Panasonic

PROGRAMMABLE CONTROLLER

FP2 Analog Unit Manual

ARCT1F283E-5

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Safety Precautions

Observe the following notices to ensure personal safety or to prevent accidents.
To ensure that you use this product correctly, read this User's Manual thoroughly before use.
Make sure that you fully understand the product and information on safety.
This manual uses two safety flags to indicate different levels of danger.

WARNING

If critical situations that could lead to user's death or serious injury is assumed by mishandling of the product.

-Always take precautions to ensure the overall safety of your system, so that the whole system remains safe in the event of failure of this product or other external factor.
-Do not use this product in areas with inflammable gas. It could lead to an explosion.
-Exposing this product to excessive heat or open flames could cause damage to the lithium battery or other electronic parts.

CAUTION

If critical situations that could lead to user's injury or only property damage is assumed by mishandling of the product.

-To prevent excessive exothermic heat or smoke generation, use this product at the values less than the maximum of the characteristics and performance that are assured in these specifications.
-Do not dismantle or remodel the product. It could cause excessive exothermic heat or smoke generation.
-Do not touch the terminal while turning on electricity. It could lead to an electric shock.
-Use the external devices to function the emergency stop and interlock circuit.
-Connect the wires or connectors securely.
The loose connection could cause excessive exothermic heat or smoke generation.
-Do not allow foreign matters such as liquid, flammable materials, metals to go into the inside of the product. It could cause excessive exothermic heat or smoke generation.
-Do not undertake construction (such as connection and disconnection) while the power supply is on. It could lead to an electric shock.

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Precautions Before You Start

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

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

Chapter 1

Functions and Restrictions

1.1 Features

Analog input

16-bit high resolution

High-speed A/D conversion (500μs to 90ms/channel)

Multiple input range (12 types such as voltage, current, and temperature sensor)

Temperature sensor (resistance thermometer device, thermocouple) direct input possible

Analog output

12-bit resolution

High-speed D/A conversion (500μs/channel)

Dual output range (±10V and 0 to 20mA)

Handling of I/O data

During the processing of the program, the analog input and output data is allocated to the normal I/O (X and Y) and refreshed.

1.2 Type of Unit

Name	Function	Order number
CPU unit with analog I/O	Analog input: 4-channel Analog output: 1-channel	FP2-C1A
Analog input unit	Analog input: 8-channel	FP2-AD8
Analog output unit	Analog output: 4-channel	FP2-DA4

1.3 Data Processing Functions

1.3.1 Analog Input

For analog input, there is the “General sampling function,” “Averaging function,” and “Offset changing function.”

1.3.1.1 General Sampling Function

The analog input values are converted point by point and the digital values are stored in converted value area (input contact area).

1.3.1.2 Averaging Function

From the data sampled according to the number of times set in the shared memory, the average value of the data (excluding the maximum and minimum values) is stored in the conversion value area (input contact area). If the number of times is 2 or less, or outside of the allowable range (65 or more), the general sampling function is used.

The time for the average value to be stored in the conversion value area changes drastically depending on the number of inputs used, the used input range, and the average number of times.

For detailed information ☛ section 6.3

1.3.1.3 Offset Changing Function

The conversion data for the all ranges of the input channels is offset by the amount set in the shared memory (range: -2048 to +2047) and stored in the conversion value area (input contact area).

1.3.2 Analog Output

For analog output, there is the “Analog output hold function.”

1.3.2.1 Analog Output Hold Function

Non-hold, hold (final value during RUN mode), and hold (any value) for the analog output during the FP2 CPU unit PROG. mode can be set by the shared memory settings.

For hold (final value during RUN mode), the analog output value is held corresponding to the final digital data written during the RUN mode before changing to the FP2 CPU unit PROG. mode.

For hold (any value), the analog output value is held corresponding to the hold data (any value) set in the shared memory when changing to the FP2 CPU unit PROG. mode.

Note

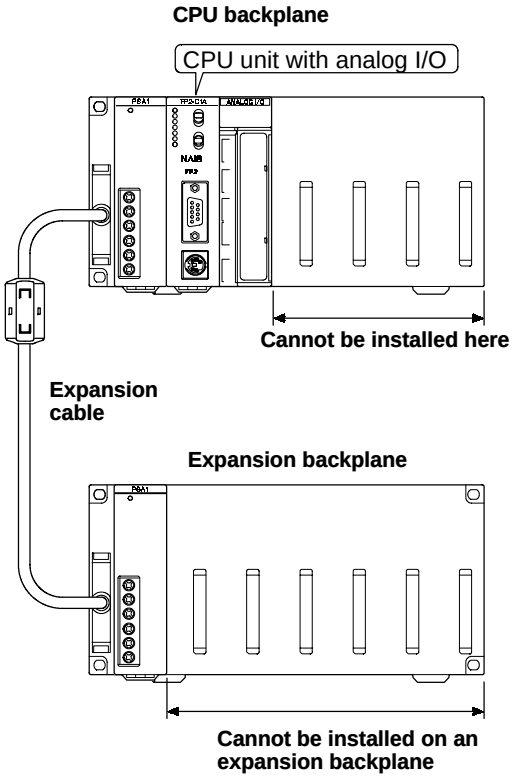
When set to either hold (final value duringl RUN mode) or hold (any value), the each analog output is held during stops in operatiohn due to FP2 CPU unit hardware malfunctions or operation delays.

1.4 Installation Restrictions

1.4.1 CPU Unit with Analog I/O

Can only be installed the CPU unit with analog I/O to the immediate right of the power supply unit on the CPU backplane (where the CPU unit is normally located).

Cannot be installed the CPU unit with analog I/O on an expansion backplane.



1.4.2 Analog Input Unit and Analog Output Unit

There are no restrictions regarding the installation position when installed on the CPU backplane or expansion backplane.

1.5 Current Consumption

The internal current consumption values for the FP2 analog units noted below.

When the system is configured, the other units being used should be taken into consideration, and a power supply unit with a sufficient capacity should be used.

Name	Order number	Current consumption (at 5 V DC)
CPU unit with analog I/O	FP2-C1A	1,060mA or less
Analog input unit	FP2-AD8	500mA or less
Analog output unit	FP2-DA4	600mA or less

For information on restrictions applying to combinations based on current consumption, refer to the FP2 hardware manual and each unit's manuals.

1.6 Range Setting Restrictions

The following combinations cannot be specified within the same unit when setting the range for each channel using software.

Range		Voltage input		Current input	Thermocouple input	R.T.D. input
		+ / - 10V, 1 to 5V	+ /- 100 mV			
Voltage input	+ / - 10 V, 1 to 5V	A	A	A	A	A
	+ / - 100 mV	A	A	N/A	A	A
Current input		A	N/A	A	N/A	N/A
Thermocouple input		A	A	N/A	A	A
R.T.D. input		A	A	N/A	A	A

A: Combination available, N/A: Combination not available

The current input and thermocouple input cannot be used at the same time.

The current input and R.T.D. input cannot be used at the same time.

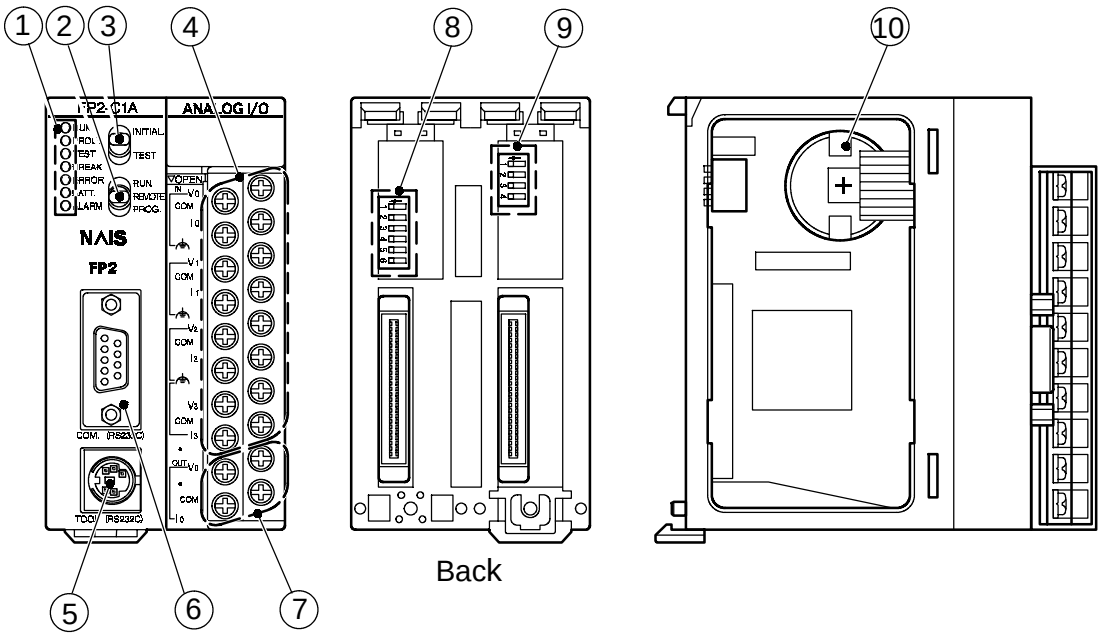
The current input and +/-100mV voltage input cannot be used at same time.

1.6 Range Setting Restrictions

Chapter 2

Parts and Specifications

2.1 CPU Unit with Analog I/O (FP2-C1A)



① **Status indicator LEDs**

display the operating condition and error statuses.

② **Mode selector**

is used to change the operation mode.

③ **Initialize/test switch**

is used to clear the errors, initializes the operation memory and set the test operation mode.

④ **Analog input terminals**

For CPU unit with analog I/O, there are analog input terminals for channels 0 to 3.

The terminal block can be removed to facilitate wiring.

For detailed information ☛ section 3.1.2

⑤ **Tool port (RS232C)**

is used to connect a programming tool.

⑥ **COM port (RS232C)**

is used to connect a computer or general-serial devices with RS232C port.

☛ next page

⑦ Analog output terminals

For CPU unit with analog I/O, there are analog output terminals for channel 1.

Terminals with a dot mark are not used; however, they are connected to the analog input circuit internally so do not connect anything to them.

The terminal block can be removed to facilitate wiring.

For detailed information ☛ section 3.1.2

⑧ Range setting switch

Used to set the analog input and output range.

For detailed information ☛ section 4.1

⑨ Operation condition switches

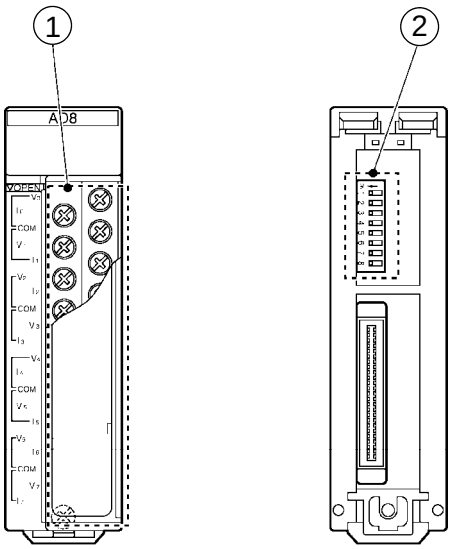
are used to set the baud rate of the programming tool, to select the program memory and to select the writing operation for the program memory.

⑩ Memory backup battery

for backup of the internal memory (RAM).

Order number: AFC8801 (CR2450 or equivalent)

2.2 Analog Input Unit (FP2-AD8)



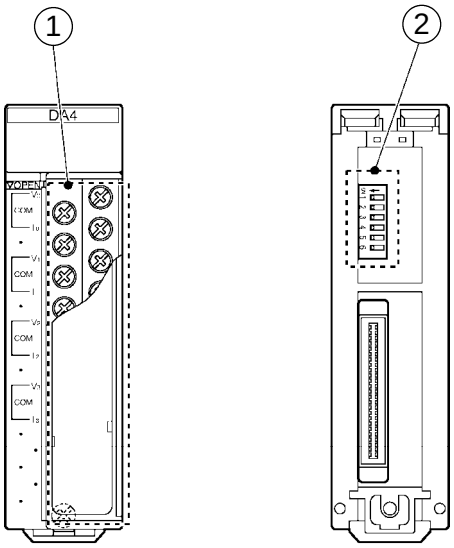
① **Analog input terminals**

For analog input unit, there are analog input terminals for channels 0 to 7.
The terminal block can be removed to facilitate wiring.
For detailed information ☛ section 3.1.2

② **Range setting switch**

Used to set the analog input range.
For detailed information ☛ section 4.1.1

2.3 Analog Output Unit (FP2-DA4)



① Analog output terminals

For analog output unit, there are analog outpput terminals for channels 0 to 3. Terminals with a dot mark are not used; however, they are connected to the analog input circuit internally so do not connect anything to them.

The terminal block can be removed to facilitate wiring.

For detailed information ☛ section 3.1.2

② Range setting switch

Used to set the analog output range.

For detailed information ☛ section 4.1.2

Chapter 3

Wiring

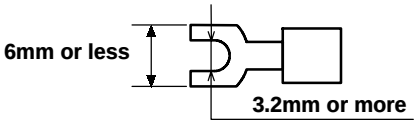
3.1 Suitable Terminals and Wires

3.1.1 Suitable Terminals and Suitable Wires

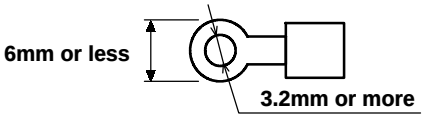
Suitable connection terminals

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

Fork type terminal



Round type terminal

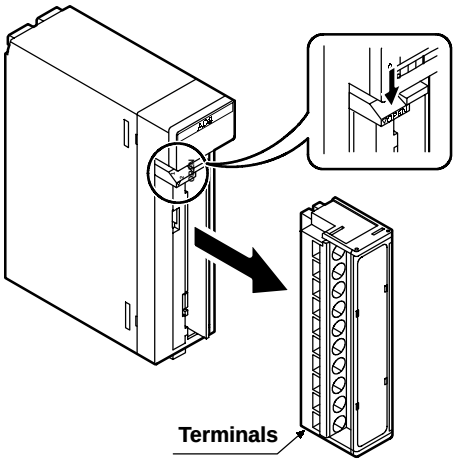


Suitable wires

Size	Torque
AWG22 to AWG14 (0.3mm^2 to 2.0mm^2)	0.5 to 0.6NVm

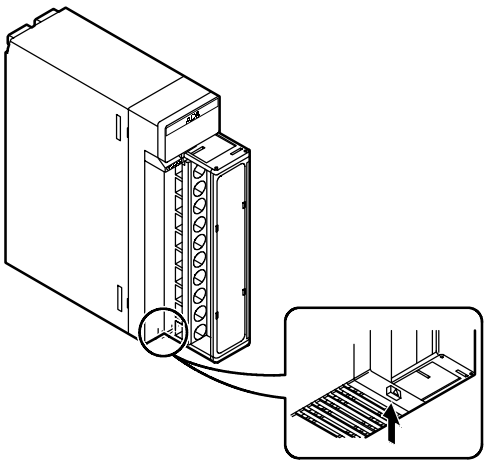
3.1.2 Wiring to Terminal Block

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



Note

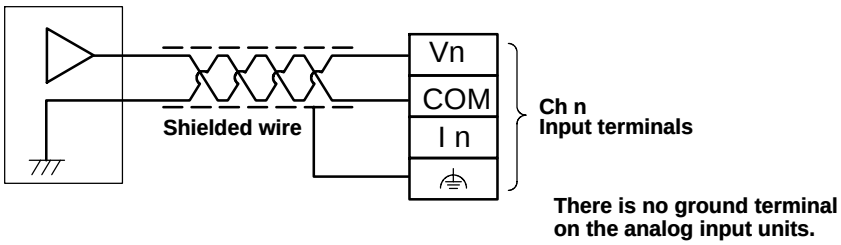
Install the terminal block by inserting it all the way to its original position and pressing the lock button on the bottom of the unit. Then confirm that the terminal block is securely attached and cannot be removed.



3.2 Wiring for Analog Input

3.2.1 Voltage Input (±10V, 1 to 5V and ±100mV ranges)

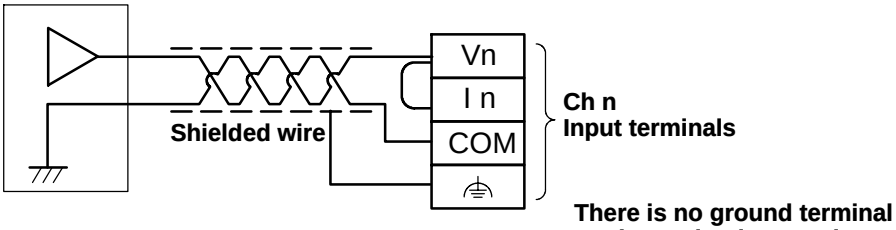
Input equipment



There is no ground terminal on the analog input units.

3.2.2 Current Input (±20mA and 4 to 20mA ranges)

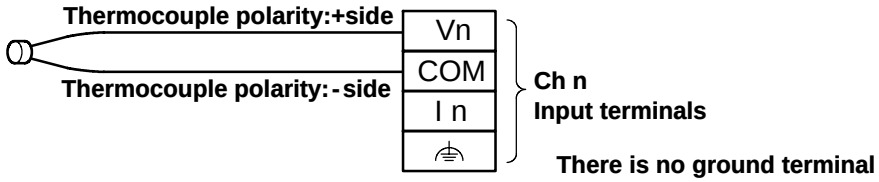
Input equipment



There is no ground terminal on the analog input units.

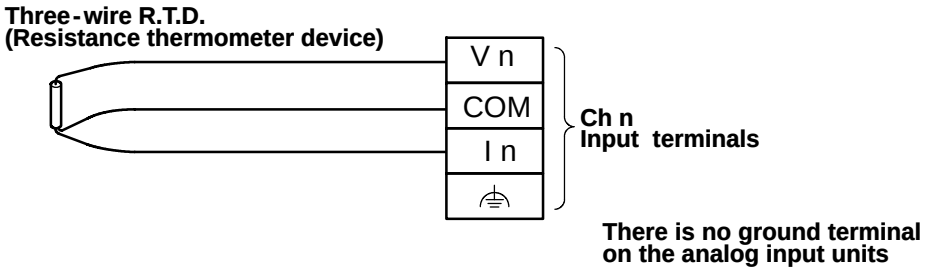
3.2.3 Thermocouple Input (J, K, R, S and T ranges)

Thermocouple



There is no ground terminal on the analog input units.

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



3.2.5 Precautions Regarding Analog Input Wiring

For the wiring of “sections 3.2.1 and 3.2.2” ranges, always use double-core twisted-pair shielded wires.

Ground the shielding of the shielded wires by connecting them to the ground terminal at the analog input terminal block (for CPU unit with analog I/O), or to the frame ground at the control panel.
The analog input terminal block’s grounding terminal of the CPU unit with analog I/O is connected to the FP2 power supply unit’s grounding terminal inside the FP2.

For the current input of “section 3.2.2”, connect terminals V and I.

For the thermocouple input of “section 3.2.3”, perform the wiring correctly according to the polarity of the thermocouple. Also, to lengthen the signal wire of the thermocouple, use the compensating wire of the thermocouple.

