Panasonic®

PROGRAMMABLE CONTROLLER

FP0 A/D Converter Unit

Technical Manual

ARCT1F321E-4

2012.9 | 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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Expansion Limit and Compatibility

Expansion limit

The unit can be connected to a combined maximum of three other expansion units and intelligent units.

Compatibility with the previous FP0 analog unit (FP0–A21)

Due to differences in the software design, the programming method is different.

Chapter 1

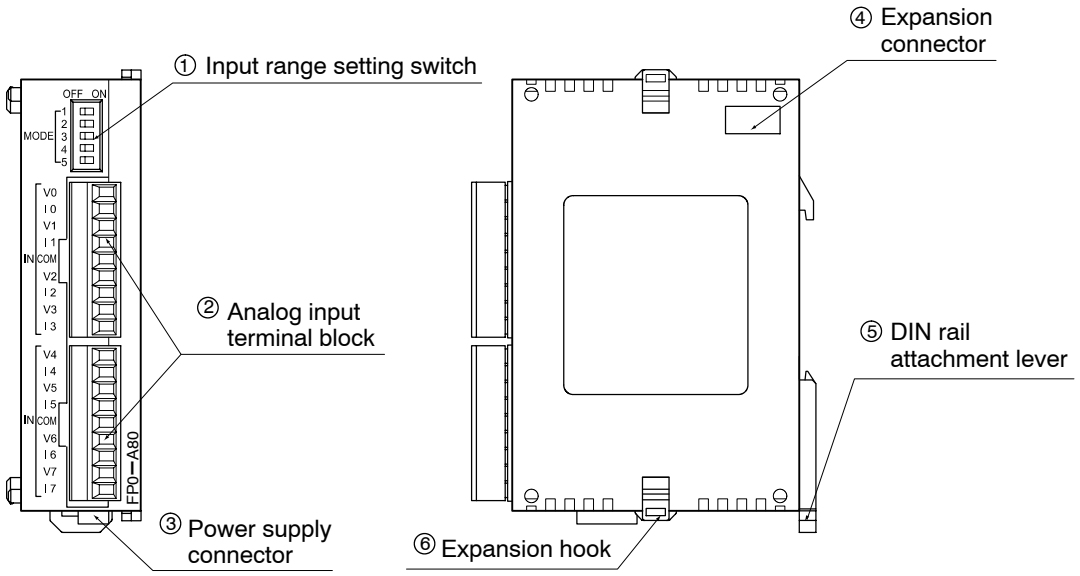
Parts and Terminology

1.1 Parts and Functions . . . . . 1 – 3

1.2 Analog Input Terminal Block . . . . . 1 – 4

1.1 Parts and Functions

FP0–A80 A/D converter unit: AFP0401



① **Input range setting switch (voltage/current)**

This switch is used to change the input mode (between voltage and current). All eight input channels of the A/D converter unit operate at the same level. Refer to page 3–3 for details.

② **Analog input terminal block (9-pin)**

Use a terminal block socket made by Phoenix Contact Co. (product number: 1840434).

③ **Power supply connector**

Supply 24V DC. It is connected using the power supply cable (AFP0581) that comes with the unit.

④ **Expansion connector**

connects an expansion unit to the internal circuit of the this unit.

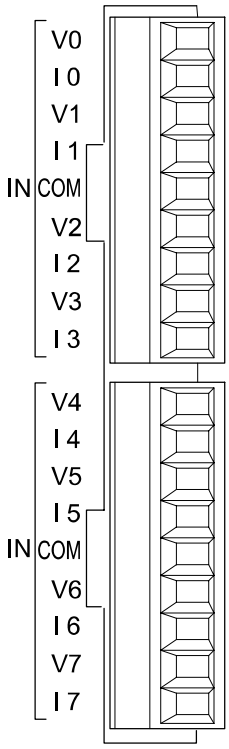
⑤ **DIN rail attachment lever**

allows simple attachment to a DIN rail. The lever is also used for installation on FP0 slim type mounting plate (AFP0803).

⑥ **Expansion hook**

is used to secure expansion units.

