bits)[1]
WX1	X10	WX3	X30	WX5	X50	WX7	X70	Disconnection detection flag [2]
	X11		X31		X51		X71	High limit alarm flag [3]
	X12		X32		X52		X72	Low limit alarm flag [4]
	X13		X33		X53		X73	Limit alarm active flag [5]
	X14		X34		X54		X74	Not used
	X15		X35		X55		X75	Maximum/minimum hold active flag [6]
	X16–X1E		X36–X3E		X56–X5E		X76–X7E	Not used
	X1F		X3F		X5F		X7F	Error flag [7]

Channel 4–7

I/O addresses								Name
Channel 4		**Channel 5**		**Channel 6**		**Channel 7**		
WX8	X80–8XF	WX10	X100–X10F	WX4	X40–X4F	WX6	X60–X6F	Digital output value (16 bits)[1]
WX9	X90	WX11	X110	WX13	X130	WX15	X150	Disconnection detection flag [2]
	X91		X111		X131		X151	High limit alarm flag [3]
	X92		X112		X132		X152	Low limit alarm flag [4]
	X93		X113		X133		X153	Limit alarm active flag [5]
	X94		X114		X134		X154	Not used
	X95		X115		X135		X155	Maximum/minimum hold active flag [6]
	X96–X9E		X116–X11E		X136–X13E		X156–X15E	Not used
	X9F		X11F		X13F		X15F	Error flag [7]

1) Digital output value

Memory area for digital values after conversion of the analog input values. If scale conversion has been set, the corresponding scaled values are stored here.

Thermocouple input:

Thermocouple	Temperature	Digital output value
K1	-100.0 to +600.0°C	-1000 to +6000
K2	-200.0 to +1000.0°C	-2000 to +10000
J1	-100.0 to +400.0°C	-1000 to +4000
J2	-200.0 to +750.0°C	-2000 to +7500
T	-270.0 to +400.0°C	-2700 to +4000
N	-270.0 to +1300.0°C	-2700 to +13000
R	0.0 to +1760.0°C	0 to +17600
S	0.0 to +1760.0°C	0 to +17600
B	0.0 to +1820.0°C	0 to +18200
E	-270.0 to +1000.0°C	-2700 to +10000
PLII	0.0 to +1390.0°C	0 to +13900
Wre5-26	0.0 to +2315.0°C	0 to +23150

Voltage input:

Voltage range	Digital output value
-10 to +10V	-31250 to +31250
0 to +5V	0 to +31250
+1 to +5V	0 to +25000
-100 to +100mV	-31250 to +31250

Current input:

Current range	Digital output value
0 to +20mA	0 to +31250
+4 to +20mA	0 to +25000

RTD input:

RTD	Temperature	Digital output value
Pt100-1	-100.0 to +200.0°C	-1000 to +2000
Pt100-2	-200.0 to +650.0°C	-2000 to +6500
JPt100-1	-100.0 to +200.0°C	-1000 to +2000
JPt100-2	-200.0 to +650.0°C	-2000 to +6500
Pt1000	-100.0 to +100.0°C	-1000 to +1000

2) Disconnection detection flag

TRUE when a disconnection has been detected.

FALSE when the connection has been restored.

(Valid for thermocouple input and 1–5V and 4–20mA ranges only.)

3) High limit alarm flag

TRUE when the digital output value exceeds the switch-on value for high limit alarm.

4) Low limit alarm flag

TRUE when the digital output value drops below the switch-on value for low limit alarm.

5) Limit alarm active flag

TRUE when the limit alarm function is active.

6) Maximum/minimum hold active flag

TRUE when the maximum and minimum value hold function is active.

7) Error flag

TRUE when an error has occurred.

8.3.2 Control flags

Control flags are allocated to the CPU's output area.

The I/O addresses in the table show offset addresses. I/O addresses actually allocated are based on the first word number allocated to the unit. Example: If the first word number is 10, the address numbers for the disconnection detection execution flag and the error flag reset flag on channel 0 will be Y100 and Y10F, respectively.