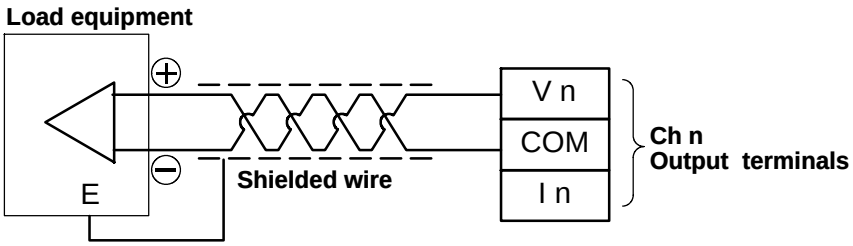
For copper wiring used in wiring the R.T.D. (resistance thermometer device) in “section 3.2.4”, use insulated wiring, and wiring with a nominal cross-section of 1.25mm^2 (or equivalent) to not allow a large build-up in electrical resistance.

Do not have the analog input wiring close to AC wires, power wires, or load wires from sources other than the PLC.

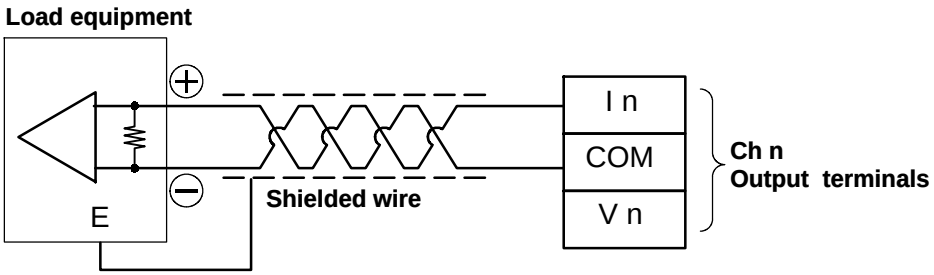
The terminals marked with a dot on the input and output terminal blocks are not to be used. However, they may be connected to circuits internally, so be sure not to connect any wiring to them.

3.3 Wiring for Analog Output

3.3.1 Voltage Output (±10V range)



3.3.2 Current Output (0 to 20mA range)



3.3.3 Precautions Regarding Analog Output Wring

For the analog output wiring, always use double-core twisted-pair shielded wires.

Ground the shielding of the shielded wires at the side of the load devices. However, depending on the conditions of the external noise, it may be necessary to ground externally, or leave the shielding open.

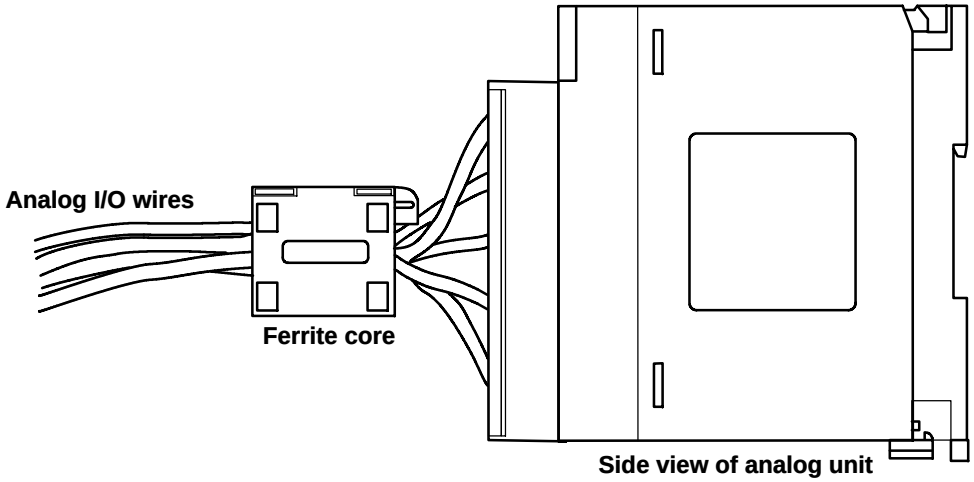
Do not have the analog output wiring close to AC wires, power wires, or load wires from sources other than the PLC.

The terminals marked with a dot on the input and output terminal blocks are not to be used. However, they may be connected to circuits internally, so be sure not to connect any wiring to them.

3.4 EMC Conformity

The FP2 CPU unit with analog I/O (FP2-C1A), FP2 Analog input unit (FP2-AD8) and FP2 Analog output unit (FP2-DA4) conform to the European EMC standards EN50081-2: 1993, EN50082-2: 1995 as required by the European EMC Directive 89/336/EEC.

As a condition for conformity to the above standards, a ferrite core is attached to the wiring that goes to the terminal blocks (as shown below).



Chapter 4

Setting the I/O Range and I/O Allocation

4.1 Setting the Input and Output Range

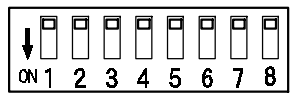
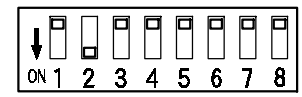
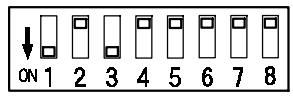
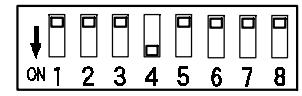
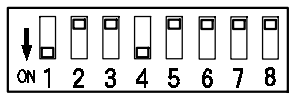
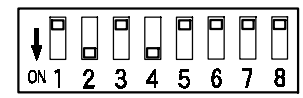
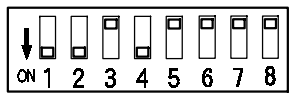
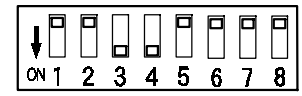
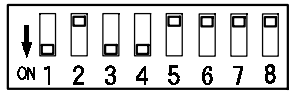
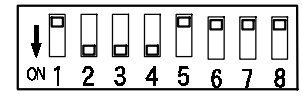
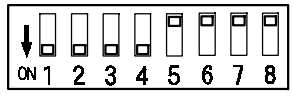
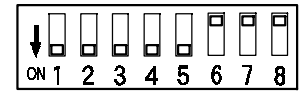
Set the analog input and output range using the range setting switch on back side of unit.

4.1.1 Setting the Analog Input Range

When setting the same range for the all the channels at once, you can only use the range setting switch. Use 1 to 5 of the range setting switch for both the CPU unit with analog I/O and analog input units. Use the table below as a base and set the range setting switch for the input range you will use.

If you will be using different input ranges together, then set the range setting switch to “Enable setting by software.” Also, for the analog input initial settings, you must set the range for each unit by the sequence program.

For detailed information ☛ section 5.1

+/-10V +/-20mA		**1 to 5V 4 to 20mA**	
+/-100mV		**Thermocouple J**	
Thermocouple K		**Thermocouple R**	
Thermocouple S		**Thermocouple T**	
R.T.D (Pt100)		**R.T.D (Pt1000)**	
Not used		**Enable setting by software**	

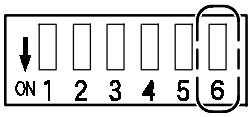
☛ **Note**

Be sure that range setting switches No.6 to 8 are off before use. If they are on, operation will not be normal.

4.1.2 Setting the Analog Output Range

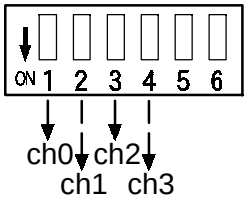
The analog output range setting can only be performed by the range setting switch. At the CPU unit with analog I/O, use range setting switch 6, and at the analog output units, use the range setting switches 1 to 4 to set the range for each channel.

CPU unit with analog I/O: Range setting switch 6



Range	Setting
0 to 20mA	ON OFF
+/-10V	ON ON

Analog output unit: Range setting switch 1 ⇒ ch 0
Range setting switch 2 ⇒ ch 1
Range setting switch 3 ⇒ ch 2
Range setting switch 4 ⇒ ch 3



Range	Setting
0 to 20mA	ON OFF
+/-10V	ON ON

For the analog output unit, be sure to have the range setting switches 5 and 6 set to off.

4.2 I/O Allocation

During sequence program processing with the FP2, the analog input and output data is allocated to the I/O (X, Y) and refreshed. The I/O allocation for the analog input and output data is as shown in the table below.

CPU unit with analog I/O	Channel	I/O Number
Analog input	Ch 0	WX0: X0 to XF
	Ch 1	WX1: X10 to X1F
	Ch 2	WX2: X20 to X2F
	Ch 3	WX3: X30 to X3F
Analog output	Ch 0	WY4: Y40 to Y4F

Analog input unit	Channel	I/O Number
Analog input	Ch 0	WX(n): X(n)0 to X(n)F
	Ch 1	WX(n+1): X(n+1)0 to X(n+1)F
	Ch 2	WX(n+2): X(n+2)0 to X(n+2)F
	Ch 3	WX(n+3): X(n+3)0 to X(n+3)F
	Ch 4	WX(n+4): X(n+4)0 to X(n+4)F
	Ch 5	WX(n+5): X(n+5)0 to X(n+5)F
	Ch 6	WX(n+6): X(n+6)0 to X(n+6)F
	Ch 7	WX(n+7): X(n+7)0 to X(n+7)F

Analog output unit	Channel	I/O Number
Analog output	Ch 0	WY(n): Y(n)0 to Y(n)F
	Ch 1	WY(n+1): Y(n+1)0 to Y(n+1)F
	Ch 2	WY(n+2): Y(n+2)0 to Y(n+2)F
	Ch 3	WY(n+3): Y(n+3)0 to Y(n+3)F

The I/O number shown by an “n” in the table above is determined according to the installed slot position and the I/O allocation for other units.

4.2 I/O Allocation

Chapter 5

Initial Settings

5.1 Analog Input Initial Settings

Performs the initial settings for each channel of the analog input. The initial settings are set by the sequence program at the first scan at the start of operation. (The initial settings for the analog unit are enabled only for one time after operation start.)

The items for the initial settings are given below.

- **No execution of analog input conversion processing setting** (when you want to eliminate conversion processing time for unused input channels)
- **Analog input range setting** (when you want to set the input range individually for each channel)
- **Average processing times setting** (when you want to perform average processing for the conversion data)
- **Analog input offset change setting** (when you want to adjust the offset for the conversion data)

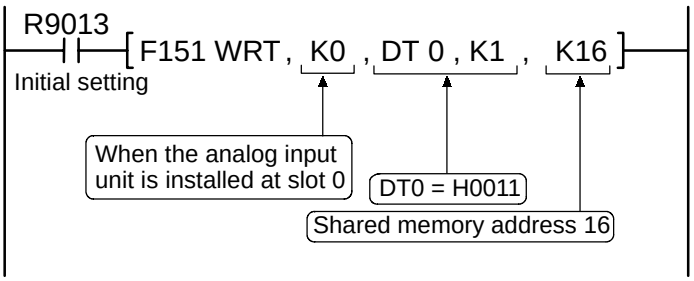
5.1.1 No Execution of Analog Input Conversion Processing Setting

Specifies the input channels that will not execute conversion processing.

(The default setting is for all channels to execute conversion processing.)

Program example:

Ch0 and ch1 will execute conversion processing, and ch2 and ch3 will not



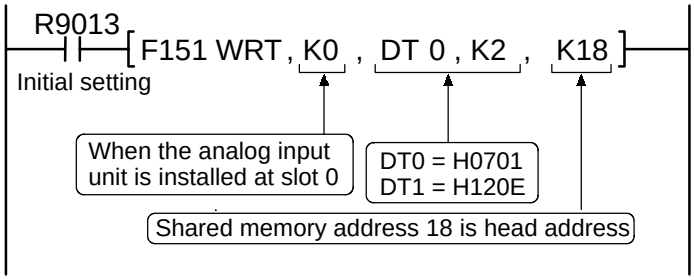
5.1.2 Analog Input Range Setting

Specifies the input range code when setting input ranges for each input channel.

(Set the range setting switch to ”Enable setting by software” and conversion will not be executed for that input channel if there is not input range code specification.)

Program example:

When ch0: ±10V, ch1: 1 to 5V, ch2: thermocouple K, and ch3: R.T.D. Pt100



5.1.3 Average Processing Times Setting

Specifies the average times for each input channel.

If there is no specification for the average times, then that input channel will perform normal sampling.

Also:

K0 (0 times) is specified: No average processing, and normal sampling processing.

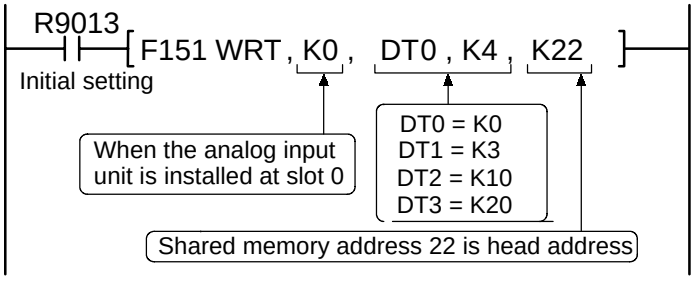
K1 (1 time) is specified: No average processing, and normal sampling processing.

K2 (2 times) is specified: No average processing, and normal sampling processing.

Other than K0 to K64 (0 to 64 times) is specified: average processing is performed with K64 as the specified setting.

Program example:

When ch0: No average processing, ch1: 3 times, ch2: 10 times, ch3: 20 times



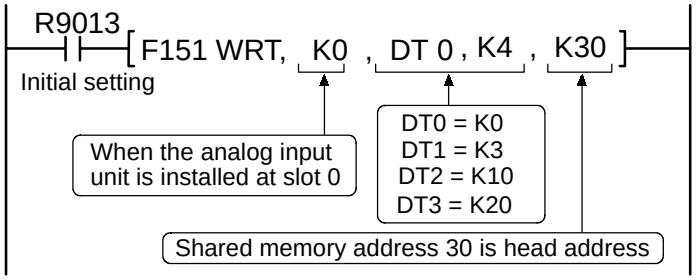
5.1.4 Analog Input Offset Changing Setting

Specifies the digital value for the offset amount for each input channel.

Between the range K-2048 to K2047 can be set as the digital value for the offset amount; however, the range that can be obtained for the analog input conversion value that the offset is applied to is limited to between K-32768 and K32767.

Program example:

When the applied offsets are ch0: K0 (no offset), ch1: K3, ch2: K10, and ch3: K20



5.2 Analog Output Initial Settings

Performs the initial settings for each channel of the analog output. The initial settings are set by sequence program at the first scan at the start of operation. (The initial settings for the analog unit are enabled only for one time after operation start.)

The items for the initial settings are given below.

- **Analog output hold setting** (when you do not want to clear the analog output in the PROG. mode)
- **Analog output hold (any value) data setting** (when you want to hold at a desired value in the PROG. mode)

5.2.1 Analog Output Hold Setting

Specifies either non-hold, hold (final value during RUN mode), or hold (any value) operation for each output channel. (Default is non-hold operation.)

5.2.2 Analog Output Hold (any value) Data Setting

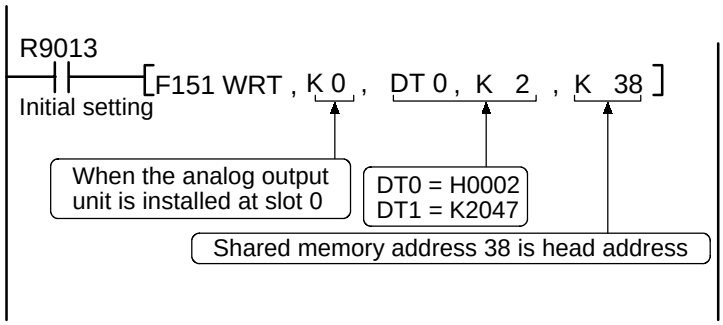
Specifies the digital data for the analog output that you want to output at the output channel set at “hold (any value)” in the analog output hold setting.

The data that can be specified is as shown below for each range.

- ±10V range: K-2048 to K2047
- 0 to 20mA: K0 to K4095

Program example:

When you want to hold a 10mA output at ch0 in the program mode.



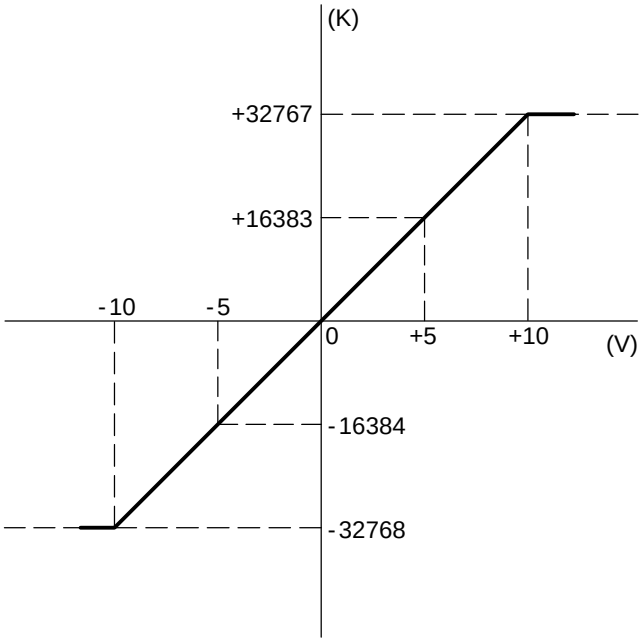
Chapter 6

Analog I/O Conversion Characteristics and Conversion Cycle Time

6.1 Analog Input Conversion Characteristics

The conversion characteristics of analog input range are shown below.