1.2 Analog Input Terminal Block



Pin number	Name	Description
1	V0	Analog input channel 0, voltage input
2	I0	Analog input channel 0, current input
3	V1	Analog input channel 1, voltage input
4	I1	Analog input channel 1, current input
5	COM	Analog input, input common
6	V2	Analog input channel 2, voltage input
7	I2	Analog input channel 2, current input
8	V3	Analog input channel 3, voltage input
9	I3	Analog input channel 3, current input

1	V4	Analog input channel 4, voltage input
2	I4	Analog input channel 4, current input
3	V5	Analog input channel 5, voltage input
4	I5	Analog input channel 5, current input
5	COM	Analog input, input common
6	V6	Analog input channel 6, voltage input
7	I6	Analog input channel 6, current input
8	V7	Analog input channel 7, voltage input
9	I7	Analog input channel 7, current input

Notes

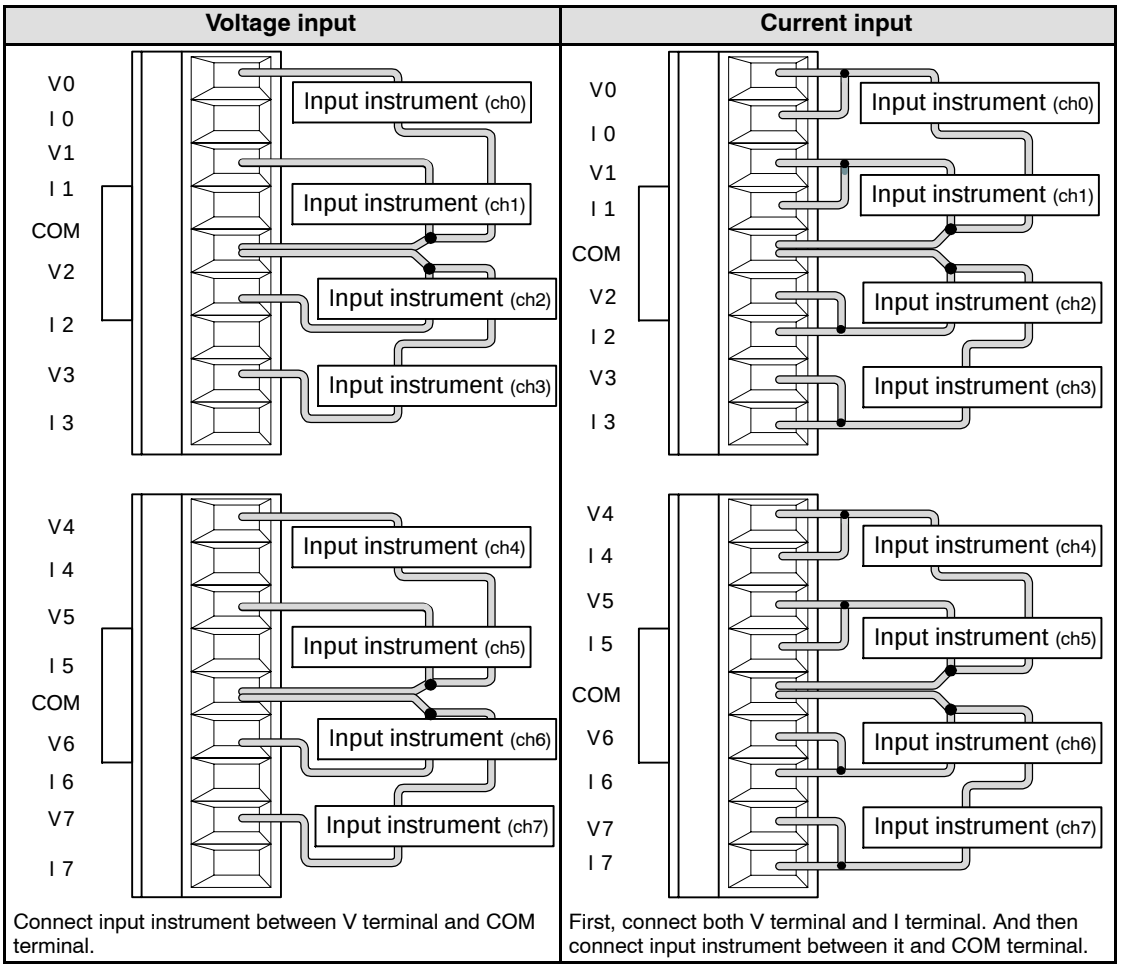
- **When the analog input is a current signal, short the V and I input pins externally.**
- **The two COM terminals are connected internally.**