Channel 0–3

I/O addresses								Name
Channel 0		Channel 1		Channel 2		Channel 3		
WY0	Y0	WY1	Y10	WY2	Y20	WY3	Y30	Disconnection detection control flag [1]
	Y1–Y2		Y11–Y12		Y21–Y22		Y31–Y32	Not used
	Y3		Y13		Y23		Y33	Limit alarm control flag [2]
	Y4		Y14		Y24		Y34	Not used
	Y5		Y15		Y25		Y35	Maximum/minimum hold control flag [3]
	Y6–YE		Y16–Y1E		Y26–Y27		Y36–Y37	Not used
	YF		Y1F		Y2F		Y3F	Error reset flag [4]

Channel 4–7

I/O addresses								Name
Channel 4		Channel 5		Channel 6		Channel 7		
WY4	Y40	WY5	Y50	WY6	Y60	WY7	Y70	Disconnection detection control flag [1]
	Y41–Y42		Y51–Y52		Y61–Y62		Y71–Y72	Not used
	Y43		Y53		Y63		Y73	Limit alarm control flag [2]
	Y44		Y54		Y64		Y74	Not used
	Y45		Y55		Y65		Y75	Maximum/minimum hold control flag [3]
	Y46–Y4E		Y56–Y5E		Y66–Y67		Y76–Y77	Not used
	Y4F		Y5F		Y6F		Y7F	Error reset flag [4]

[1] **Disconnection detection control flag**

> TRUE to execute the disconnection detection function.
>
> FALSE to turn the disconnection detection flag (Xn0) to FALSE.
>
> (Valid for 1–5V and 4–20mA ranges only.)

[2] **Limit alarm control flag**

> TRUE to execute the limit alarm function.
>
> FALSE to turn the high limit alarm flag (Xn1) and low limit alarm flag (Xn2) to FALSE.

[3] **Maximum/minimum hold control flag**

> TRUE to execute the maximum/minimum hold function.
>
> FALSE to turn the maximum/minimum hold active flag (Xn5) to FALSE.

4) Error reset flag

TRUE to reset the error flag (XnF).

8.4 Unit memory addresses

8.4.1 Allocation of unit memory addresses

There is no need to set unit memory values, because unit memory values will be written automatically if they are set in the "Analog unit settings" dialog of Control FPWIN Pro. To change parameters by user program, write the desired value to the parameter's unit memory address.

Channel 0–3

Setting item		Unit memory address			
		Channel 0	Channel 1	Channel 2	Channel 3
Unit memory update		UM00028			
Power frequency		UM00071			
Conversion time		UM00072			
Conversion processing		UM00080	UM00090	UM000A0	UM000B0
Range setting		UM00081	UM00091	UM000A1	UM000B1
Function setting 1	Average processing Offset/gain processing Scale conversion	UM00082	UM00092	UM000A2	UM000B2
Function setting 2	Limit alarm Maximum and minimum value hold Disconnection detection Disconnection detection reset	UM00083	UM00093	UM000A3	UM000B3
Average count or time period		UM00084	UM00094	UM000A4	UM000B4
Offset value		UM00085	UM00095	UM000A5	UM000B5
Gain value		UM00086	UM00096	UM000A6	UM000B6
Scale conversion	Upper limit of scale	UM00087	UM00097	UM000A7	UM000B7
	Lower limit of scale	UM00088	UM00098	UM000A8	UM000B8
Limit alarm	High limit alarm switch-on value	UM00089	UM00099	UM000A9	UM000B9
	High limit alarm switch-off value	UM0008A	UM0009A	UM000AA	UM000BA
	Low limit alarm switch-off value	UM0008B	UM0009B	UM000AB	UM000BB
	Low limit alarm switch-on value	UM0008C	UM0009C	UM000AC	UM000BC
Maximum and minimum value hold	Maximum hold value	UM00170	UM00171	UM00172	UM00173
	Minimum hold value	UM00178	UM00179	UM0017A	UM0017B