-10V to +10V DC



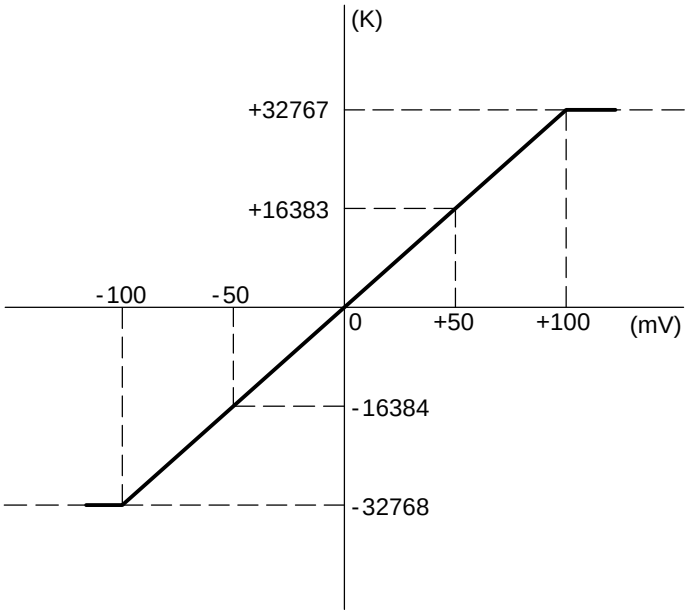
Input range -10V to +10V DC

V	K
-10	-32768
-7.5	-24576
-5	-16384
-2.5	-8192
0	0
2.5	8191
5	16383
7.5	24574
10	32767

If the input value exceeds the rated analog input range, the converted value becomes:

Input value	Converted value
-10V or less	-32768
+10V or more	+ 32767

-100mV to +100mV DC



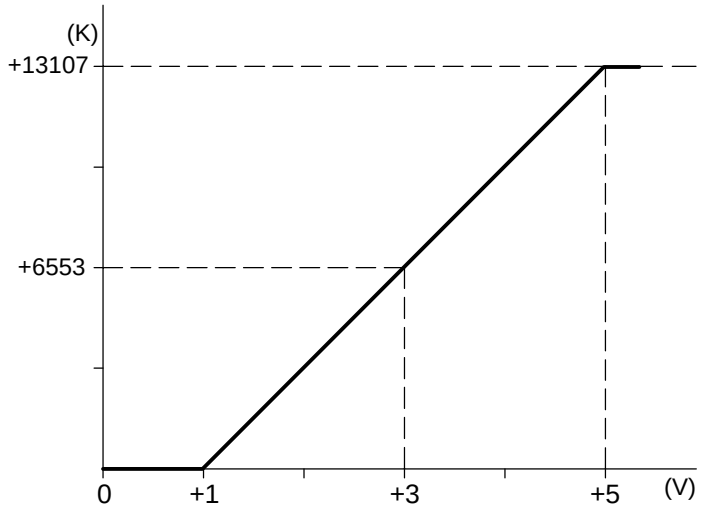
Input range -100mV to +100mV DC

V	K
-100	-32768
-75	-24576
-50	-16384
-25	-8192
0	0
25	8191
50	16383
75	24574
100	32767

If the input value exceeds the rated analog input range, the converted value becomes:

Input value	Converted value
-100mV or less	-32768
+100mV or more	+32767

1V to 5V DC



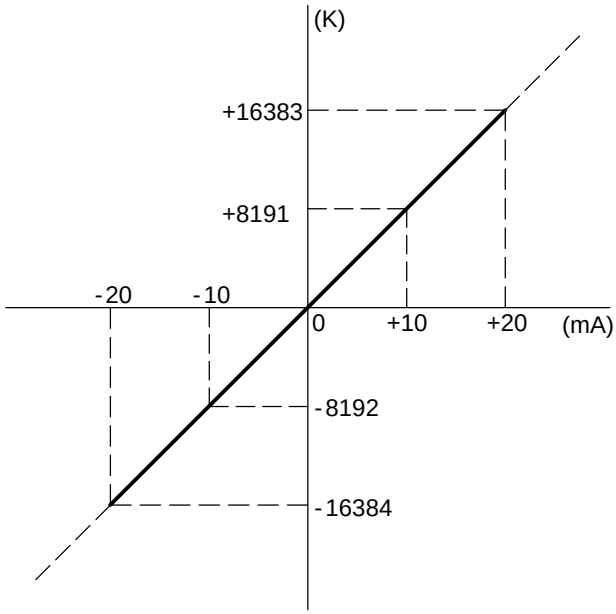
Input range 1V to 5V DC

V	K
1	0
2	3276
3	6553
4	9829
5	13107

If the input value exceeds the rated analog input range, the converted value becomes:

Input value	Converted value
1V or less	0
5V or more	+13107

-20mA to +20mA DC



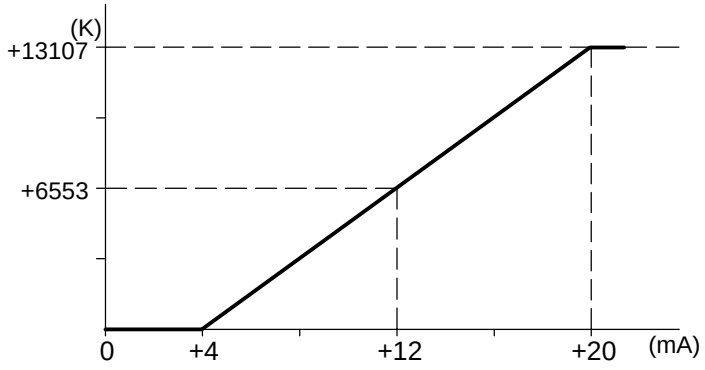
Input range -20mA to +20mA DC

mA	K
-20	-16384
-15	-12288
-10	-8192
-5	-4096
0	0
5	4095
10	8191
15	12285
20	16383

If the input value exceeds the rated analog input range, the converted value becomes:

Input value	Converted value
-20mA or less	Conversion will be performed even when outside of the allowable range, but the precision cannot be guaranteed.
+20mA or more	

4mA to 20mA DC



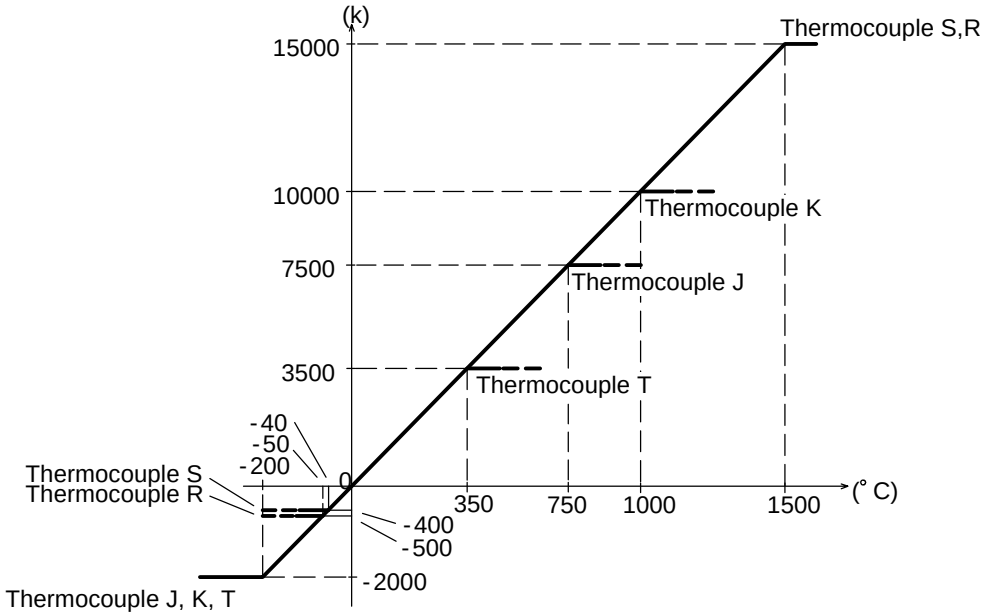
Input range 4mA to 20mA DC

mA	K
4	0
8	3276
12	6553
16	9828
20	13107

If the input value exceeds the rated analog input range, the converted value becomes:

Input value	Converted value
4mA or less	0
20mA or more	+13107

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



Thermocouple S

°C	K
-40	-400
-20	-200
0	0
250	2500
500	5000
750	7500
1000	10000
1250	12500
1500	15000

Thermocouple J

°C	K
-200	-2000
-100	-1000
0	0
125	1250
250	2500
375	3750
500	5000
625	6250
750	7500

Thermocouple K

°C	K
-200	-2000
-150	-1500
-100	-1000
-50	-500
0	0
250	2500
500	5000
750	7500
1000	10000

Thermocouple T

°C	K
-200	-2000
-100	-1000
-50	-500
0	0
70	700
140	1400
210	2100
280	2800
350	3500

Thermocouple R

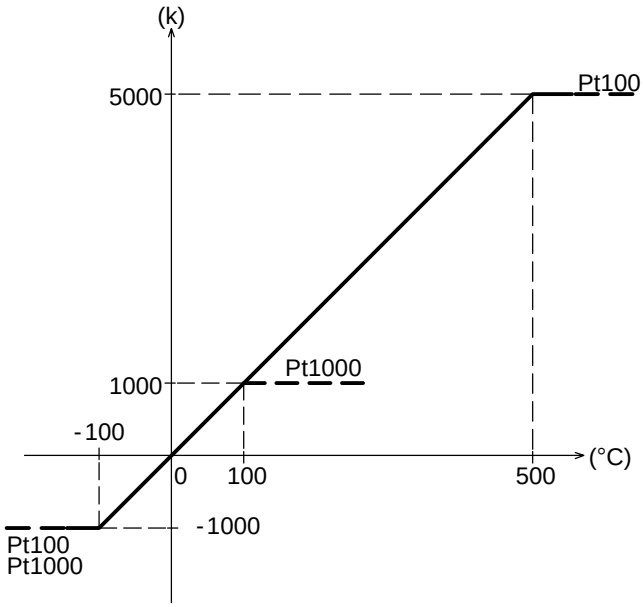
°C	K
-50	-500
-25	-250
0	0
250	2500
500	5000
750	7500
1000	10000
1250	12500
1500	15000

If the input value exceeds the rated analog input range, the converted value becomes:

Range	Input value	Converted value
Thermocouple S	-40_C or less (*)	-400
	+1500_C or more	+15000
Thermocouple J	-200_C or less	-2000
	+750_C or more	+7500
Thermocouple K	-200_C or less	-2000
	+1000_C or more	+10000
Thermocouple T	-200_C or less	-2000
	+350_C or more	+3500
Thermocouple R	-50_C or less (*)	-500
	+1500_C or more	+15000
Broken wire	————————	+20000

(*) For the S and R ranges, conversion will be performed even if the input is outside of the ranges 0 to -40°C and 0 to -50°C (respectively), but the precision cannot be guaranteed.

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



R.T.D. Pt100

°C	K
-100	-1000
-50	-500
-25	-250
0	0
100	1000
200	2000
300	3000
400	4000
500	5000

R.T.D. Pt1000

°C	K
-100	-1000
-75	-750
-50	-500
-25	-250
0	0
25	250
50	500
75	750
100	1000

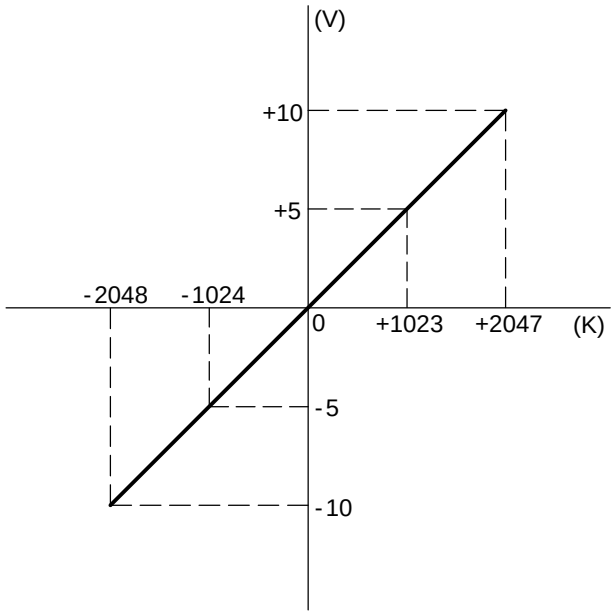
If the input value exceeeds the rated analog input range, the converted value becomes:

Range	Input value	Converted value
Pt100	-100_C or less	-1000
	+500_C or more	+5000
Pt1000	-100_C or less	-1000
	+100_C or more	+1000
Broken wire	————————	+20000

6.2 Analog Output Conversion Characteristics

The conversion characteristics of analog output range are shown below.

-10V to +10V DC



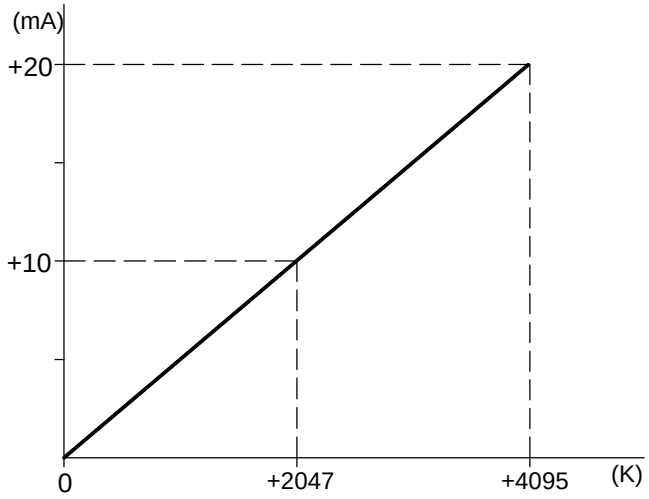
Output range -10V to +10V DC

V	K
-10	-2048
-7.5	-1536
-5	-1024
-2.5	-512
0	0
2.5	511
5	1023
7.5	1534
10	2047

If the input value exceeds the rated digital input range, the analog output value becomes:

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

0mA to 20mA DC



Output range 0mA to 20mA DC

mA	K
20	4095
17.5	3580
15	3069
12.5	2558
10	2047
7.5	1534
5	1023
2.5	511
0	0

If the input value exceeds the rated digital input range, the analog output value becomes:

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

6.3 Analog Input and Output Conversion Cycle Time

6.3.1 Analog Input Conversion Cycle Time

When setting the range for each analog input channel, the conversion cycle time of the channel you want can be calculated by the formula below.

Conversion cycle time = (0.5 ms × n1 + 2 ms × n2 + 3 ms × n3) × n4

n1: Number of input channels used (number of input channels set for execution of conversion processing)

n2: Number of gain types among all the used input channels
When used with different input ranges, the processing will differ due to the difference in the signal processing gain at each input range. Therefore, clarify the gain types among the used input channels based on the table below.

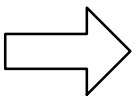
n3: Number of temperature input channels among all the used input channels

n4: Conversion processing coefficient
The coefficient that corresponds to the input range of the channel for which you want to ascertain the conversion cycle time (refer to table below).

Input range	Gain	Conversion processing coefficient
±10V	1 time	n4 = 1
1 to 5V		
±20mA		
4 to 20mA		
±100mV	100 times	
Thermocouple (Pt100)	150 times	n4 = 30
Thermocouple (Pt1000)	50 times	

Example of conversion cycle time calculation 1

Ch0 thermocouple k
Ch1 thermocouple J
Ch2 ±10V
Ch3 Pt1000
Ch4 thermocouple J
Ch5 ±100mV
Ch6 thermocouple J
Ch7 Pt100



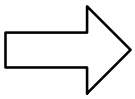
Number of input channels used: n1 = 8
Number of gain types: n2 = 4
Number of temperature input channels: n3 = 6

Ch2 (±10V) conversion cycle time = (0.5 × 8 + 2 × 4 + 3 × 6) × 1 = 30ms

Ch0 (thermocouple K) conversion cycle time = (0.5 × 8 + 2 × 4 + 3 × 6) × 30 = 900ms

Example of conversion cycle time calculation 2

Ch0 thermocouple K
Ch1 thermocouple J
Ch2 ±10V
Ch3 thermocouple J
Ch4 not used
Ch5 not used
Ch6 thermocouple J
Ch7 not used



Number of input channels used: n1 = 5
Number of gain types: n2 = 2
Number of temperature input channels: n3 = 4

Ch2 (±10V) conversion cycle time = (0.5 × 5 + 2 × 2 + 3 × 4) × 1 = 18.5ms

Ch0 (thermocouple K) conversion cycle time = (0.5 × 5 + 2 × 2 + 3 × 4) × 30 = 555ms

The conversion cycle time when setting the range for each analog input channel was explained above; however, the conversion cycle time when the ranges for all channels are set together by the DIP switches can be determined by the formula below.

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

6.3.2 Analog Output Conversion Cycle Time

The analog output conversion cycle time can be determined by the formula below.

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

Chapter 7

Procedure for Handling Analog Unit

7.1 Outline of Procedure for Handling Analog Unit

The procedure for handling the FP2 analog unit is as follows.

Procedure:

1. **Setting the analog input and output range**
   Set the range using the range setting switch on back side of unit.
2. **Unit installation**
   Install the unit onto the backplane.
3. **Wiring**
   Connect the analog input and output signal.
4. **Turn on power**
5. **Analog input and output initial setting**
   Sets the initial settings by the sequence program. (The initial settings are set by the first scan at operation start.)
6. **Analog input data reading**
   Analog output data writing
   Performs the reading and writing by the sequence program.

7.2 Reading the Analog Input Data

During sequence program processing with the FP2, the analog input data is allocated to the general input (X) and refreshed. In other words, the analog input conversion data is automatically refreshed and stored from the analog input circuit to the FP2 input relay area.

When the analog input conversion data is processed at the sequence program, refer to the allocated input relay area (WX) data.

For detailed information ☛ section 4.2

Precautions regarding the analog input data reading

The time from the end of startup of the FP2 to the setting of the first analog input data of the conversion processing to the readable area of FP2 CPU unit on the analog input circuit differs depending on the analog input range and is given in the table below.

Input range	CPU unit with analog I/O (FP2-C1A)	Analog input unit (FP2-AD8)
Voltage input range	460ms	430ms
Current input range	460ms	430ms
Thermocouple input range	910ms	1330ms
R.T.D. (Resistance thermometer device) input range	3350ms	6490ms

Until the first conversion data is set, the analog input data of the area is zero (K0).

Perform the processing by taking into consideration the time until the first conversion data is set during the analog input conversion data processing of the sequence program.

To ascertain the timing of how the first conversion is set, use the preparation completion flags of the shared memory.

7.3 Writing the Analog Output Data

During sequence program processing with the FP2, the analog output data is allocated to the general output (Y) and refreshed.

The analog output data is automatically refreshed and written from the FP2 output relay area to the analog output circuit. When the analog output is processed at the sequence program, write the data that you want for analog output for the allocated output relay area (WY).

For detailed information ☛ section 4.2

7.3 Writing the Analog Output Data

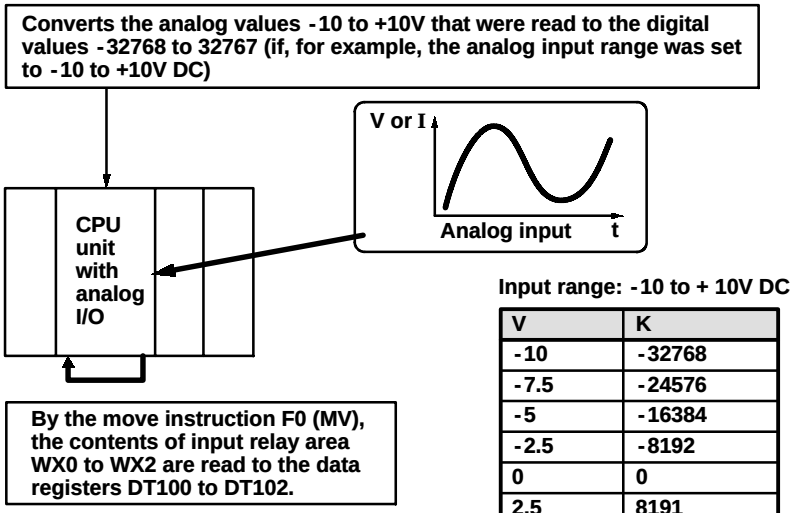
Chapter 8

Sample Program for Analog Input

8.1 Basic Program (CPU Unit with Analog I/O)

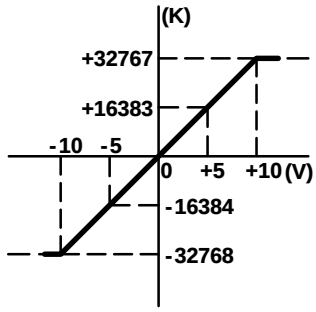
Program outline

Using ch 0 to ch 2 (set for no execution of input conversion processing) of the CPU unit with analog I/O, this program reads the analog input data to the data registers DT100 to DT102 using the preparation completion flag.