Chapter 2

Connection to Input Devices

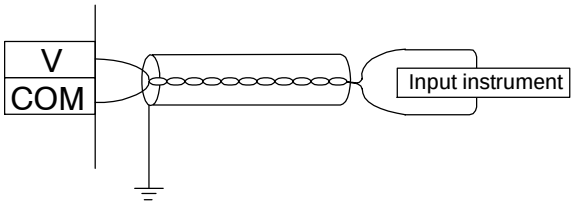
2.1 Wiring . . . . . 2 – 3

2.1 Wiring



Notes

- **Tie the COM connectors for two channels together as indicated by the black circles ("•") in the diagram above so that no more than two wires go to each COM terminal.**
- **The two COM terminals are connected internally.**
- **We recommend that you use dual–core twisted pair shielded wiring for the analog input wiring, and that you connect the shield to earth.**



2.1 Wiring

Chapter 3

Input Range Setting

3.1 Input Range Setting Switch . . . . . 3 – 3

3.1 Input Range Setting Switch

Mode	Switch number	Range		
Analog input range	1 and 2	0 to 5V 0 to 20mA *1	–10 to 10V	–100 to 100mV
	1 2 ON			or

Number of input channels	3 and 4	Conver-sion channel	Number of input channels	Conver-sion channel	Number of input channels	Conver-sion channel	Number of input channels	Conver-sion channel	Number of input channels
		ch0 and 1	2	ch0 to 3	4	ch0 to 5	6	ch0 to 7	8
	3 4 ON								

Averaging function	5	No averaging ∗2	with averaging ∗3
	5 ON		

Notes

- **(∗1) It is possible to use the 0 to 5V range and 0 to 20mA range together.**
- **(∗2) The A/D conversion data is set for the specified input contact point area for each A/D conversion, on each channel.**
- **(∗3) On each channel, for each A/D conversion, the maximum and minimum values from the data of the last ten times are excluded, and the data from the other eight times is averaged, and the result set. (Use when the environment contains much noise.)**
- **The switch reads only once when the power supply of FP0 control unit is turned on.**

3.1 Input Range Setting Switch

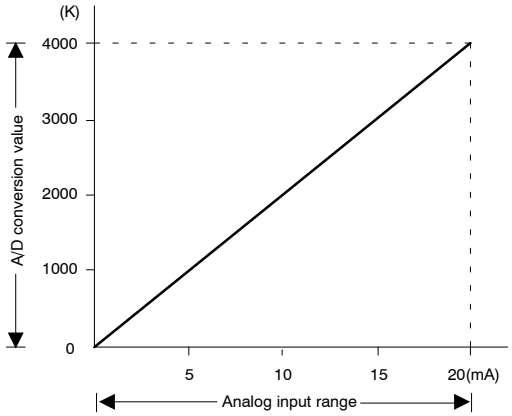
Chapter 4

A/D Conversion Characteristics

4.1 A/D Conversion Characteristics . . . . . 4 – 3

4.1 A/D Conversion Characteristics

Current range: 0 to 20mA DC input



Correspondence table of A/D conversion values

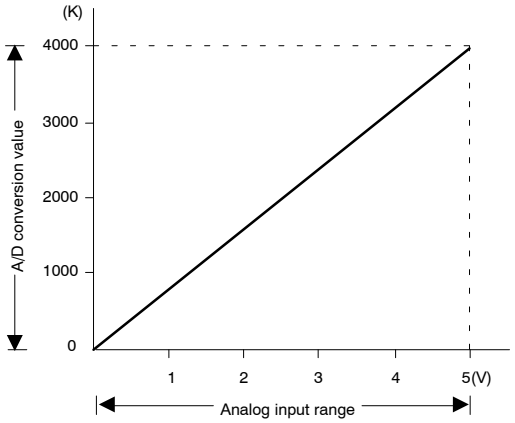
Input current (mA)	A/D conversion value
0.0	0
2.5	500
5.0	1000
7.5	1500
10.0	2000
12.5	2500
15.0	3000
17.5	3500
20.0	4000

Processing if the range is exceeded

Input value	Converted value
0mA or less (including negative value)	0
20mA or more	4000