Channel 4–7

Setting item		Unit memory address			
		Channel 4	Channel 5	Channel 6	Channel 7
Unit memory update		UM00028			
Power frequency		UM00071			
Conversion time		UM00072			
Conversion processing		UM000C0	UM000D0	UM000E0	UM000F0
Range setting		UM000C1	UM000D1	UM000E1	UM000F1
Function setting 1	Average processing Offset/gain processing Scale conversion	UM000C2	UM000D2	UM000E2	UM000F2
Function setting 2	Limit alarm Maximum and minimum value hold Disconnection detection Disconnection detection reset	UM000C3	UM000D3	UM000E3	UM000F3
Average count or time period		UM000C4	UM000D4	UM000E4	UM000F4
Offset value		UM000C5	UM000D5	UM000E5	UM000F5
Gain value		UM000C6	UM000D6	UM000E6	UM000F6
Scale conversion	Upper limit of scale	UM000C7	UM000D7	UM000E7	UM000F7
	Lower limit of scale	UM000C8	UM000D8	UM000E8	UM000F8
Limit alarm	High limit alarm switch-on value	UM000C9	UM000D9	UM000E9	UM000F9
	High limit alarm switch-off value	UM000CA	UM000DA	UM000EA	UM000FA
	Low limit alarm switch-off value	UM000CB	UM000DB	UM000EB	UM000FB
	Low limit alarm switch-on value	UM000CC	UM000DC	UM000EC	UM000FC
Maximum and minimum value hold	Maximum hold value	UM00174	UM00175	UM00176	UM00177
	Minimum hold value	UM0017C	UM0017D	UM0017E	UM0017F

System memory areas

Memory area	Unit memory address
Reserved for the system	UM00000 to UM0006F (UM00028 can be set)
Configuration area	UM00070 to UM000FF
Reserved for the system	UM00100 to UM0016F
Monitor area	UM00170 to UM001FF
Reserved for the system	UM00200 to UM0FFFF

8.4.2 Bit settings in unit memory areas

General settings (common to all channels)

Unit memory address	Name	Default	Setting range
UM00028	Unit memory up-date	16#0	16#0: Unused 16#55AA: Refresh unit configuration To change the configuration, make the desired bit settings in the unit memory of the corresponding parameter and write "16#55AA" to unit memory UM00028. After the configuration has been updated, unit memory UM00028 will be set to 0.
UM00071	Power frequency	16#0	16#0: 60Hz 16#1: 50Hz
UM00072	Conversion time	16#0	16#0: 25ms 16#1: 5ms

Individual settings for AFP7TC8 (settings per channel)

The unit memory addresses are listed in ascending order for the supported channels (e.g. first unit memory address applies to channel 0, second to channel 1 etc.).

Unit memory address	Name	Default	Setting range
UM00080 UM00090 UM000A0 UM000B0 UM000C0 UM000D0 UM000E0 UM000F0	Conversion processing	16#1	16#0: Disable 16#1: Enable
UM00081 UM00091 UM000A1 UM000B1 UM000C1 UM000D1 UM000E1 UM000F1	Range setting	16#1	16#1: Voltage input -10 to +10V 16#2: Voltage input 0 to +5V 16#3: Voltage input 1 to +5V 16#4: Voltage input -100 to +100mV 16#5: Current input 0 to +20mA 16#6: Current input +4 to +20mA 16#10: Thermocouple input K1(-100.0°C to 600.0°C) 16#11: Thermocouple input K2(-200.0°C to 1000.0°C) 16#12: Thermocouple input J1(-100.0°C to 400.0°C) 16#13: Thermocouple input J2(-200.0°C to 750.0°C) 16#14: Thermocouple input T(-270.0°C to 400.0°C) 16#15: Thermocouple input N(-270.0°C to 1300.0°C) 16#16: Thermocouple input R(0.0°C to 1760.0°C) 16#17: Thermocouple input S(0.0°C to 1760.0°C) 16#18: Thermocouple input B(0.0°C to 1820.0°C) 16#19: Thermocouple input E(-270.0°C to 1000.0°C) 16#1A: Thermocouple input PLII(0.0°C to 1390.0°C) 16#1B: Thermocouple input WRe5-26(0.0°C to 2315.0°C)