Input range: -10 to + 10V DC

V	K
-10	-32768
-7.5	-24576
-5	-16384
-2.5	-8192
0	0
2.5	8191
5	16383
7.5	24574
10	32767



Settings

Channels that execute analog input conversion processing
H111: ch 0 to ch 2 are set for execution and ch 3 is not set for execution

I/O allocation

I/O number	Contents
WX0	Analog input data for ch 0
WX1	Analog input data for ch 1
WX2	Analog input data for ch 2

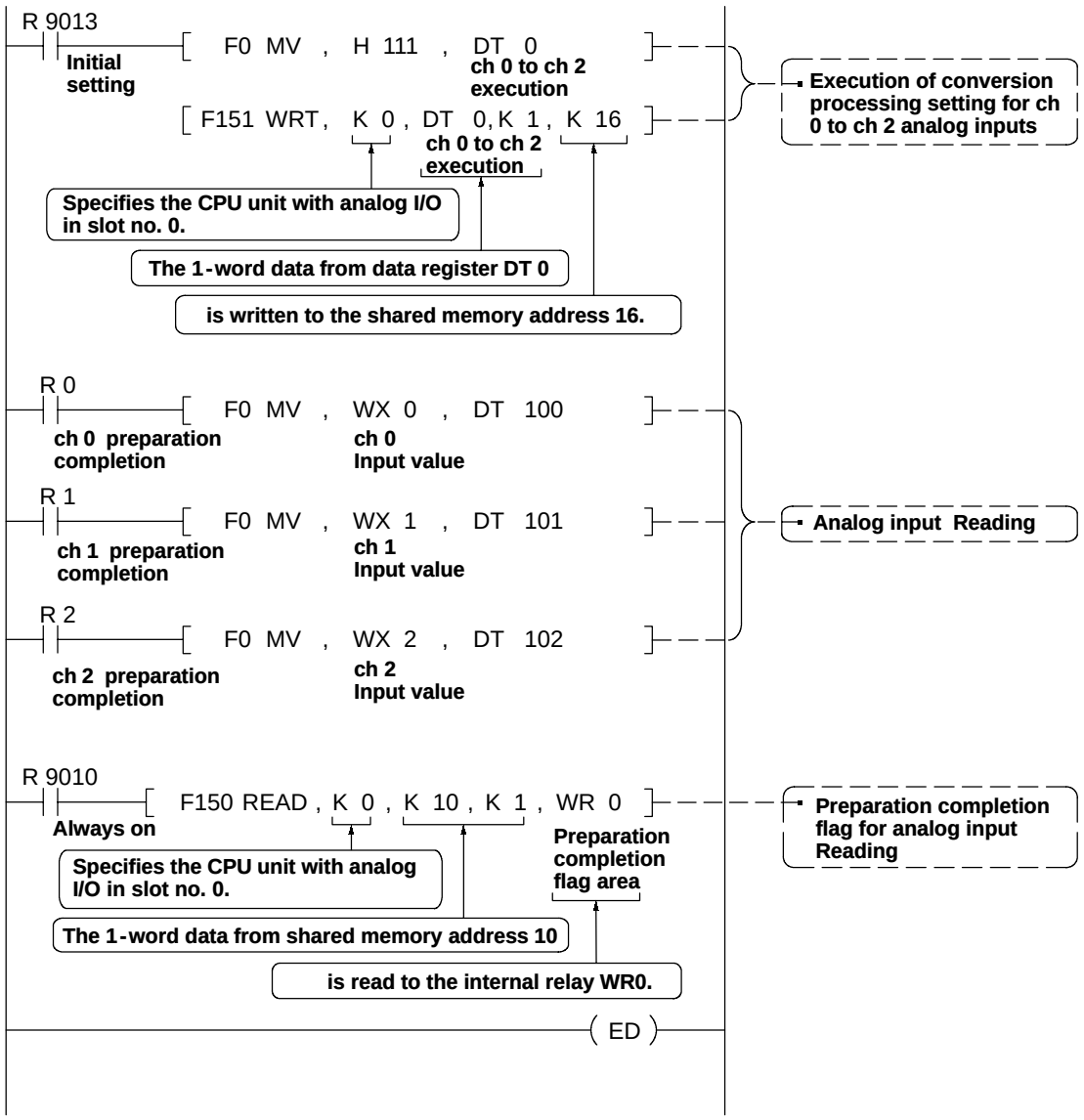
Shared memory

Address 10	Preparation completion flag for ch 0 to ch 3 analog inputs
Address 16	No execution of conversion processing setting for ch 0 to ch 3 analog inputs

For detailed information ☛ section 14.3.1

8.1 Basic Program (CPU Unit with Analog I/O)

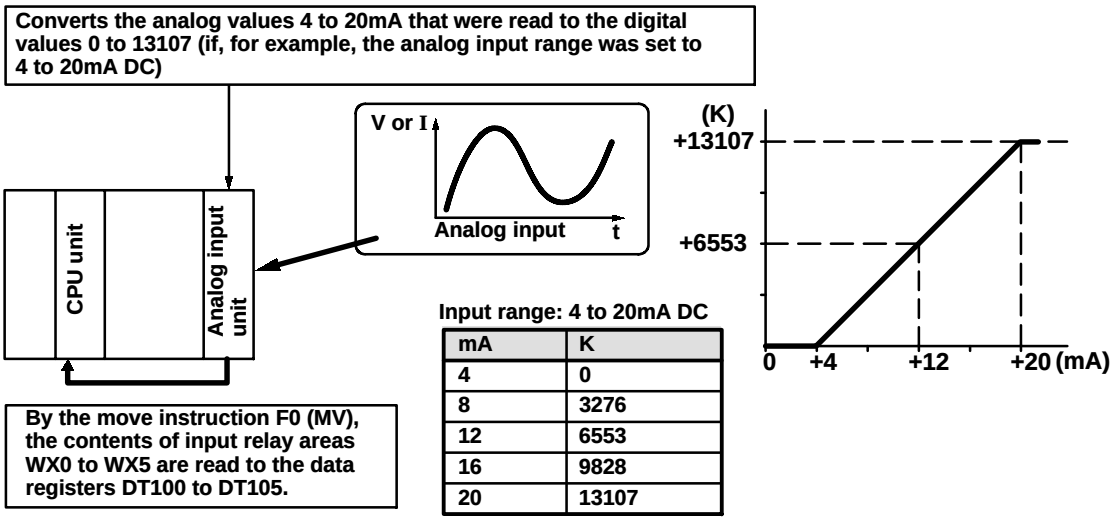
Sample program:



8.2 Basic Program (Analog Input Unit)

Program outline

Using ch 0 to ch 5 (set for no execution of input conversion processing) of the analog input unit, this program reads the analog input data to the data registers DT100 to DT105 using the preparation completion flag.



mA	K
4	0
8	3276
12	6553
16	9828
20	13107

Settings

Channels that execute analog input conversion processing
H1111: ch 0 to ch 3 are set for execution
H11: ch 4 and ch 5 are set for execution and ch 6 and ch 7 are not set for execution

I/O allocation

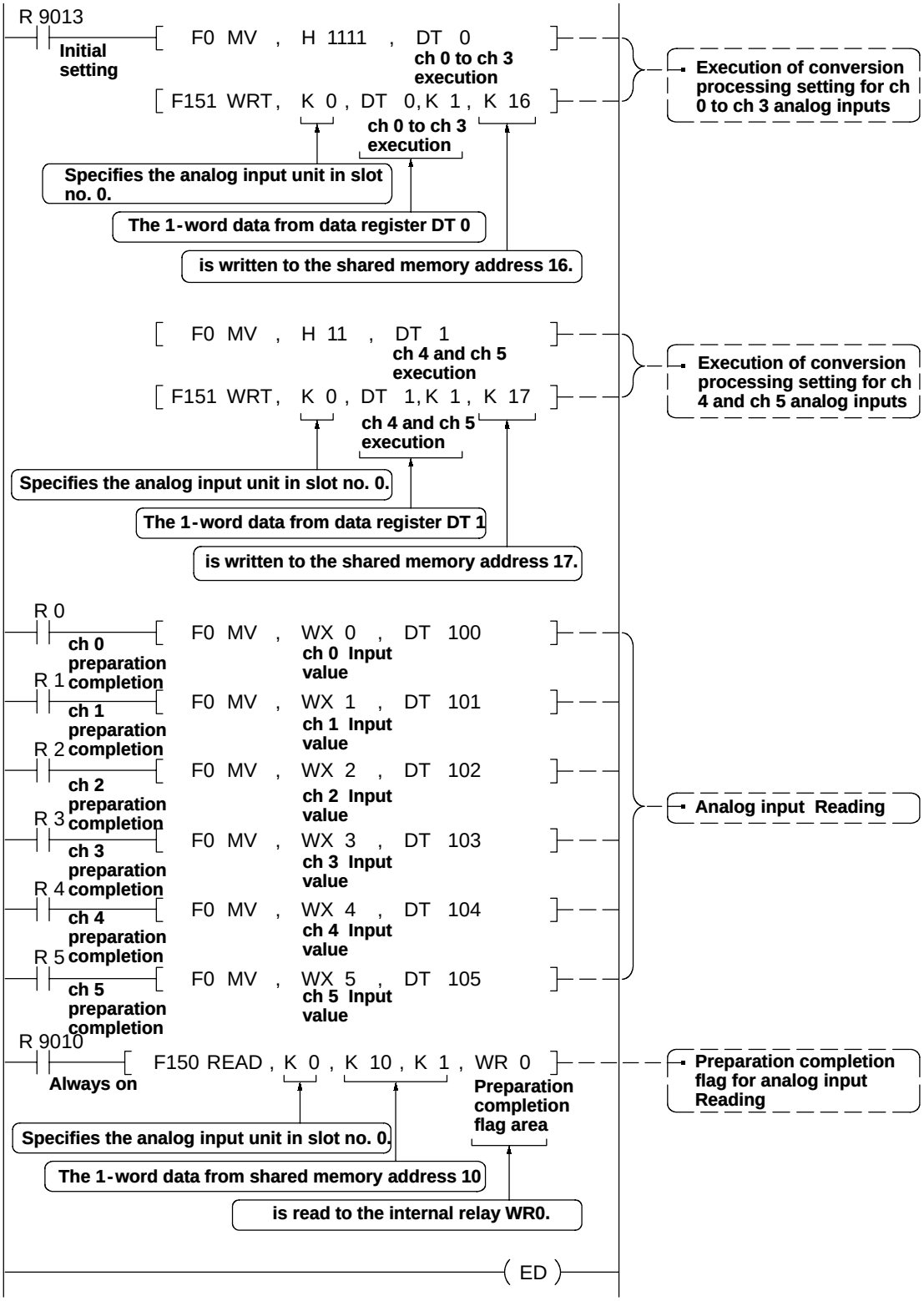
I/O number	Contents
WX0	Analog input data for ch 0
WX1	Analog input data for ch 1
WX2	Analog input data for ch 2
WX3	Analog input data for ch 3
WX4	Analog input data for ch 4
WX5	Analog input data for ch 5

Shared memory

Address 10	Preparation completion flag for ch 0 to ch 7 analog inputs
Address 16	No execution of conversion processing setting for ch 0 to ch 3 analog inputs
Address 17	No execution of conversion processing setting for ch 4 to ch 7 analog inputs

For detailed information ☛ section 14.3.2

Sample program:

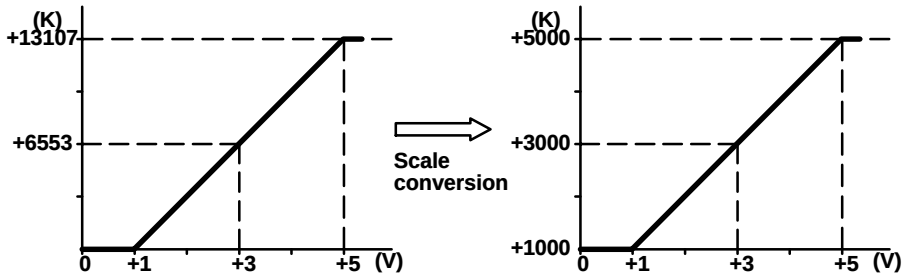


8.3 Scale Conversion Processing Program (CPU Unit with Analog I/O)

Program outline

Using ch 0 to ch 2 (set for no execution of input conversion processing) of the CPU unit with analog I/O, this program reads the **scale-converted*** analog input data to the data registers DT104 and DT114 using the preparation completion flag.

***Scale-converted**: Conversion of the analog input data to numerical values that are easier to manage.



For the sample program, the input data is converted to easy-to-use value using the high-level instructions **F30 (*)** "16-bit multiplier", **F33 (D%)** "32-bit subtractor" and F22 (+) "16-bit addition."

In the case of ch 0, the data read to DT100 is multiplied by K4000, and the result is stored in DT101 (as ch 0-conversion-1). The data stored in DT101 is divided by K13107, and that result is stored in DT103 (as ch 0-conversion-2). Then the data stored in DT104 is added by K1000, and the result is stored in DT104 (as ch0-conversion-3).

Example: Contents of DT100 "6553" × K4000 ÷ K13107 +K1000 → 3000
Contents of DT100 "13107" × K4000 ÷ K13107 +K1000 → 5000

Settings

Channels that execute analog input conversion processing
H11: ch 0 and ch 1 are set for execution and ch2 and ch 3 are not set for execution

I/O allocation

I/O number	Contents
WX0	Analog input data for ch 0
WX1	Analog input data for ch 1

Data register

DT104	Stores scale-converted input data (ch 0-conversion-3) for ch 0
DT114	Stores scale-converted input data (ch 1-conversion-3) for ch 1

☛ next page

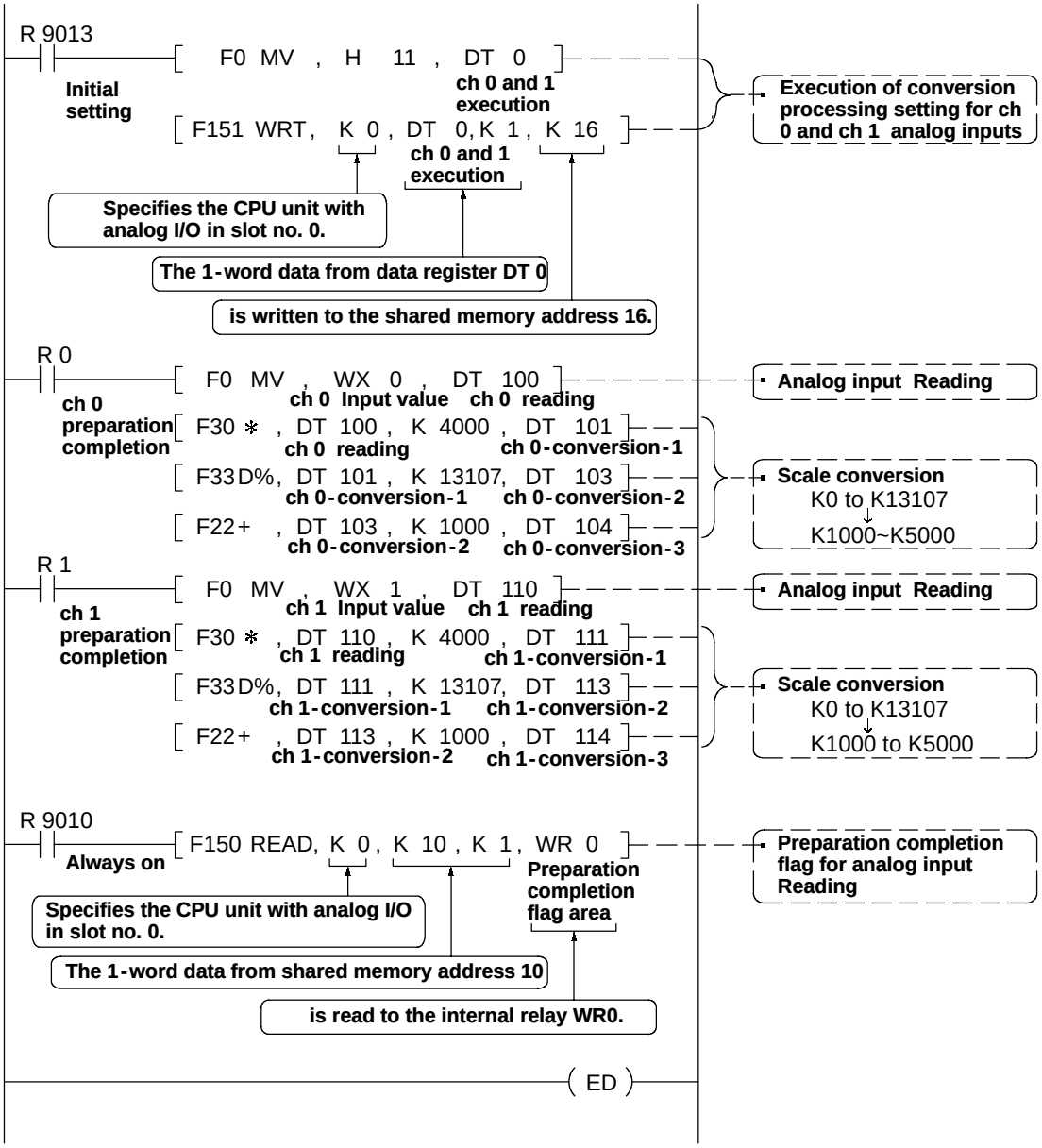
8.3 Scale Conversion Processing Program (CPU Unit with Analog I/O)

Shared memory

Address 10	Preparation completion flag for ch 0 to ch 3 analog inputs
Address 16	No execution of conversion processing setting for ch 0 to ch 3 analog inputs

For detailed information ☛ section 14.3.1

Sample program:



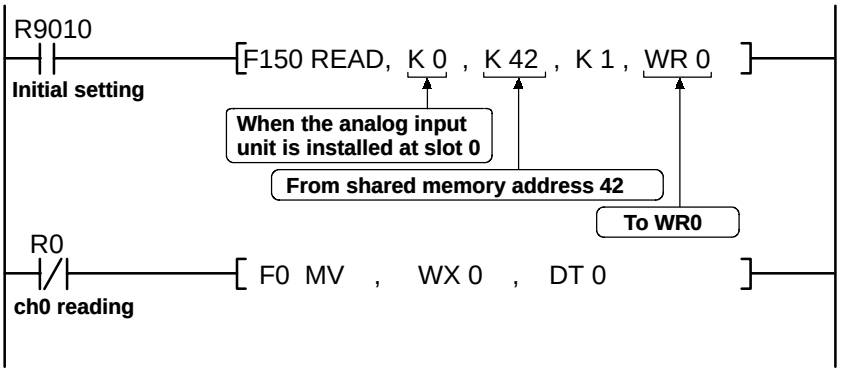
8.4 Temperature Sensor Input Broken Wire Detection

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

For the detection of the broken wires, there are two methods of detection: one is detection performed by the broken-wire detection flags in shared memory, and the other is detection by the temperature sensor input conversion data (the conversion data is K20000).

Program example:

When the reading conditions for the analog input ch0 conversion data is to use the broken-wire detection flag and read to DT0.



Precautions when using broken wire detection for the resistance thermometer device input wiring

For broken wire detection in the FP2 three-wire resistance thermometer device input wiring, depending on which wire breaks as shown below, there are situations where the broken wire detection cannot be performed.