4.1 A/D Conversion Characteristics

Voltage range: 0 to 5V DC input



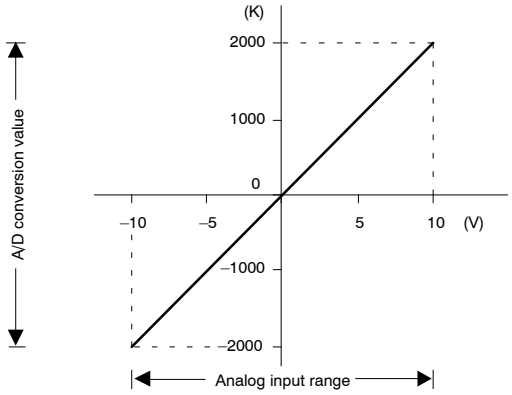
Correspondence table of A/D conversion values

Input voltage (V)	A/D conversion value
0.0	0
0.5	400
1.0	800
1.5	1200
2.0	1600
2.5	2000
3.0	2400
3.5	2800
4.0	3200
4.5	3600
5.0	4000

Processing if the range is exceeded

Input value	Converted value
0V or less (including negative value)	0
5V or more	4000

Voltage range: –10 to +10V DC input



Correspondence table of A/D conversion values

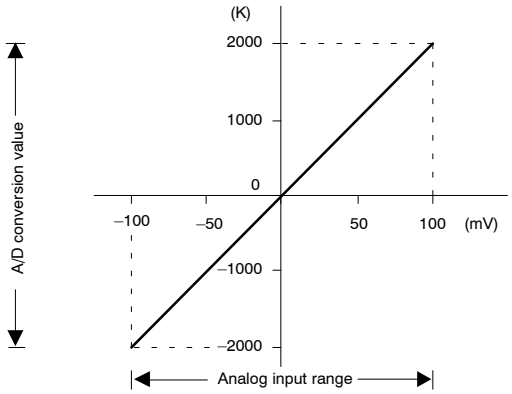
Input voltage (V)	A/D conversion value
–10.0	–2000
–7.5	–1500
–5.0	–1000
–2.5	–500
0.0	0
+2.5	+500
+5.0	+1000
+7.5	+1500
+10.0	+2000

Processing if the range is exceeded

Input value	Converted value
–10V or less	–2000
+10V or more	+2000

4.1 A/D Conversion Characteristics

Voltage range: –100 to +100mV DC input



Correspondence table of A/D conversion values

Input voltage (mV)	A/D conversion value
–100.0	–2000
–75.0	–1500
–50.0	–1000
–25.0	–500
0.0	0
+25.0	+500
+50.0	+1000
+75.0	+1500
+100.0	+2000

Processing if the range is exceeded

Input value	Converted value
–100mV or less	–2000
+100mV or more	+2000

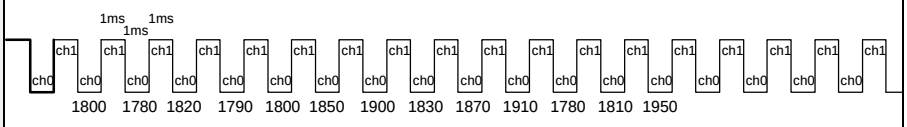
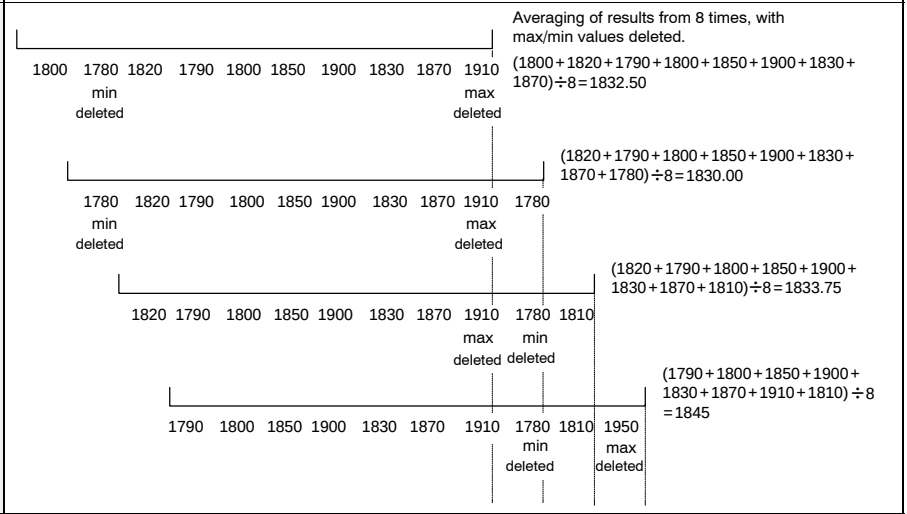
Chapter 5

Averaging for Voltage Ranges and Current Ranges

5.1 Averaging Function . . . . . 5 – 3

5.1 Averaging Function

When the averaging function is set to on, the internal processing of the A/D conversion unit is as shown in the diagram below (in this example there are two input channels, and the input range setting switch Nos. 3 and 4 are off).