Unit memory address	Name	Default	Setting range	
UM00082 UM00092 UM000A2 UM000B2 UM000C2 UM000D2 UM000E2 UM000F2	Average pro-cessing	16#0	Bit 0-3	16#0: Disable 16#1: Count-based average 16#2: Time-based average 16#4: Moving average
	Offset/gain pro-cessing	16#0	Bit 4–7	16#0: Disable 16#1: Enable
	Scale conversion	16#0	Bit 8–11	16#0: Disable 16#1: Enable
			Bit 12–15	Not used
UM00083 UM00093 UM000A3 UM000B3 UM000C3 UM000D3 UM000E3 UM000F3	Limit alarm	16#0	Bit 0-3	16#0: Disable 16#1: Enable
	Maximum and minimum value hold	16#0	Bit 4–7	16#0: Disable 16#1: Enable
	Disconnection detection	16#0	Bit 8–11	16#0: Disable 16#1: Enable
	Disconnection detection reset	16#0	Bit 12–15	16#0: Automatic 16#1: Manual
UM00084 UM00094 UM000A4 UM000B4 UM000C4 UM000D4 UM000E4 UM000F4	Average count or time period	200	To apply the setting, an average processing method must be enabled. Count-based average: 2–60000[*] counts Time-based average: 200–60000ms[*] Moving average: 3–64[*] counts [*] (specified with an unsigned integer)	
UM00085 UM00095 UM000A5 UM000B5 UM000C5 UM000D5 UM000E5 UM000F5	Offset value	0	To apply the setting, "Offset/gain processing" must be enabled. Setting range: -3000 to +3000 (specified with a signed integer)	
UM00086 UM00096 UM000A6 UM000B6 UM000C6 UM000D6 UM000E6 UM000F6	Gain value	10000	To apply the setting, "Offset/gain processing" must be enabled. Setting range: +9000 to +11000: 0.9x to 1.1x (specified with a signed integer)	
UM00087 UM00097 UM000A7 UM000B7 UM000C7 UM000D7 UM000E7 UM000F7	Upper limit of scale	10000	To apply the setting, "Scale conversion" must be enabled. Setting range: -30000 to +30000 (specified with a signed integer)	

Unit memory address	Name	Default	Setting range
UM00088 UM00098 UM000A8 UM000B8 UM000C8 UM000D8 UM000E8 UM000F8	Lower limit of scale	0	
UM00089 UM00099 UM000A9 UM000B9 UM000C9 UM000D9 UM000E9 UM000F9	High limit alarm switch-on value	0	To apply the setting, "Limit alarm" must be enabled. Setting range: -31250 to +31250 (specified with a signed integer)
UM0008A UM0009A UM000AA UM000BA UM000CA UM000DA UM000EA UM000FA	High limit alarm switch-off value	0	
UM0008B UM0009B UM000AB UM000BB UM000CB UM000DB UM000EB UM000FB	Low limit alarm switch-off value	0	
UM0008C UM0009C UM000AC UM000BC UM000CC UM000DC UM000EC UM000FC	Low limit alarm switch-on value	0	

Individual settings for AFP7RTD (settings per channel)

The unit memory addresses are listed in ascending order for the supported channels (e.g. first unit memory address applies to channel 0, second to channel 1 etc.).

Unit memory address	Name	Default	Setting range		
UM00080 UM00090 UM000A0 UM000B0 UM000C0 UM000D0 UM000E0 UM000F0	Conversion processing	16#1	16#0: Disable 16#1: Enable		
UM00081 UM00091 UM000A1 UM000B1 UM000C1 UM000D1 UM000E1 UM000F1	Range setting	16#1	16#1: RTD input Pt100-1(-100.0°C to 200.0°C) 16#2: RTD input Pt100-2(-200.0°C to 650.0°C) 16#3: RTD input JPt100-1(-100.0°C to 200.0°C) 16#4: RTD input JPt100-2(-200.0°C to 650.0°C) 16#5: RTD input Pt1000-1(-100.0°C to 100.0°C)		
UM00082 UM00092 UM000A2 UM000B2 UM000C2 UM000D2 UM000E2 UM000F2	Average processing	16#0	Bit 0-3	16#0: Disable 16#1: Count-based average 16#2: Time-based average 16#4: Moving average	
	Offset/gain processing	16#0	Bit 4-7	16#0: Disable 16#1: Enable	
	Scale conversion	16#0	Bit 8-11	16#0: Disable 16#1: Enable	
			Bit 12-15	Not used	
UM00083 UM00093 UM000A3 UM000B3 UM000C3 UM000D3 UM000E3 UM000F3	Limit alarm	16#0	Bit 0-3	16#0: Disable 16#1: Enable	
	Maximum and minimum value hold	16#0	Bit 4-7	16#0: Disable 16#1: Enable	
UM00084 UM00094 UM000A4 UM000B4 UM000C4 UM000D4 UM000E4 UM000F4	Average count or time period	200	To apply the setting, an average processing method must be enabled. Count-based average: 2−60000[*) counts Time-based average: 200−60000ms[*) Moving average: 3−64[*) counts [*) (specified with an unsigned integer)		
UM00085 UM00095 UM000A5 UM000B5 UM000C5 UM000D5 UM000E5 UM000F5	Offset value	0	To apply the setting, "Offset/gain processing" must be enabled. Setting range: -3000 to +3000 (specified with a signed integer)		