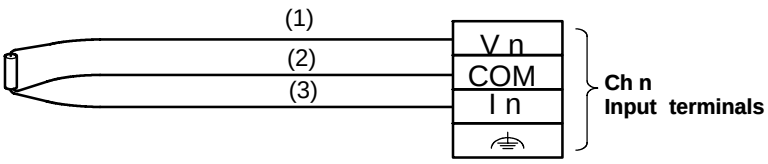
Wire (1) is broken: Broken wire detection is possible

Only (2) wire is broken: Broken wire detection is not possible

Only (3) wire is broken: Broken wire detection is not possible

Wires (2) and (3) are broken: Broken wire detection is possible

Three-wire R.T.D (Resistance thermometer device)



8.4 Temperature Sensor Input Broken Wire Detection

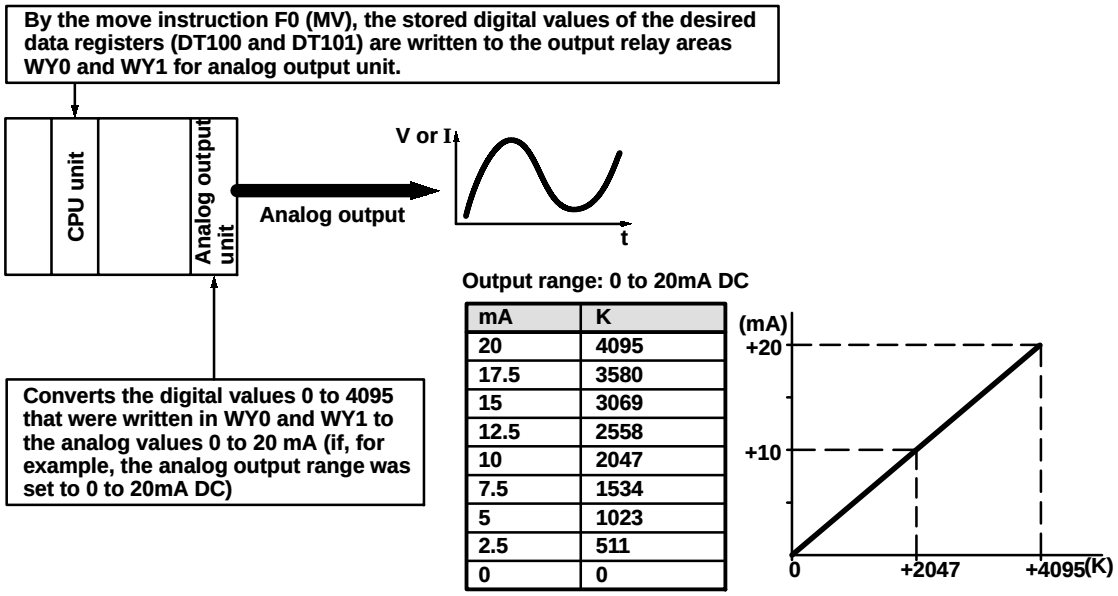
Chapter 9

Sample Program for Analog Output

9.1 Basic Program (Analog Output Unit)

Program outline

This program writes the output data stored in data registers DT100 and DT101 to the output relay areas WY0 and WY1, which correspond to the output channels ch 0 and ch 1 of the analog output unit set for the execution of conversion processing.



Output range: 0 to 20mA DC

mA	K
20	4095
17.5	3580
15	3069
12.5	2558
10	2047
7.5	1534
5	1023
2.5	511
0	0

Settings

Channels that execute analog output conversion processing
H11: ch 0 and ch 1 are set for execution and ch 2 and ch 3 is not set for execution

I/O Allocation

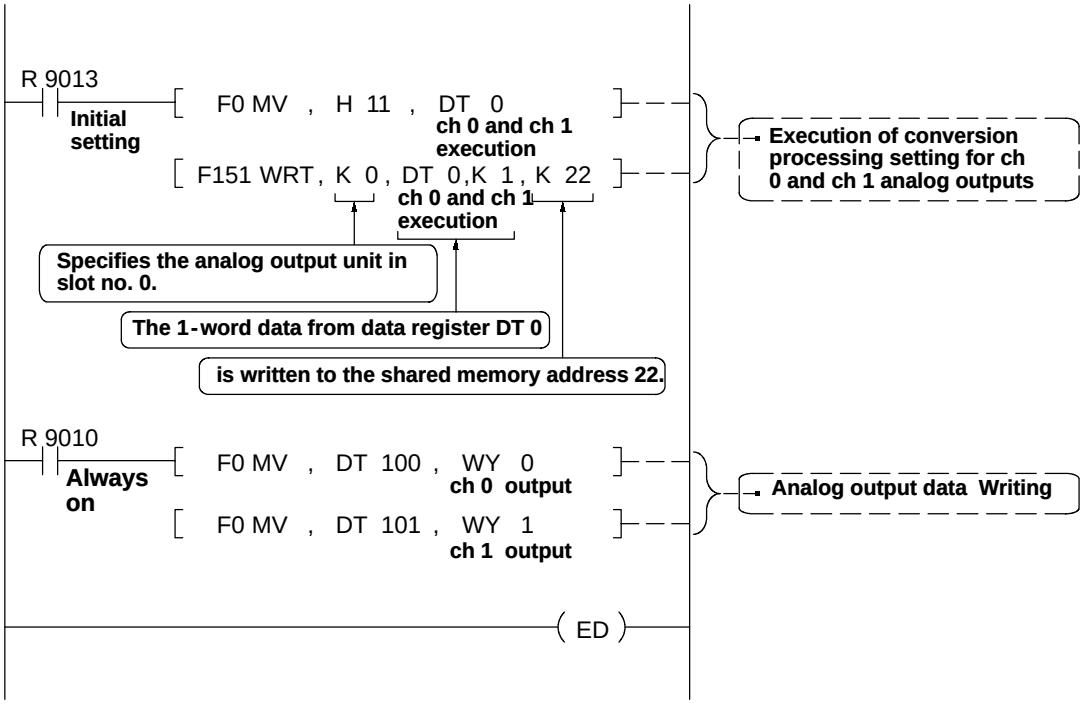
I/O number	Contents
WY0	Analog output data for ch 0
WY1	Analog output data for ch 1

Shared memory

Address 22	No execution of conversion processing setting for ch 0 to ch 3 analog outputs

For detailed information ☛ section 14.3.3

Sample program:



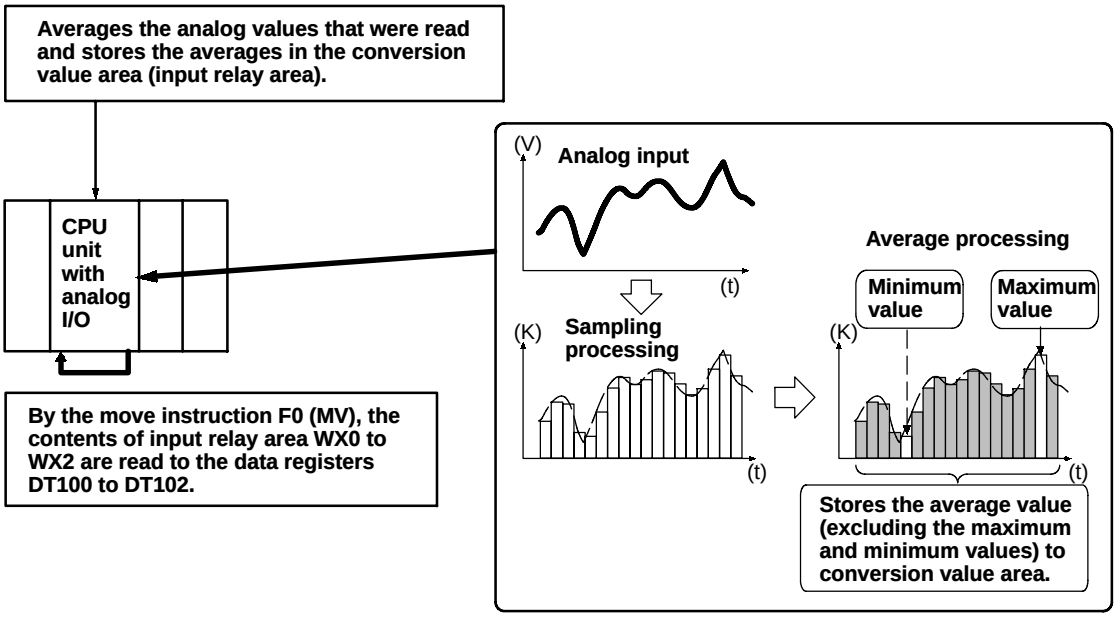
Chapter 10

Sample Program for Analog Input Average Processing Setting

10.1 Sample Program (CPU Unit with Analog I/O)

Program outline

After averaging the analog input data for ch 0 to ch 2 (set for no execution of input conversion processing) of the CPU unit with analog I/O, this program reads the averages to the data registers DT100 to DT102 using the preparation completion flag.



Settings

Channels that execute analog input conversion processing
H111: ch 0 to ch 2 are set for execution and ch 3 is not set for execution

I/O allocation

I/O number	Contents
WX0	Analog input data for ch 0
WX1	Analog input data for ch 1
WX2	Analog input data for ch 2

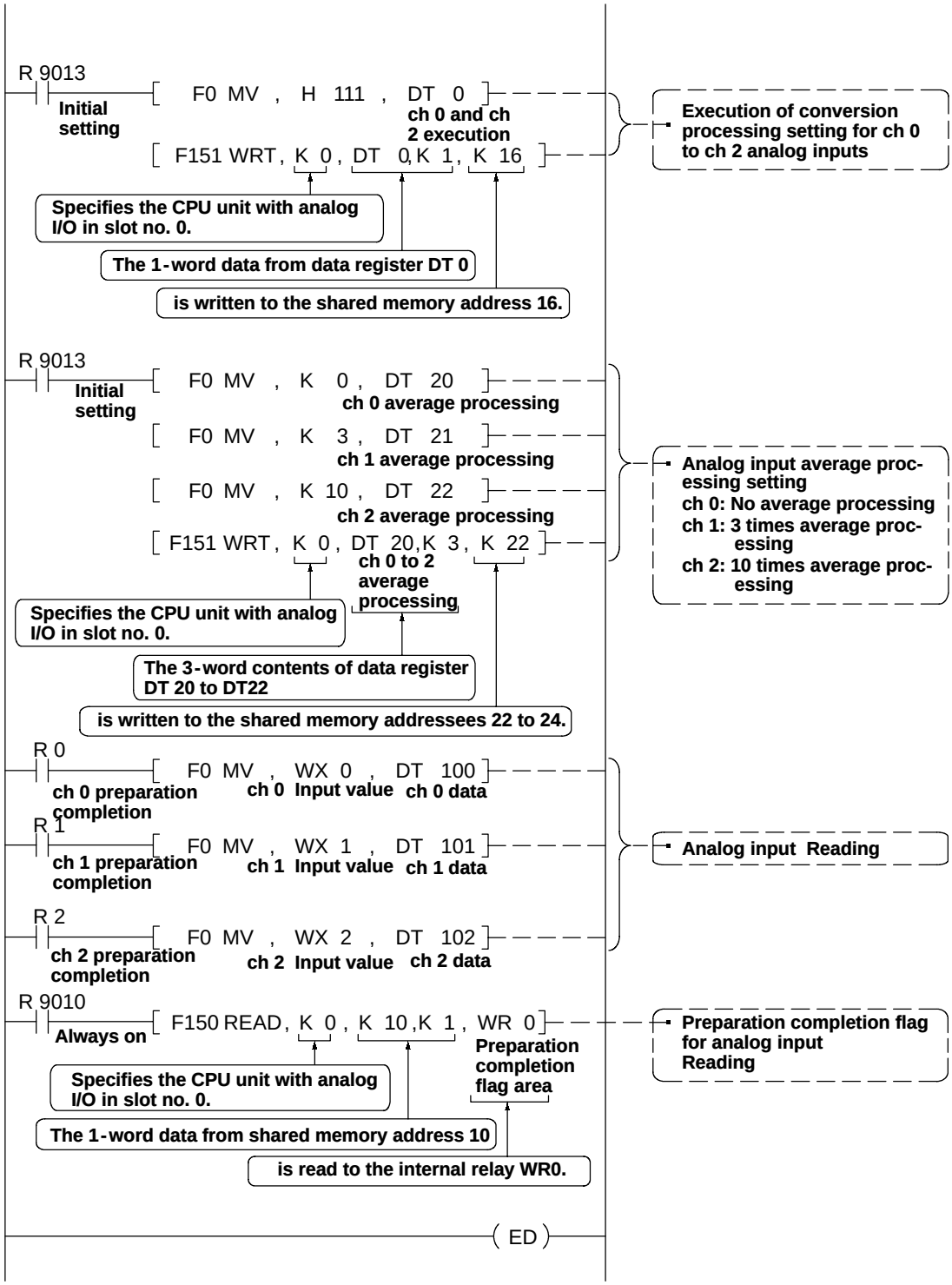
Shared memory

Address 10	Preparation completion flag for ch 0 to ch 3 analog inputs
Address 16	No execution of conversion processing setting for ch 0 to ch 3 analog inputs
Address 22 to 24	Average processing times setting for ch 0 to ch 2

For detailed information ➨ section 14.3.1

10.1 Sample Program (CPU Unit with Analog I/O)

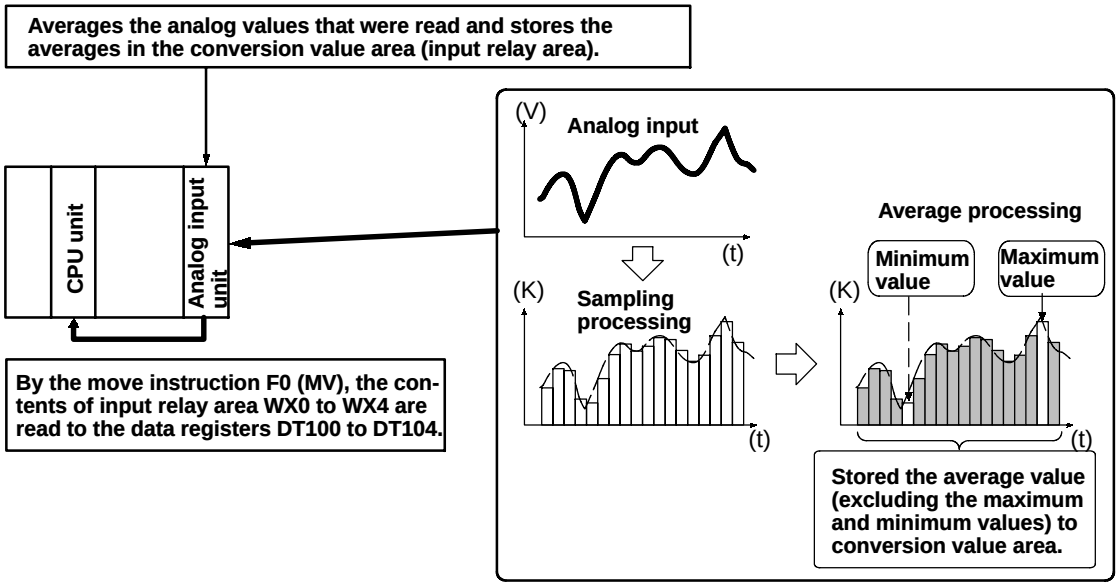
Sample program:



10.2 Sample Program (Analog Input Unit)

Program outline

After averaging the analog input data for ch 0 to ch 4 (set for no execution of input conversion processing) of the analog input unit, this program reads the averages to the data registers DT100 to DT104 using the preparation completion flag.



Settings

Channels that execute analog input conversion processing
H1111: ch 0 to ch 3 are set for execution
H1: ch 4 is set for execution and ch 5 to ch 7 are not set for execution

I/O allocation

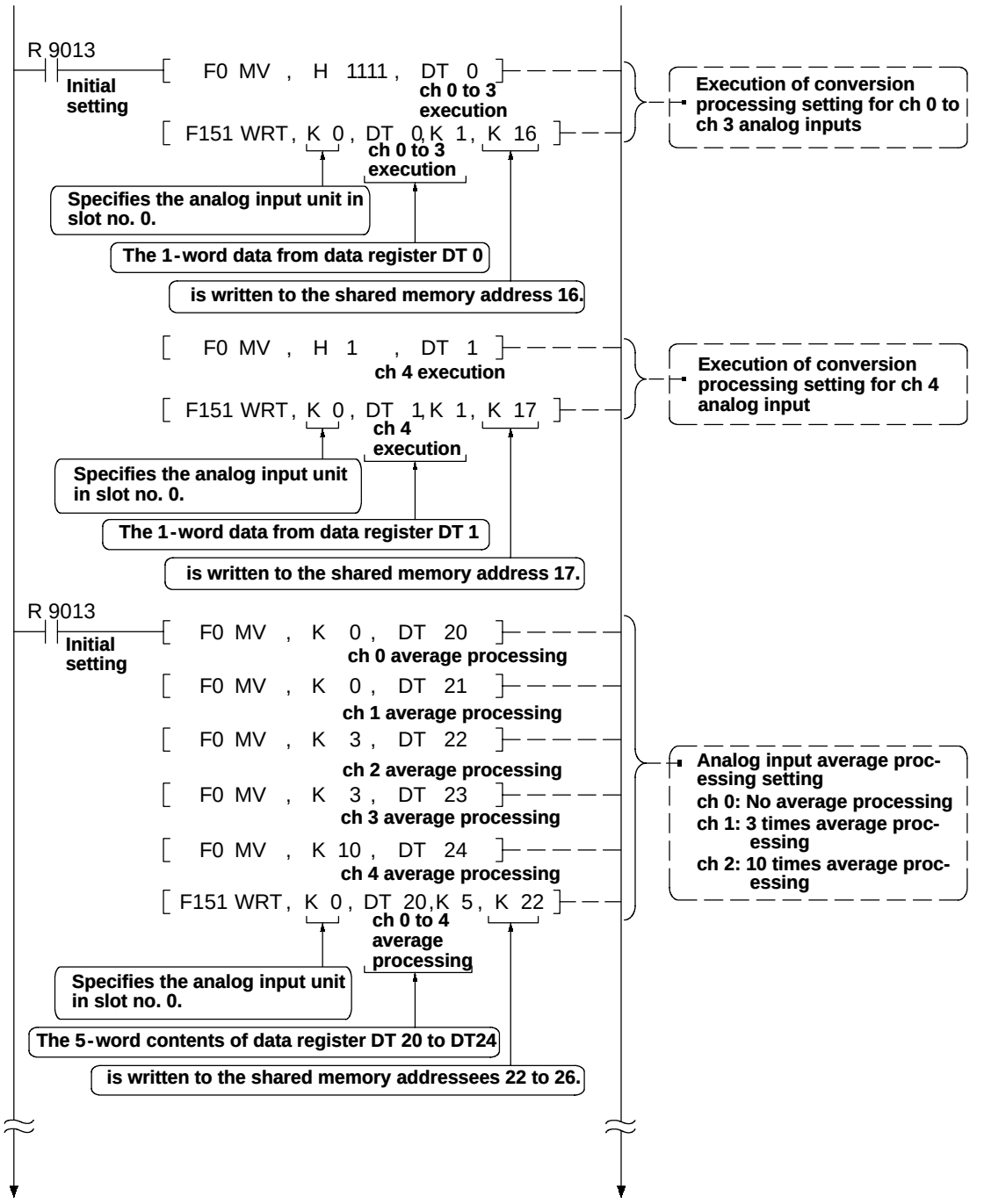
I/O number	Contents
WX0	Analog input data for ch 0
WX1	Analog input data for ch 1
WX2	Analog input data for ch 2
WX3	Analog input data for ch 3
WX4	Analog input data for ch 4