Operation item	Time chart
Analog input value for ch0 (Reading time)	
Internal processing for A/D conversion unit ch0	
Digital output value for ch0	

The largest and smallest values from the most recent 10 data values are deleted, and the remaining eight values are averaged and output on WX2 and WX3. The values output at this time always use the most recent averaged value (decimals are discarded).

5.1 Averaging Function

Chapter 6

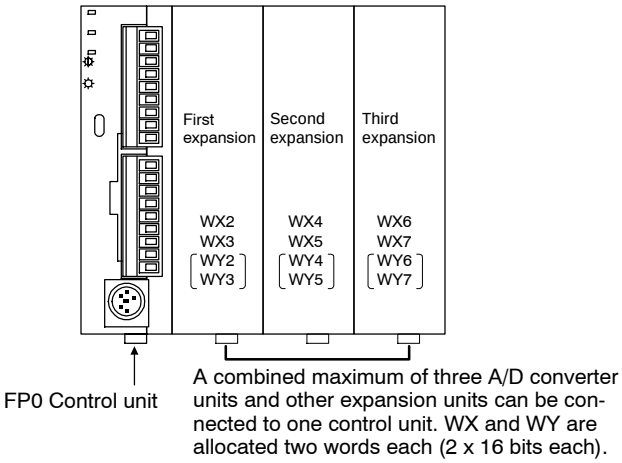
I/O Allocation and Program

6 .1 I/O Number of A/D Converter Unit . . . . . 6 – 3

6 .2 Program of A/D Converter Unit . . . . . 6 – 5

6.1 I/O Number of A/D Converter Unit

I/O number of A/D converter unit

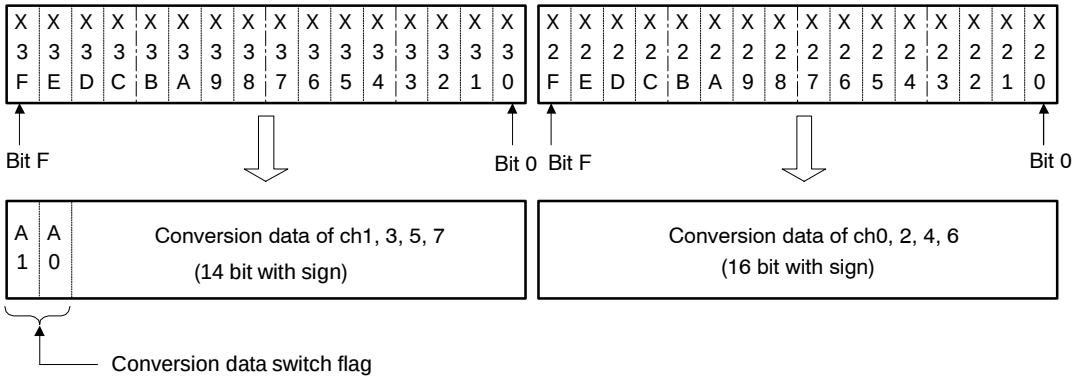


With the setup illustrated in the diagram on the above, the data for each channel is allocated as I/O data as indicated in the table below.

A/D converter unit input channel	First expansion	Second expansion	Third expansion
ch0, 2, 4, 6 (Each 16 points)	WX2 (X20 to X2F)	WX4 (X40 to X4F)	WX6 (X60 to X6F)
ch1, 3, 5, 7 (Each 16 points)	WX3 (X30 to X3F)	WX5 (X50 to X5F)	WX7 (X70 to X7F)

Example of I/O allocation

Allocation of each channel's conversion data and WX2 and WX3 when this unit is connected to the first expansion.