| Unit memory address	Name	Default	Setting range
UM00086 UM00096 UM000A6 UM000B6 UM000C6 UM000D6 UM000E6 UM000F6	Gain value	10000	To apply the setting, "Offset/gain processing" must be enabled. Setting range: +9000 to +11000: 0.9x to 1.1x (specified with a signed integer)
UM00087 UM00097 UM000A7 UM000B7 UM000C7 UM000D7 UM000E7 UM000F7	Upper limit of scale	10000	To apply the setting, "Scale conversion" must be enabled. Setting range: -30000 to +30000 (specified with a signed integer)
UM00088 UM00098 UM000A8 UM000B8 UM000C8 UM000D8 UM000E8 UM000F8	Lower limit of scale	0	
UM00089 UM00099 UM000A9 UM000B9 UM000C9 UM000D9 UM000E9 UM000F9	High limit alarm switch-on value	0	To apply the setting, "Limit alarm" must be enabled. Setting range: -31250 to +31250 (specified with a signed integer)
UM0008A UM0009A UM000AA UM000BA UM000CA UM000DA UM000EA UM000FA	High limit alarm switch-off value	0	
UM0008B UM0009B UM000AB UM000BB UM000CB UM000DB UM000EB UM000FB	Low limit alarm switch-off value	0	
UM0008C UM0009C UM000AC UM000BC UM000CC UM000DC UM000EC UM000FC	Low limit alarm switch-on value	0	

Maximum and minimum value hold areas (per channel)

To monitor a value, "Maximum and minimum value hold" must be enabled.

The unit memory addresses are listed in ascending order for the supported channels (e.g. first unit memory address applies to channel 0, second to channel 1 etc.).

Unit memory address	Name	Default	Description
UM00170 UM00171 UM00172 UM00173 UM00174 UM00175 UM00176 UM00177	Maximum hold value	0	Maximum range: -31250 to +31250 (specified with a signed integer)
UM00178 UM00179 UM0017A UM0017B UM0017C UM0017D UM0017E UM0017F	Minimum hold value	0	

8.5 Dimensions

Record of changes

Manual no.	Date	Description of changes
ACGM0705V1EN	07/2015	First edition
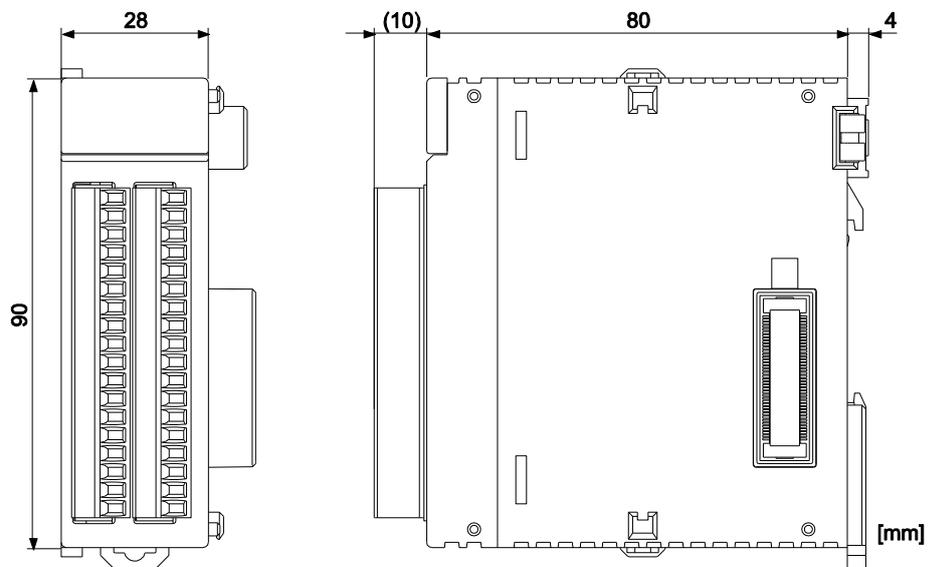
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