Shared memory

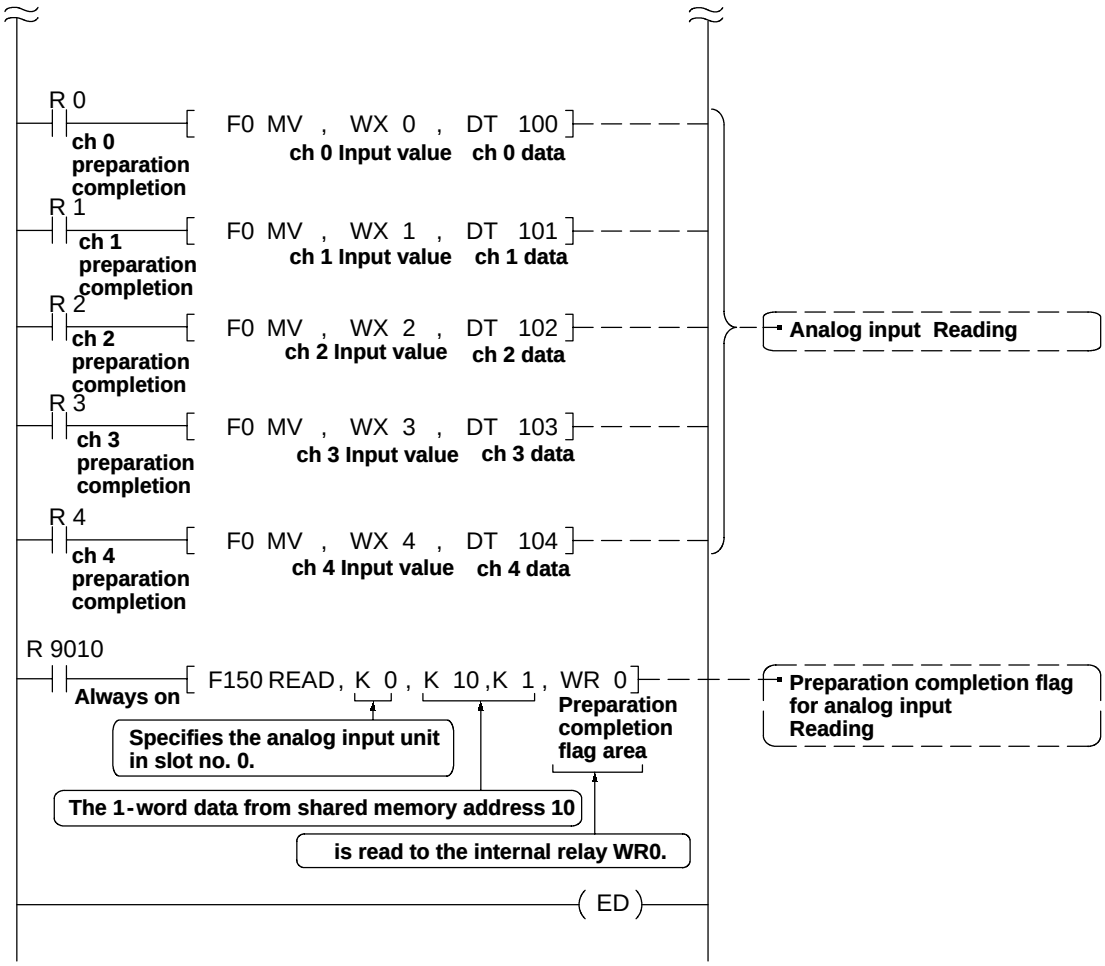
Address 10	Preparation completion flag for ch 0 to ch 7 analog inputs
Address 16	No execution of conversion processing setting for ch 0 to ch 3 analog inputs
Address 17	No execution of conversion processing setting for ch 4 to ch 7 analog inputs
Address 22 to 26	Average processing times setting for ch 0 to ch 4

For detailed information ☛ section 14.3.2

Sample program:



next page


R 0
ch 0 preparation completion
F0 MV , WX 0 , DT 100
ch 0 Input value
ch 0 data
R 1
ch 1 preparation completion
F0 MV , WX 1 , DT 101
ch 1 Input value
ch 1 data
R 2
ch 2 preparation completion
F0 MV , WX 2 , DT 102
ch 2 Input value
ch 2 data
R 3
ch 3 preparation completion
F0 MV , WX 3 , DT 103
ch 3 Input value
ch 3 data
R 4
ch 4 preparation completion
F0 MV , WX 4 , DT 104
ch 4 Input value
ch 4 data
Analog input Reading
R 9010
Always on
F150 READ , K 0 , K 10 , K 1 , WR 0
Specifies the analog input unit in slot no. 0.
The 1-word data from shared memory address 10
Preparation completion flag area
is read to the internal relay WR0.
Preparation completion flag for analog input Reading
ED

10.2 Sample Program (Analog Input Unit)

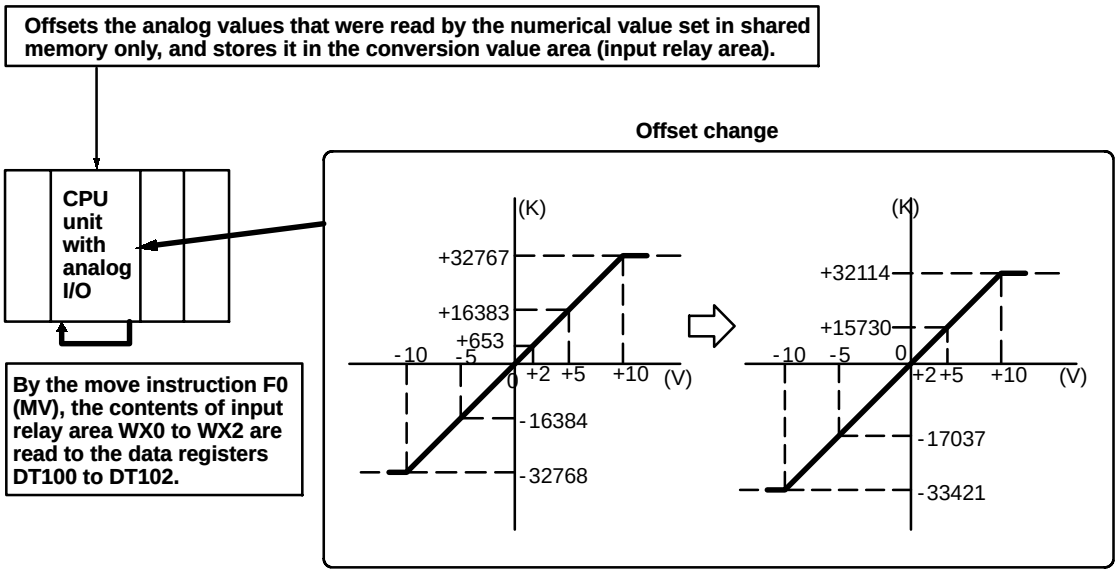
Chapter 11

Sample Program of Analog Input Offset Setting

11.1 Sample Program (CPU Unit with Analog I/O)

Program outline

This program offsets the analog input data for ch 0 to ch 2 (set for no execution of input conversion processing) of the CPU unit with analog I/O by the set numerical amount only, and then reads it to the data registers DT100 to DT102 using the preparation completion flag.



Settings

Channels that execute analog input conversion processing
H111: ch 0 to ch 2 are set for execution and ch 3 is not set for execution

I/O allocation

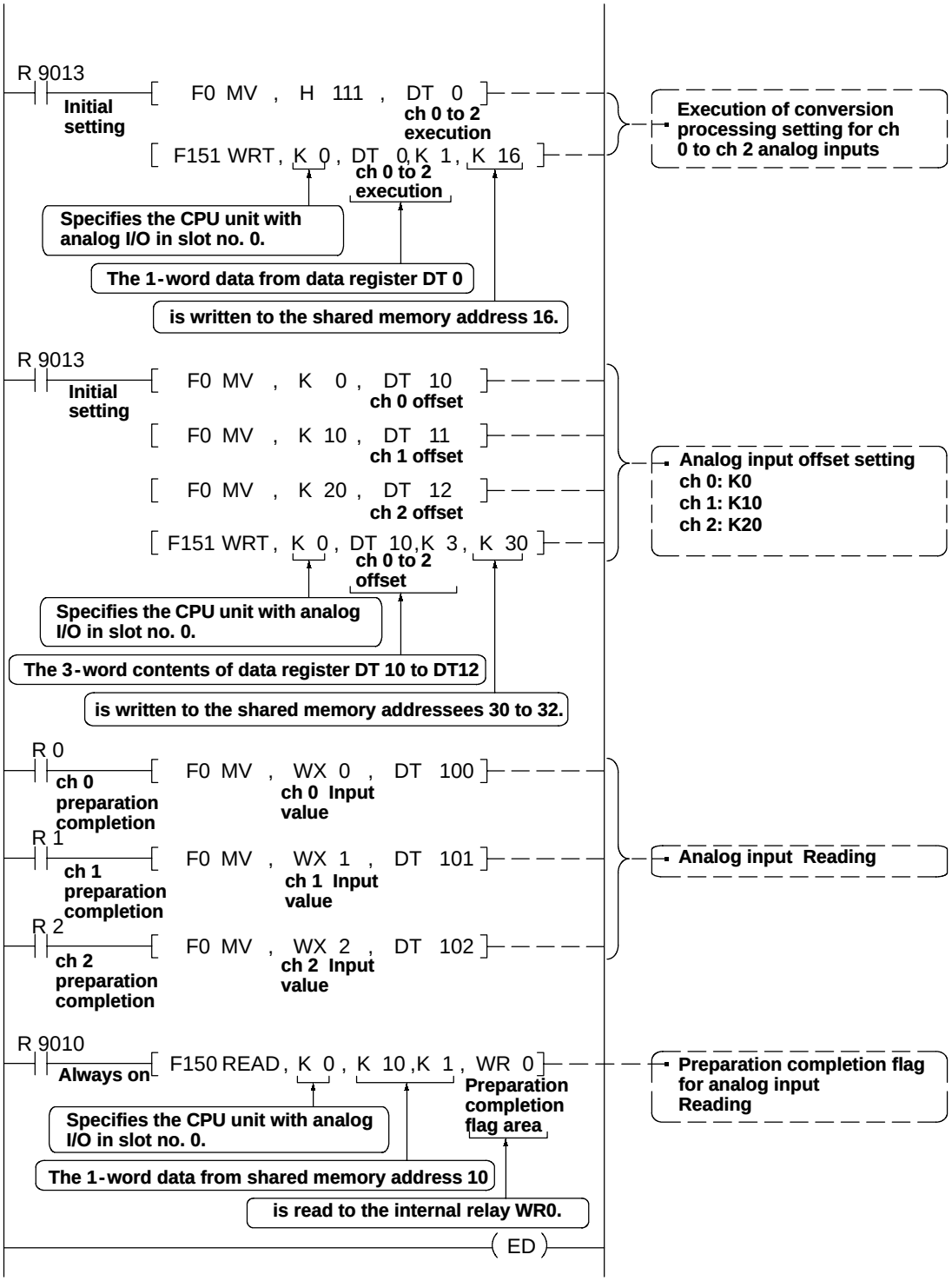
I/O number	Contents
WX0	Offset changed analog input value for ch 0
WX1	Offset changed analog input value for ch 1
WX2	Offset changed analog input value for ch 2

Shared memory

Address 10	Preparation completion flag for ch 0 to ch 3 analog inputs
Address 16	No execution of conversion processing setting for ch 0 to ch 3 analog inputs
Addresses 30 to 32	Offset changing setting for ch 0 to ch 2

For detailed information ☛ section 14.3.1

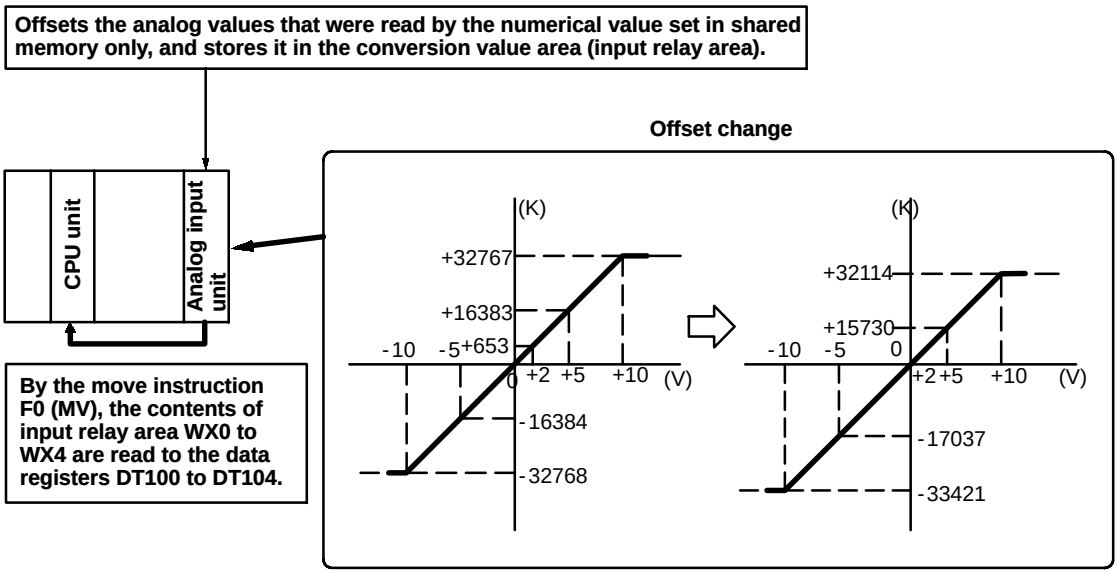
Sample program:



11.2 Sample Program (Analog Input Unit)

Program outline

This program offsets the analog input data for ch 0 to ch 4 (set for no execution of input conversion processing) of the analog input unit by the set numerical amount only, and then reads it to the data registers DT100 to DT104 using the preparation completion flag.



Settings

Channels that execute analog input conversion processing
H1111: ch 0 to ch 3 are set for execution
H1: ch 4 is set for execution and ch 5 to ch 7 are not set for execution

I/O allocation

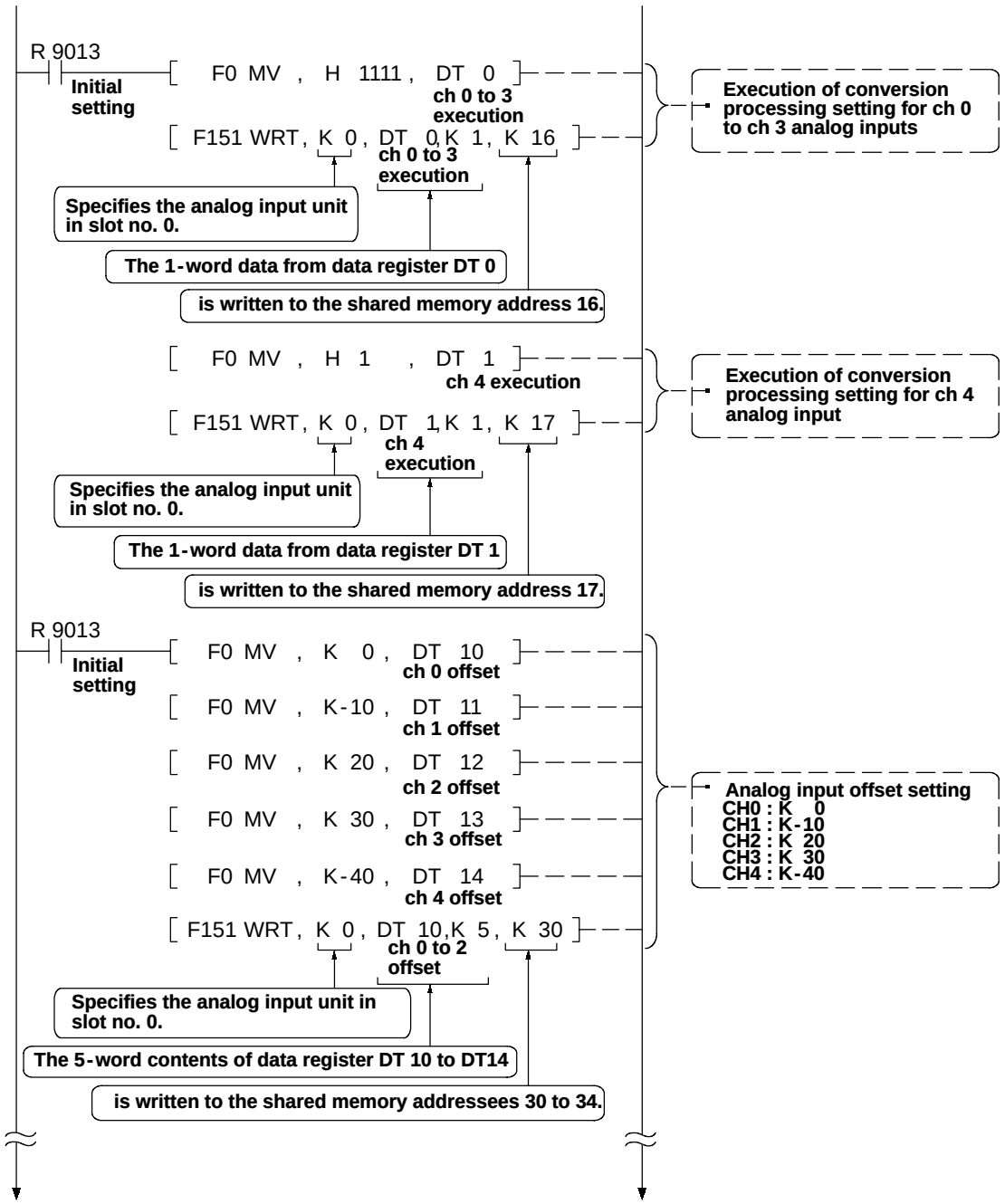
I/O number	Contents
WX0	Offset changed analog input value for ch 0
WX1	Offset changed analog input value for ch 1
WX2	Offset changed analog input value for ch 2
WX3	Offset changed analog input value for ch 3
WX4	Offset changed analog input value for ch 4

Shared memory

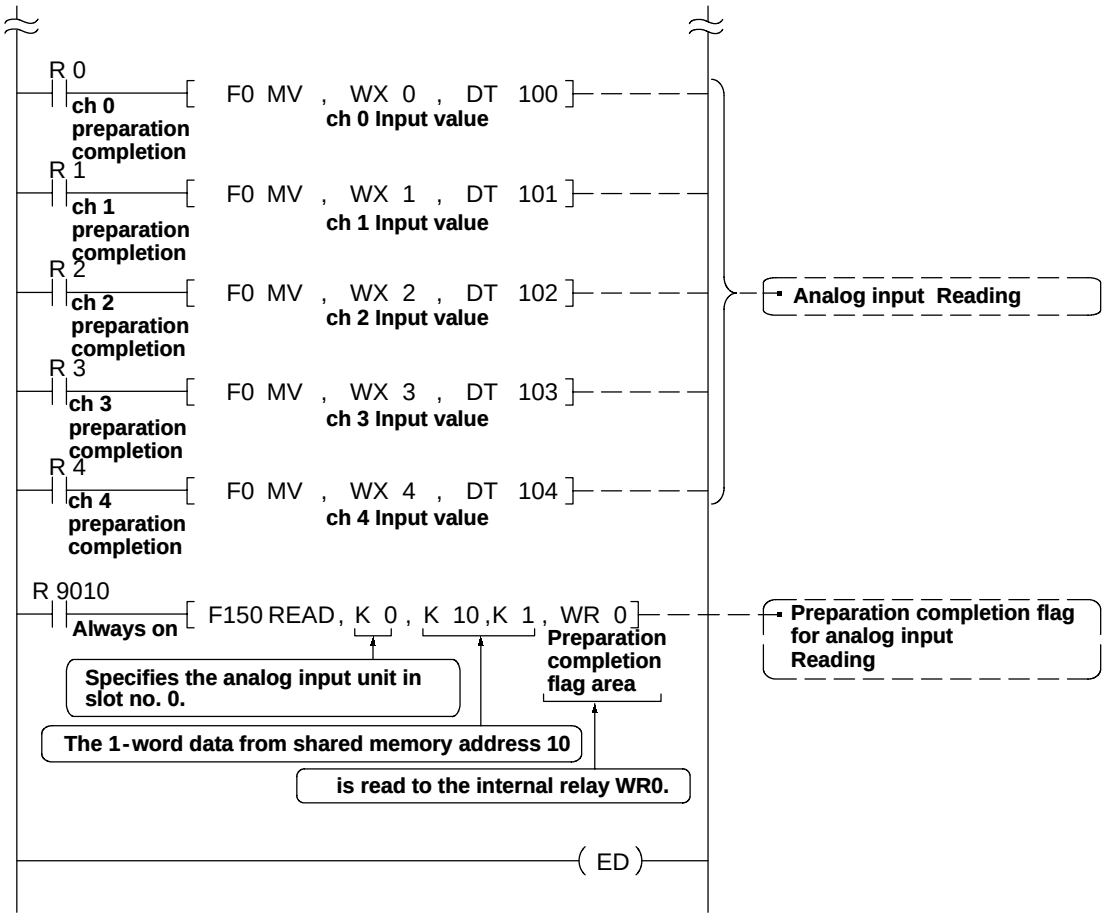
Address 10	Preparation completion flag for ch 0 to ch 3 analog inputs
Address 16	No execution of conversion processing setting for ch 0 to ch 3 analog inputs
Address 17	No execution of conversion processing setting for ch 4 to ch 7 analog inputs
Address 30 to 34	Offset changing setting for ch 0 to ch 4

For detailed information ☛ section 14.3.2

Sample program:



next page


R 0
ch 0 preparation completion
F0 MV , WX 0 , DT 100
ch 0 Input value
R 1
ch 1 preparation completion
F0 MV , WX 1 , DT 101
ch 1 Input value
R 2
ch 2 preparation completion
F0 MV , WX 2 , DT 102
ch 2 Input value
R 3
ch 3 preparation completion
F0 MV , WX 3 , DT 103
ch 3 Input value
R 4
ch 4 preparation completion
F0 MV , WX 4 , DT 104
ch 4 Input value
Analog input Reading
R 9010
Always on
F150 READ , K 0 , K 10 , K 1 , WR 0
Preparation completion flag area
Preparation completion flag for analog input Reading
Specifies the analog input unit in slot no. 0.
The 1-word data from shared memory address 10
is read to the internal relay WR0.
ED

11.2 Sample Program (Analog Input Unit)

Chapter 12

Sample Program for Analog Output Hold Setting

12.1 Output Hold Setting Basic Program (CPU Unit with Analog I/O)

Program outline

When switching from the RUN mode to the PROG. mode, this program holds the analog output at the **final value of the RUN*** mode according to the shared memory (address 38) setting. Then the program writes the data stored in data register DT0 to the output relay area WY4 of output channel ch 0 for the CPU unit with analog I/O.