A1	A0	WX3	WX2
0	**0**	ch1 data	ch0 data
0	**1**	ch3 data	ch2 data
1	**0**	ch5 data	ch4 data
1	**1**	ch7 data	ch6 data

About the conversion data switch flags

The resolution of the A/D converter unit is 12 bits, but when data is transferred to the control unit, it is converted to 16–bit data. Therefore, although the WX2 data requires no processing, for the WX3 data, the top two bits are used as conversion data switching flags. Accordingly, the top two bits are processed as follows.

When the A/D conversion data is negative “–”, the WX2 and WX3 data become two’s complement.
In other words, bit C to bit F of WX2 and bit C to bit D of WX3 become “1”.
Also, because the top two bits of WX3 are used as conversion data switch flags, masking is required so that the bits are “00” when the conversion data is positive “+”, and “11” when the conversion data is negative “–”.

ch3 data	WX3	→	Data after masking
1	0100000000000001	→	0000000000000001
–1	0111111111111111	→	1111111111111111

Conversion data switch flags Mask applied to the above values

6.2 Program of A/D Converter Unit

Ladder program example for loading data from each channel

Indicates the program that stores in data registers DT0 to DT7 the from ch0 to ch7 A/D conversion data that is assigned to the first expansion.

```
0   Reading flag switchig
    When each flags R0 to R11 turns on, the data for CH0 to CH7 is read
    sequentially.
    X3F  X3E                                                  R0
    -|/|--|/|-------------------------------------------------[ ]-- CH0 data
    R0   X3D                                                  R1
3   -| |--|/|-------------------------------------------------[ ]-- When CH1 data is positive.
    R0   X3D                                                  R2
6   -| |--| |-------------------------------------------------[ ]-- When CH1 data is negative.
    X3F  X3E                                                  R3
9   -|/|--| |-------------------------------------------------[ ]-- CH2 data
    R3   X3D                                                  R4
12  -| |--|/|-------------------------------------------------[ ]-- When CH3 data is positive.
    R3   X3D                                                  R5
15  -| |--| |-------------------------------------------------[ ]-- When CH3 data is negative.
    X3F  X3E                                                  R6
18  -| |--|/|-------------------------------------------------[ ]-- CH4 data
    R6   X3D                                                  R7
21  -| |--|/|-------------------------------------------------[ ]-- When CH5 data is positive.
    R6   X3D                                                  R8
24  -| |--| |-------------------------------------------------[ ]-- When CH5 data is negative.
    X3F  X3E                                                  R9
27  -| |--| |-------------------------------------------------[ ]-- CH6 data
    R9   X3D                                                  R10
30  -| |--|/|-------------------------------------------------[ ]-- When CH7 data is positive.
    R9   X3D                                                  R11
33  -| |--| |-------------------------------------------------[ ]-- When CH7 data is negative.
36  Conversion data is read.
    Higher word data: The higher 2 digits are masked.
                      When the value is positive, masking is carried out with "00".
                      When the value is negative, masking is carried out with "11".
    Lower word data: It is read as is.
    R0
    -| |--[F0  MV   , WX 2  , DT 0   ]                          -- CH0 data → DT0
    R1
42  -| |--[F65 WAN  , WX 3  , H 3FFF , DT 1   ]                 -- When CH1 data is positive. → DT1
    R2
50  -| |--[F66 WOR  , WX 3  , H C000 , DT 1   ]                 -- When CH1 data is negative. → DT1
    R3
58  -| |--[F0  MV   , WX 2  , DT 2   ]                          -- CH2 data → DT2
    R4
64  -| |--[F65 WAN  , WX 3  , H 3FFF , DT 3   ]                 -- When CH3 data is positive. → DT3
    R5
72  -| |--[F66 WOR  , WX 3  , H C000 , DT 3   ]                 -- When CH3 data is negative. → DT3
    R6
80  -| |--[F0  MV   , WX 2  , DT 4   ]                          -- CH4 data → DT4
    R7
86  -| |--[F65 WAN  , WX 3  , H 3FFF , DT 5   ]                 -- When CH5 data is positive. → DT5
    R8
94  -| |--[F66 WOR  , WX 3  , H C000 , DT 5   ]                 -- When CH5 data is negative. → DT5
    R9
102 -| |--[F0  MV   , WX 2  , DT 6   ]                          -- CH6 data → DT6
    R10
108 -| |--[F65 WAN  , WX 3  , H 3FFF , DT 7   ]                 -- When CH7 data is positive. → DT7
    R11
116 -| |--[F66 WOR  , WX 3  , H C000 , DT 7   ]                 -- When CH7 data is negative. → DT7
124 ---------------------------------------------------( ED )---
```