Final value of RUN mode:

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

Settings

I/O allocation

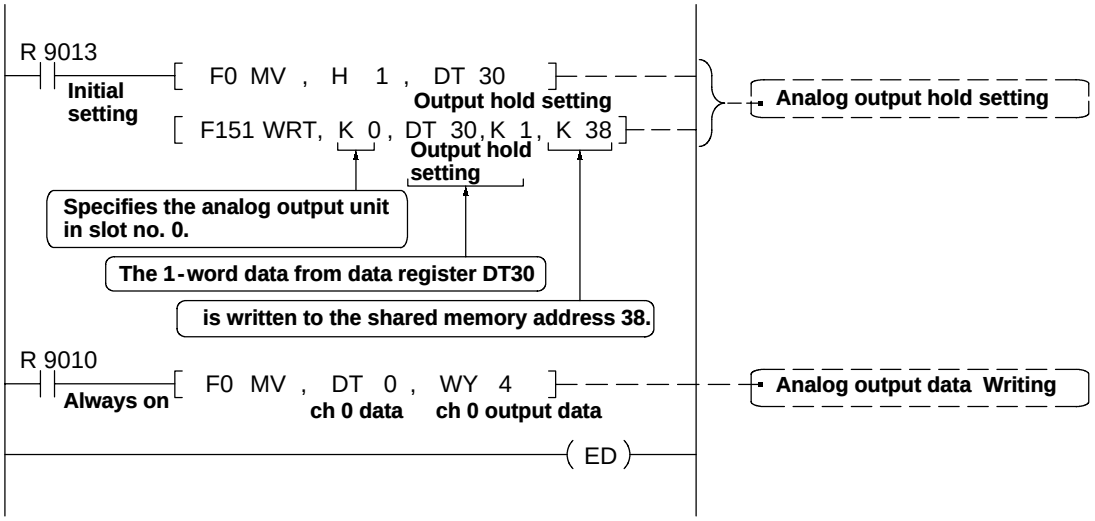
I/O number	Contents
WY4	Analog output data for ch 0

Shared memory

Address 38	Analog output hold setting H0: Non-hold H1: Hold (holds analog output at final value of RUN mode) H2: Hold (holds analog output at any desired value)

For detailed information ☛ section 14.3.1

Sample program:



12.2 Output Hold (Any Value) Setting Program

12.2.1 Basic Program (CPU Unit with Analog I/O)

Program outline

When switching from the RUN mode to the PROG. mode, this program holds the analog output at any desired value according to the shared memory (addresses 38 and 39) settings. Then the program writes the data stored in data register DT0 to the output relay area WY4 of output channel ch 0 for the CPU unit with analog I/O.

Settings

I/O allocation

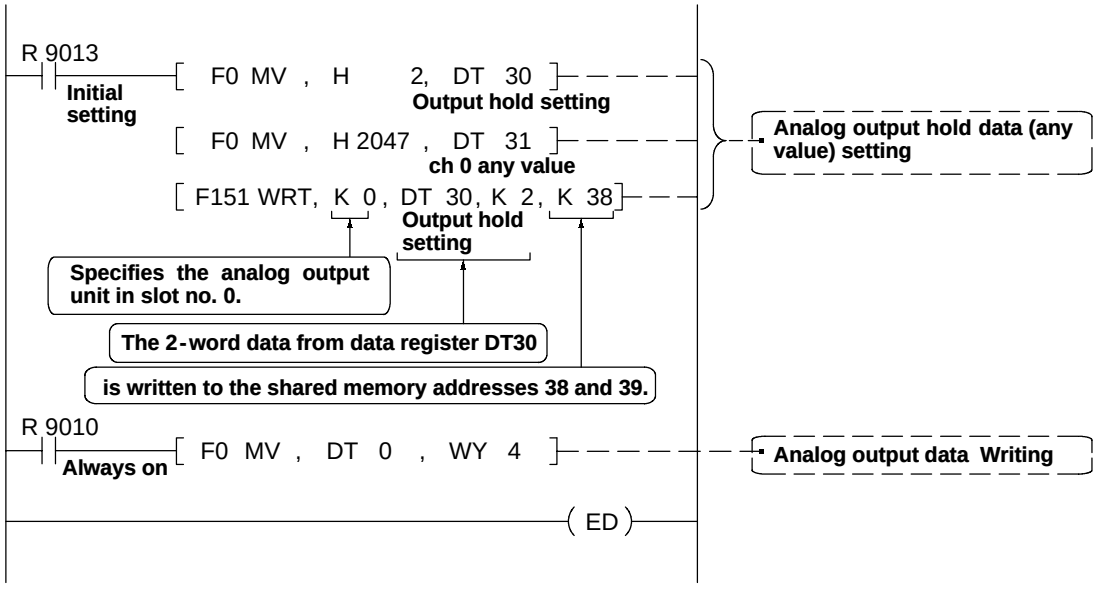
I/O number	Contents
WY4	Analog output data for ch 0

Shared memory

Address 38	Analog output hold setting H0: Non-hold H1: Hold (holds analog output at final value of RUN mode) H2: Hold (holds analog output at any desired value)
Address 39	Analog output hold data (any value) setting Range of any value setting -10 to +10V output range: K-2048 to K2047 0 to 20mA output range: K0 to K4095

For detailed information ☛ section 14.3.1

Sample program:



12.2.2 Basic Program (Analog Output Unit)

Program outline

When switching from the RUN mode to the PROG. mode, this program holds the analog output at any desired value according to the shared memory (addresses 17 to 21) settings. Then the program writes the data stored in data register DT100 to DT103 to the output relay areas WY0 to WY3 of output channels ch 0 to ch 3 for the analog output unit.

Settings

I/O allocation

I/O number	Contents
WY0	Analog output data for ch 0
WY1	Analog output data for ch 1
WY2	Analog output data for ch 2
WY3	Analog output data for ch 3

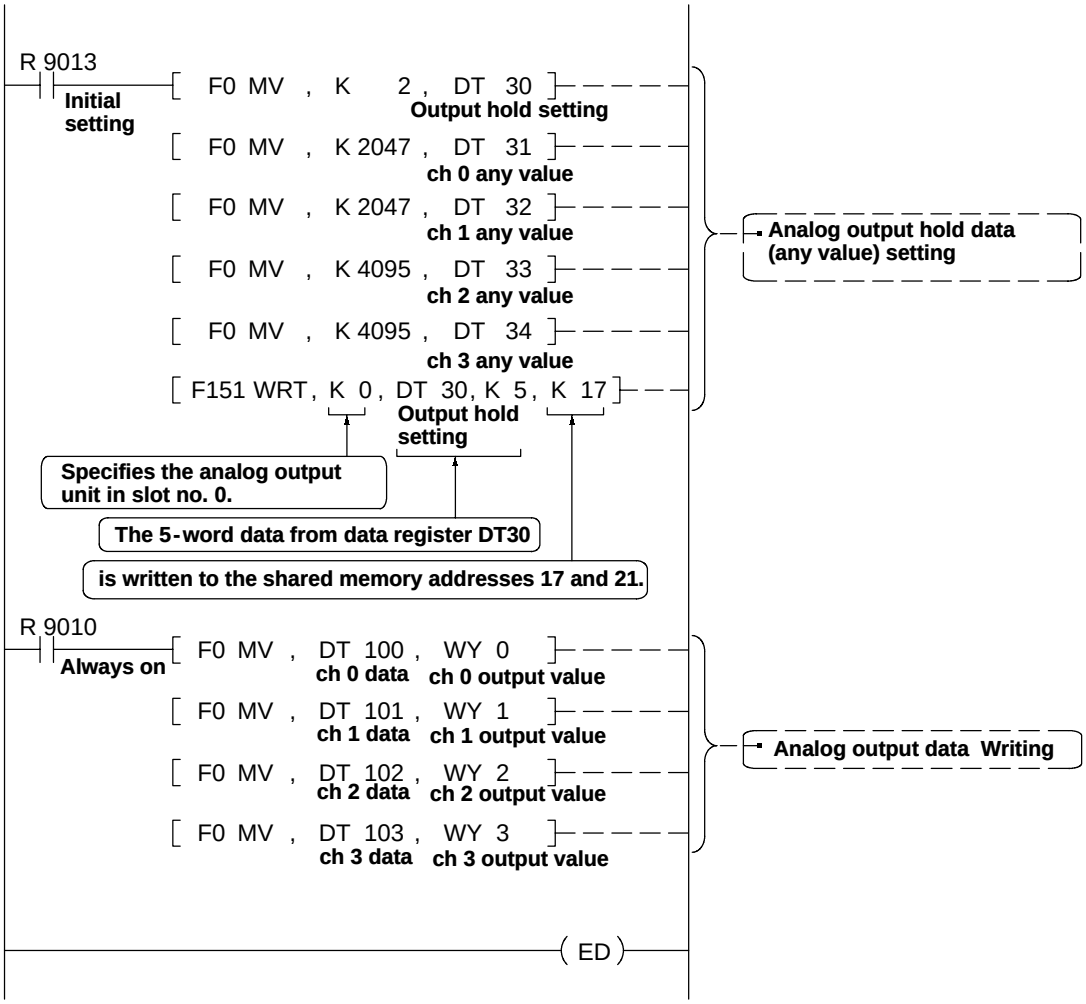
Shared memory

Address 17	Analog output hold setting H0: Non-hold H1: Hold (holds analog output at final value of RUN mode) H2: Hold (holds analog output at any desired value)
Address 18 to 21	Analog output hold data (any value) setting Range of any value setting -10 to +10V output range: K-2048 to K2047 0 to 20mA output range: K0 to K4095

For detailed information ☛ section 14.3.3

12.2 Output Hold (Any Value) Setting Program

Sample program:



Chapter 13

Troubleshooting

13.1 Problems Concerning the Analog Input

Problem	Remedy
Analog input conversion value cannot be read.	Check the I/O allocation for the analog units. Check the range settings. Check the settings for no execution of conversion processing (shared memory setting). Check the analog signal wiring.
Proper current input conversion value cannot be obtained.	Check the terminal block wiring. Check the current input devices.
Conversion value is unsteady.	Make sure that you are using shielded twisted-pair wiring for the input signal wires. Make sure that the shielding of the shielded twisted-pair wiring is properly connected. Make sure that no input signal wires are near other power wires.
Proper conversion value cannot be obtained during R.T.D. Pt100 connection.	Check the range settings. Check the three-wire wiring and restart the equipment.
Proper conversion value cannot be obtained during thermocouple connection.	Check the range settings. Check the polarity of the thermocouple.

13.2 Problems Concerning the Analog Output

Problem	Remedy
Proper analog output cannot be obtained.	Make sure that the FP2 CPU unit is in RUN mode. Check the I/O allocation for the analog units. Check the range settings. Check the settings for no execution of conversion processing (shared memory setting). Make sure that the analog output data given to the analog unit is proper for the range. For current output, make sure that the impedance of the output load device is 300Ω or less. Check the analog signal wiring.
Analog output value is unsteady.	Make sure that you are using shielded twisted-pair wiring for the output signal wires. Make sure that the shielding of the shielded twisted-pair wiring is properly connected. Make sure that no output signal wires are near other power wires. Check the sequence program that gives the output data to the analog unit.

Chapter 14

Specifications

14.1 Table of Performance Specifications

14.1.1 General Specifications

<table>
<tr><th>Item</th><th>Specifications</th></tr>
<tr><td>Ambient temperature</td><td>0 to 55°C/32 to 131°F
Use the FP2 Analog output unit (FP2-DA4) within the ranges given below.
<table>
<tr><th>Output range</th><th>Ambient operating temperature</th></tr>
<tr><td>Current output range (0 to 20mA)</td><td>When using 4 channels: 0 to 45°C/32 to 113°F
When using 3 channels: 0 to 50°C/32 to 122°F
When using 1 or 2 channels: 0 to 55°C/32 to 131°F</td></tr>
<tr><td>Voltage output range (±10V)</td><td>When using 4 channels: 0 to 55°C/32 to 131°F</td></tr>
</table></td></tr>
<tr><td>Storage temperature</td><td>-20 to +70°C/-4 to +158°F</td></tr>
<tr><td>Ambient humidity</td><td>30 to 85% RH (non-condensing)</td></tr>
<tr><td>Storage humidity</td><td>30 to 85% RH (non-condensing)</td></tr>
<tr><td>Breakdown voltage</td><td>D 500V AC, 1 minute between analog input terminal and analog output terminal for FP2-C1A
D 500V AC, 1 minute between analog input/output terminal and ground
D 1500V AC, 1 minute between analog input/output terminal and AC external terminal</td></tr>
<tr><td>Insulation resistance</td><td>100MΩ or more (measured with a 500V DC megger testing)
- between analog input terminal and analog output terminal for FP2-C1A
- between analog input/output terminal and ground
- between analog input/output terminal and AC external terminal</td></tr>
<tr><td>Vibration resistance</td><td>10 to 55Hz, 1cycle/min: double amplitude of 0.75mm/0.030in., 10min. on X, Y and Z directions</td></tr>
<tr><td>Shock resistance</td><td>98m/s^2 or more, 4 times on X, Y and Z directions</td></tr>
<tr><td>Noise immunity</td><td>1,500Vp-p with pulse widths 50ns and 1μs
(based on in-house measurements)</td></tr>
<tr><td>Operating conditions</td><td>Free from corrosive gases and excessive dust</td></tr>
<tr><td>Weight</td><td>FP2-C1A: 260g/9.171oz
FP2-AD8: 160g/5.644oz
FP2-DA4: 160g/5.644oz</td></tr>
</table>

14.1.2 Analog Input Specifications

Item		Specifications
Number of input points		4 channels: FP2-C1A, 8 channels: FP2-AD8
Input range (resolution)	**Voltage**	±10V (1/65536)
		1 to 5V (1/13107)
		±100mV (1/65536)
	Current	±20mA (1/32768)
		4 to 20mA (1/13107)
	Thermocouple	S: 0 to +1500_C (0.1_C)/32 to 2732_F (32.18_F)
		J: -200 to +750_C(0.1_C)/-328 to +1382_F (32.18_F)
		K: -200 to +1000_C (0.1_C)/-328 to +1832_F (32.18_F)
		T: -200 to +350_C (0.1_C)/-328 to +662_F (32.18_F)
		R: 0 to +1500_C (0.1_C)/-32 to +2732_F (32.18_F)
	R.T.D	Pt100: -100 to +500_C (0.1_C)/-148 to +932_F (32.18_F)
		Pt1000: -100 to +100_C (0.1_C)/-148 to +212_F (32.18_F)
Conversion speed	**Voltage input**	500μs channel (±100mV range: 650μs/channel) (* Note 1)
	Current input	
	Thermocouple input	90ms/channel (* Note 1)
	R.T.D input	
Overall accuracy		±1.0% F.S. or less (0 to 55_C/32 to 131_F) (* Note 2)
Input impedance	**Voltage input**	Min. 1MΩ
	Current input	250Ω
	Thermocouple input	Min. 1MΩ
Absolute maximum input	**±10V range**	±15V
	1 to 5V range	
	±100mV range	±150mV
	±20mA range	± 30mA
	4 to 20mA range	
	Thermocouple S range	-50 to +1700_C/58 to 3092_F
	Thermocouple J range	-210 to +1200_C/346 to 2192_F
	Thermocouple K range	-270 to +1370_C/454 to 2498_F
	Thermocouple T range	-270 to +400_C/454 to 752_F
	Thermocouple R range	-50 to +1760_C/58 to 3200_F
	R.T.D. Pt 100 range	-150 to +600_C/238 to 1112_F
	R.T.D. Pt 1000 range	-150 to +250_C/238 to 482_F
Insulation method		D Between analog input terminal and FP2 internal circuits: Optical coupler insulation S Between analog input channels: Non insulation S Between analog input terminal and analog output terminal: DC/DC converter insulation (for FP2-C1A)

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Item		Specifications	
Digital output processing	**Averaging**	3 to 64 times/each channels	
	Offset setting	K-2047 to K+2047/ each channels	
Broken wire sensing		Only thermocouple range or R.T.D input range/each channels	
Input range change method		All channels: By dip switch setting	
		Each channels: By shared memory setting	
Conversion execution processing channels setting		Each channels: By shared memory setting	
Permission resistance of input wire	**R.T.D input**	Under 30Ω (each side)	
Input conversion data setup time (After FP2 system power has been turned on)	**Input range**	FP2-C1A	FP2-AD8
	Voltage input range (all channels together)	460ms	430ms
	Current input range (all channels together)	460ms	430ms
	Thermocouple input range (all channels together)	910ms	1330ms
	R.T.D input range (all channels together)	3350ms	6490ms

Notes

1) Only when the DIP switch setting is setting the range for all the channels together. For information regarding when the shared memory is used to set the ranges for each channel, refer to "section 6.2 Analog I/O Conversion Cycle Time."