The data for CH0 and CH1

The data for CH2 and CH3

The data for CH4 and CH5

The data for CH6 and CH7

The data for CH0 and CH1 to be read

The data for CH2 and CH3 to be read

The data for CH4 and CH5 to be read

The data for CH6 and CH7 to be read

Note

If the expansion positions have changed, refer to page 6 – 3 “6.1 I/O Number of A/D Converter Unit” and change X3D, X3E, X3F, WX2 and WX3.

6.2 Program of A/D Converter Unit

Chapter 7

Specifications

7.1 Specifications . . . . . 7 – 3

7.2 Dimensions . . . . . 7 – 6

7.1 Specifications

General specifications

Item	Description
Rated operation voltage	24V DC
Operating voltage range	21.6 to 26.4V DC
Rated current consumption	60mA or less (at 24V DC)
Current consumption increase of control unit	20mA or less (at 24V DC)*
Allowable instantaneous stop time	10ms
Ambient temperature	0 to +55°C/32 to + 131°F
Storage temperature	–20 to +70°C/–4 to +158°F
Ambient humidity	30 to 85%RH (at 25°C non–condensing)
Storage humidity	30 to 85%RH (at 25°C non–condensing)
Breakdown voltage	500V AC for 1 minute between analog input terminal and power supply/ground terminal
Insulation resistance	Min. 100MΩ (measured with a 500V DC megger) for between analog input terminal and power supply/ground terminal
Vibration resistance	10 to 55Hz, 1 cycle/min: double amplitude of 0.75mm/ 0.030 in., 10 min on 3 axes
Shock resistance	Shock of 98 m/s^2, 4 times on 3 axes
Noise immunity	1,000 Vp-p with pulse widths 50ns and 1μs (based on in-house measurements)
Operating condition	Free from corrosive gases and excessive dust
Weight	Approx. 90g/3.175oz

Note

- **(*)For each additional A/D converter unit connected to a control unit, the current consumption increases by 20mA (max.).**

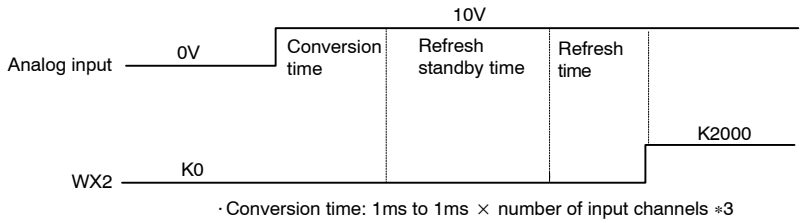
7.1 Specifications

Analog input specifications

Item		Description
Number of input points		8 channels/unit (the number of input points can be switched to 2, 4, 6 or 8 channels)
Input range	**Voltage range**	0 to 5 V, −10 to +10 V, −100 to +100 mV
	Current range	0 to 20mA
Digital output	**0 to 5 V** **0 to 20mA**	K0 to K4000 (H0000 to H0FA0)*1
	−10 to +10V **−100 to 100mV**	K −2000 to K +2000 (HF830 to H07D0)*1
Resolution	**Voltage/Current range**	1/4000 (12bits)
Conversion speed	**Voltage/Current range**	1ms/channel*2
Overall precision	**Voltage/Current range**	±1%F.S. or less (at 0 to 55°C/32 to 131°F), ±0.6% F.S. or less (at 25°C/77°F)
Input impedance	**Voltage range**	1 MΩ or more
	Current range	250Ω
Absolute maximum input	**Voltage range**	±15V
	Current range	+30mA
Insulation method*5		· Between analog input terminal to FP0 internal circuit: photocoupler insulation (non-insulated between analog inputs) · Between analog input terminal to A/D converter unit external power supply: insulation-type DC/DC converter
Number of FP0 input contact points		· 32 input contact points First half (16 points): analog input ch0, 2, 4 and 6 data (WX2)*6 Second half (16 points): analog input ch1, 3, 5 and 7 data (WX3)*6} · 32 output contact points (Not used)
Averaging function		Can be switched on and off

Notes

- **(*1) If the analog input value exceeds the upper/lower limit, the digital value is held at the upper/lower limit.**
- **(*2) The time noted below is required before the analog data is reflected in the control unit input.**

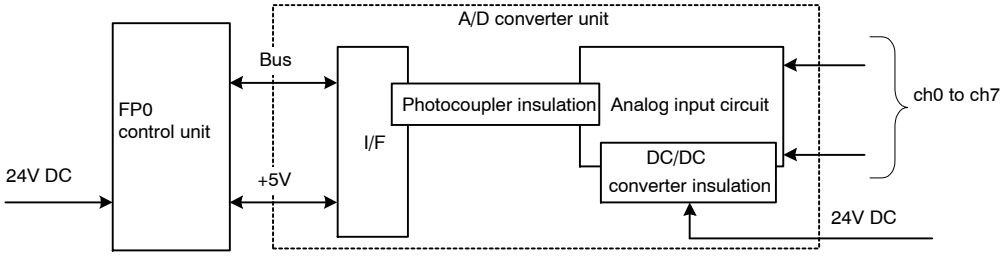


· Conversion time: 1ms to 1ms × number of input channels *3

· Refresh standby time: 0ms to scan time × $\left(\frac{\text{number of input channels}}{2}\right)$

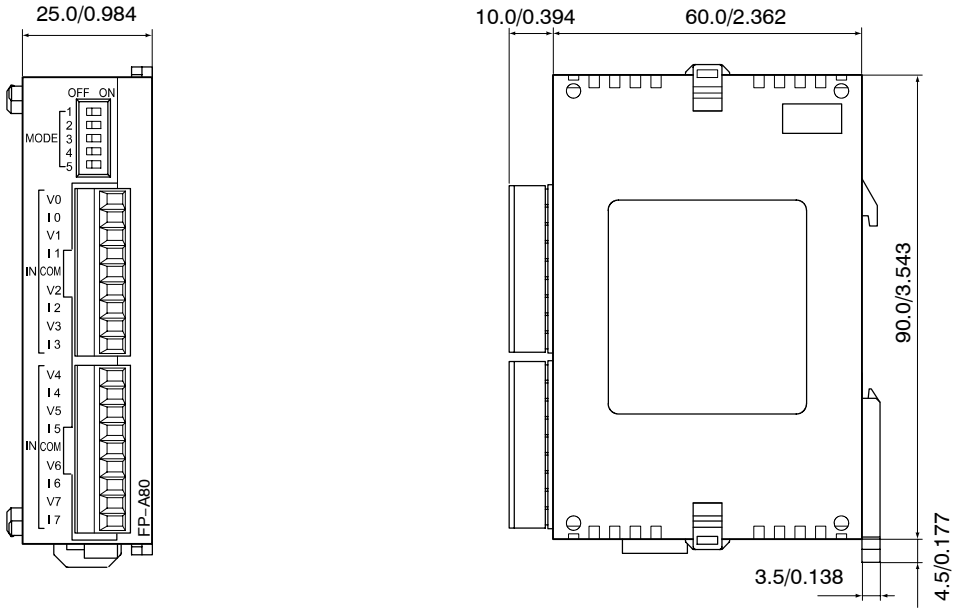
· Refresh time: 1ms × number of expnasion units

- **(*3) Setting value switch for the number of input channels**
- **(*4) The control unit loads two channels' worth of data at each control unit scan.**
  In other words, if the switch for the number of input channels is set to eight channels, the control unit data is updated once every four scans.
- **(*5) Refer to the schematic diagram of insulation methods below.**



- **(*6) The contact numbers change depending on the expansion position (these values are for the case when the unit is installed in the closest position to the control unit).**
  For details refer to page 6 – 3, "6.1 I/O Number of A/D Converter Unit".

7.2 Dimensions



(unit: mm/in.)

Record of changes

Manual No.	Date	Description of changes
ARCT1F321E/ ACG-M321E	NOV.2000	First edition
ARCT1F321E-1/ ACG-M321E-1	FEB.2006	Second edition
ARCT1F321E-2/ ACG-M321E-2	NOV.2008	Third edition - Change in Corporate name
ARCT1F321E-3	AUG.2011	Fourth edition - Change in Corporate name
ARCT1F321E-4	SEP.2012	Fifth edition

Please contact .....

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