2) The full scale (F.S.) for each of analog input voltage 1 to 5V, current 4 to 20mA and T range of thermocouple is ±10V, ± 20mA and -200 to 1,000_C/-328 to +1,832_F respectively.

14.1.3 Analog Output Specifications

Item		Specifications
Number of output points		1 channel (FP2-C1A), 4 channels (FP2-DA4) (* Note 1)
Output range (digital input)	**Voltage**	±10V (K-2048 to K+2047)
	Current	0 to 20mA (K0 to K4095)
Resolution		1/4096
Conversion speed		500μs/channel (* Note 2)
Overall accuracy		Max. ±1.0% F.S. (0 to 55_C/32 to 131_F)
Output impedance		Voltage output: Max. 0.5Ω
Maximum output current		Voltage output: 10mA (FP2-C1A), 5mA (FP2-DA4)
Allowable output load resistance		Current output: Max. 300Ω
Insulation method		S Between analog output terminal and FP2 internal circuits: Optical coupler insulation S Between analog output channels: Non insulation (for FP2-DA4) S Between analog output terminal and analog input terminal: DC/DC converter insulation (for FP2-C1A)
Analog output hold setting		Hold/non hold setting by shared memory setting

Notes

1) For the FP2 analog output unit (FP2-DA4), there are restrictions regarding the ambient temperature that depend on how many channels are used. Use according to the restrictions listed in “Ambient temperature“of “section 14.1.1 General Specifications.”

2) For information regarding the conversion cycle time when using multiple channels, refer to “section 6.2 Analog I/O Conversion Cycle Time.”

14.2 Table of Input/Output Contact Allocation

CPU unit with analog I/O

Channel		FP2 I/O Number
Analog input	**Ch 0**	WX0: X0 to XF
	Ch 1	WX1: X10 to X1F
	Ch 2	WX2: X20 to X2F
	Ch 3	WX3: X30 to X3F
Analog output	**Ch 0**	WY4: Y40 to Y4F

Analog input unit

Channel		FP2 I/O Number
Analog input	**Ch 0**	WX(n): X(n)0 to X(n)F
	Ch 1	WX(n+1): X(n+1)0 to X(n+1)F
	Ch 2	WX(n+2): X(n+2)0 to X(n+2)F
	Ch 3	WX(n+3): X(n+3)0 to X(n+3)F
	Ch 4	WX(n+4): X(n+4)0 to X(n+4)F
	Ch 5	WX(n+5): X(n+5)0 to X(n+5)F
	Ch 6	WX(n+6): X(n+6)0 to X(n+6)F
	Ch 7	WX(n+7): X(n+7)0 to X(n+7)F

Analog output unit

Channel		FP2 I/O Number
Analog output	**Ch 0**	WY(n): Y(n)0 to Y(n)F
	Ch 1	WY(n+1): Y(n+1)0 to Y(n+1)F
	Ch 2	WY(n+2): Y(n+2)0 to Y(n+2)F
	Ch 3	WY(n+3): Y(n+3)0 to Y(n+3)F

The I/O number shown by an “n” in the table above is determined according to the installed slot position and the I/O allocation for other units.

14.3 Table of Shared Memory Area

In the FP2 CPU unit with analog I/O, analog input unit, and analog output unit, in addition to control of the analog input and output, shared memory that allows reading and writing by the sequence program is stored.

14.3.1 Shared Memory of CPU Unit with Analog I/O

Address	Descriptions	Initial value	See section
10	Preparation completion flag for analog input ch 0 to 3	H0000	14.4.1
16	No execution of conversion processing setting for analog input ch 0 to 3	H1111	14.4.2
18	Range setting for analog input ch 0 and 1	HFFFF	14.4.3
19	Range setting for analog input ch 2 and 3	HFFFF	
22	Average times setting for analog input ch 0	K1	14.4.4
23	Average times setting for analog input ch 1	K1	
24	Average times setting for analog input ch 2	K1	
25	Average times setting for analog input ch 3	K1	
30	Offset changing setting for analog input ch 0	K0	14.4.5
31	Offset changing setting for analog input ch 1	K0	
32	Offset changing setting for analog input ch 2	K0	
33	Offset changing setting for analog input ch 3	K0	
38	Analog output hold setting	H0000	14.5.1
39	Analog output hold (any value) data setting	K0000	14.5.2
42	Broken wire detection flag for temperature sensor input (TC, R.T.D)	H0000	14.4.6

Notes

- **Shared memory addresses other than those listed above are not used. Do not perform reading and writing with addresses that are not used. And the addresses 10 and 42 cannot be written to using a user program.**
- **The shared memory addresses are all preset when the power is turned from off to on (they return to the initial values).**
- **Addresses 16, 22 to 25, 30 to 33, 38, and 39 can be written to by the program as many times as desired when the mode is changed from the PROG. mode to the RUN mode.**
- **Addresses 10 and 42 cannot be written to using a user program. Reading is possible all the time.**

- **Address 10 can only be written to after the first conversion is complete when the power is turned on.**
- **Addresses 18 to 21 can only be written to once using a user program after RUN. Reading is possible all the time.**
- **Regarding the preparation complete flag for analog input of address 10, when switching from PROG.to RUN mode, the preparation complete flags of all channels will turn on because all channels are undergoing conversion execution. When the non-execution setting for each channel is set, this is reflected in the bit that corresponds to address 10.**
  When “Enable setting by software” is specified at the range setting switch, the address 10 “analog input preparation complete flag” will not turn on because conversion will not take place until the range setting is performed.

14.3.2 Shared Memory of Analog Input Unit

Address	Descriptions	Initial value	See section
10	Preparation completion flag for analog input ch 0 to 7	H0000	14.4.1
16	No execution of conversion processing setting for analog input ch 0 to 3	H1111	14.4.2
17	No execution of conversion processing setting for analog input ch 4 to 7	H1111	
18	Range setting for analog input ch 0 and 1	HFFFF	14.4.3
19	Range setting for analog input ch 2 and 3	HFFFF	
20	Range setting for analog input ch 4 and 5	HFFFF	
21	Range setting for analog input ch 6 and 7	HFFFF	
22	Average times setting for analog input ch 0	K1	14.4.4
23	Average times setting for analog input ch 1	K1	
24	Average times setting for analog input ch 2	K1	
25	Average times setting for analog input ch 3	K1	
26	Average times setting for analog input ch 4	K1	
27	Average times setting for analog input ch 5	K1	
28	Average times setting for analog input ch 6	K1	
29	Average times setting for analog input ch 7	K1	
30	Offset changing setting for analog input ch 0	K0	14.4.5
31	Offset changing setting for analog input ch 1	K0	
32	Offset changing setting for analog input ch 2	K0	
33	Offset changing setting for analog input ch 3	K0	
34	Offset changing setting for analog input ch 4	K0	
35	Offset changing setting for analog input ch 5	K0	
36	Offset changing setting for analog input ch 6	K0	
37	Offset changing setting for analog input ch 7	K0	
42	Broken wire detection flag for temperature sensor input (TC, R.T.D)	H0000	14.4.6

☞ Notes

- **Shared memory addresse other than those listed above are not used. Do not perform reading and writing with addresses that are not used. And the addresses 10 and 42 cannot be written to using a user program.**
- **The shared memory addresses are all preset when the power is turned from off to on (they return to the initial values).**
- **Addresses 16, 17, and 22 to 37 can be written to by the program as many times as desired when the mode is changed from the PROG. mode to the RUN mode.**
- **Addresses 10 and 42 cannot be written to using a user program. Reading is possible all the time.**

- **Address 10 can only be written to after the first conversion is complete when the power is turned on.**
- **Addresses 18 to 21 can only be written to once using a user program after RUN. Reading is possible all the time.**
- **Regarding the preparation complete flag for analog input of address 10, when switching from PROG. to RUN mode, the preparation complete flags of all channels will turn on because all channels are undergoing conversion execution. When the non-execution setting for each channel is set, this is reflected in the bit that corresponds to address 10.**
  When “Enable setting by software” is specified at the range setting switch, the address 10 “analog input preparation complete flag” will not turn on because conversion will not take place until the range setting is performed.

14.3.3 Shared Memory of Analog Output Unit

Address	Descriptions	Initial value	See section
17	Output hold setting for analog output ch 0 to 3	H0000	14.5.1
18	Output hold (any value) data setting for analog output ch 0	K0000	14.5.2
19	Output hold (any value) data setting for analog output ch 1	K0000	
20	Output hold (any value) data setting for analog output ch 2	K0000	
21	Output hold (any value) data setting for analog output ch 3	K0000	
22	No execution of conversion processing setting for analog output ch 0 to 3	H1111	14.5.3

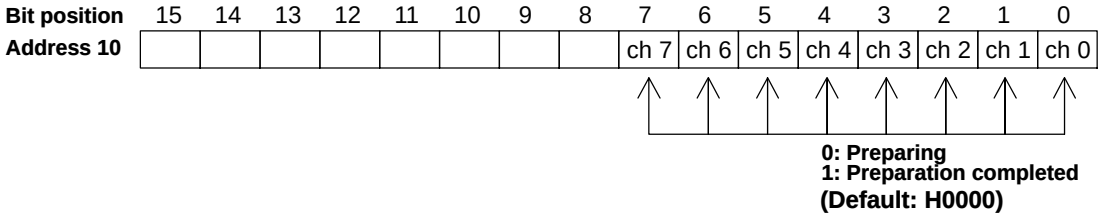
Notes

- **Shared memory addresses other than those listed above are not used. Do not perform reading and writing with addresses that are not used.**
- **The shared memory addresses are all preset when the power is turned from off to on (they return to the initial values).**
- **Addresses 17 to 22 can be written to by the program as many times as desired when the mode is changed from the PROG. mode to the RUN mode.**

14.4 Shared Memory for Analog Input Processing

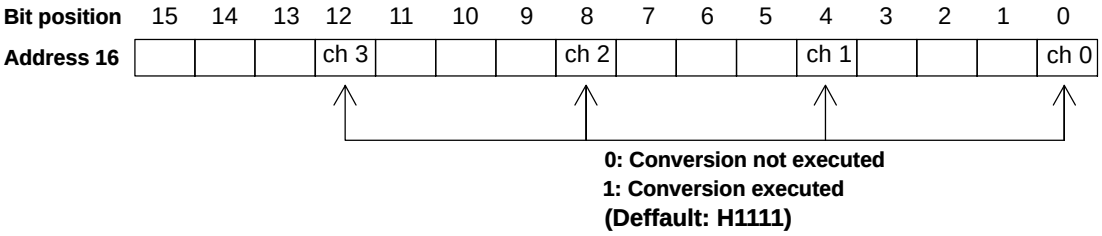
14.4.1 Analog Input Preparation Completion Flag (address 10)

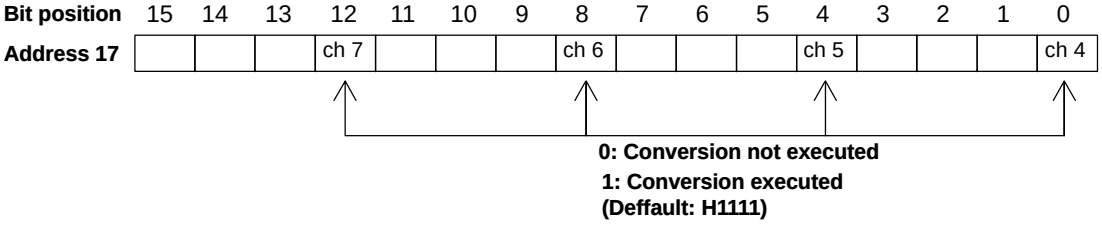
After the power is turned on and the first conversion is completed, the input channel where the conversion data preparation is completed is copied to the bits shown below.



14.4.2 No Execution of Analog Input Conversion Processing Setting (address 16 and 17)

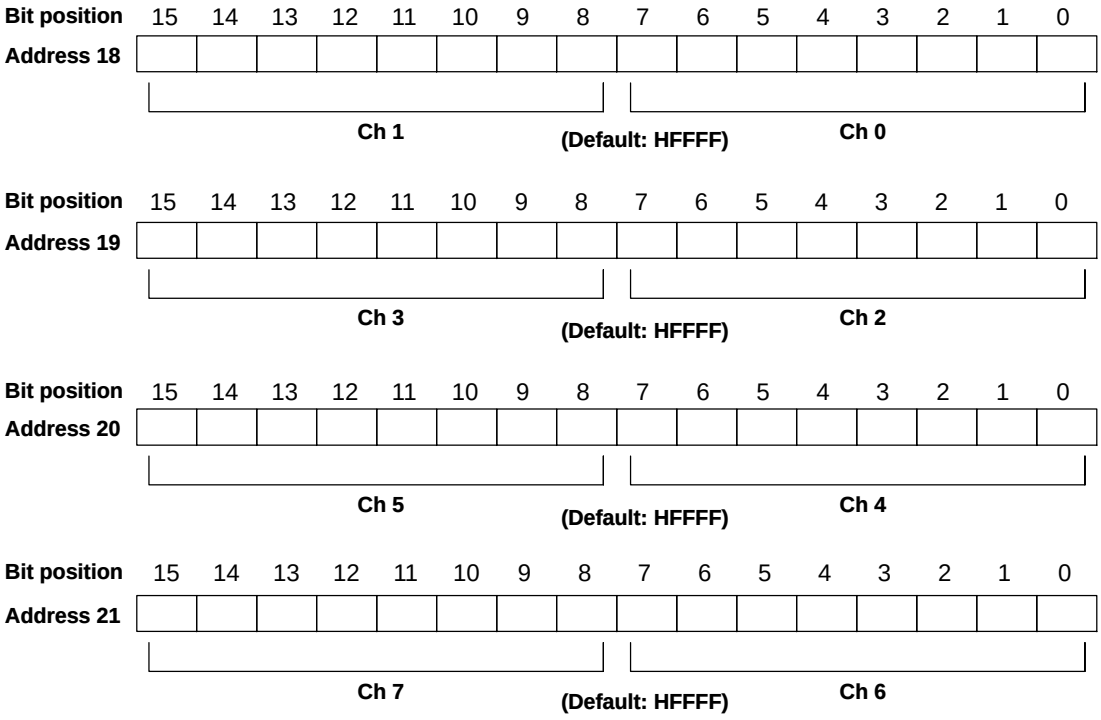
Specifies the input channel where conversion processing is not executed.





14.4.3 Analog Input Range Setting (addresses 18 to 21)

When setting the input range independently for each input channel, after setting the range setting switch to ”Enable setting by software,” the codes for the range settings shown below are set to addresses 18 to 21.

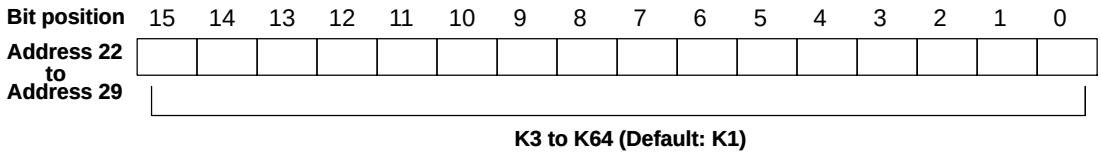


Input range	Code
±10V (±20mA)	H01
±100mV	H04
1 to 5V (4 to 20mA)	H07
Thermocouple J	H0D
Thermocouple K	H0E
Thermocouple R	H0F
Thermocouple S	H10
Thermocouple T	H11
R.T.D Pt100	H12
R.T.D Pt1000	H13

If a code different from those above are set (excluding HFF), the input range is set to ±10V (±20mA). Also, if HFF is set, conversion will not be executed for that input channel.

14.4.4 Average Times Setting (addresses 22 to 29)

Sets the number of times for average processing for each channel that executes average processing (range: 3 to 64 times).



Address 22: Analog input ch 0

Address 23: Analog input ch 1

Address 24: Analog input ch 2

Address 25: Analog input ch 3

Address 26: Analog input ch 4

Address 27: Analog input ch 5

Address 28: Analog input ch 6

Address 29: Analog input ch 7

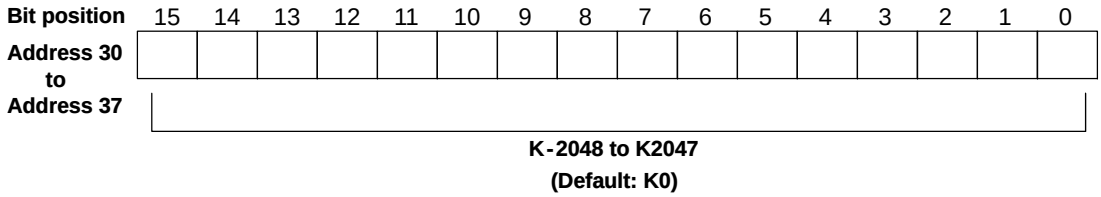
For the channels with values set that are different from those above, the average processing becomes as shown below.

K0, K1 or K2 is set: No average processing; general sampling processing.

Other than K0 to K64 is set: Average processing is performed with K64 as the set value.

14.4.5 Offset Changing Setting (address 30 to 37)

Sets the offset data for each channel that executes offset changing (range: -2048 to +2047).



Address 30: Analog input ch 0

Address 31: Analog input ch 1

Address 32: Analog input ch 2

Address 33: Analog input ch 3

Address 34: Analog input ch 4

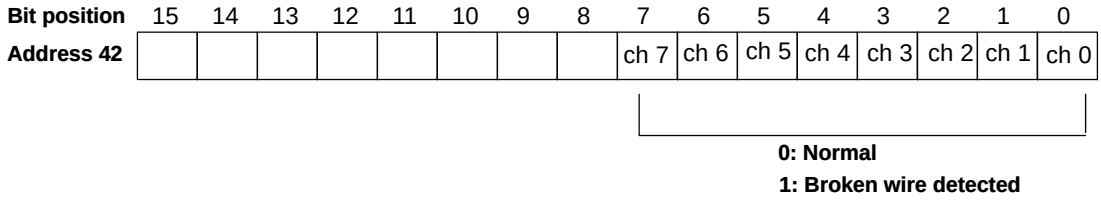
Address 35: Analog input ch 5

Address 36: Analog input ch 6

Address 37: Analog input ch 7

14.4.6 Input Sensor (TC, R.T.D.) Broken Wire Detection Flag (address 42)

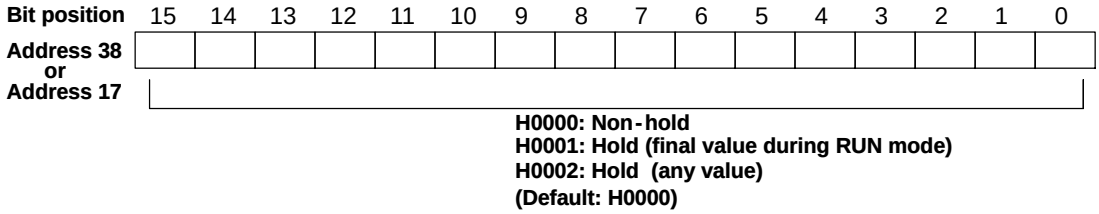
Detects broken wires in the input wiring onlly for each input channel tha is set for the thermocouple input range or R.T.D. (resistance thermometer device) input range, and copies the data to the bits shown below.



14.5 Shared Memory of Analog Output Processing

14.5.1 Analog Output Hold Setting (CPU unit with analog I/O: address 38) (Analog output unit: address 17)

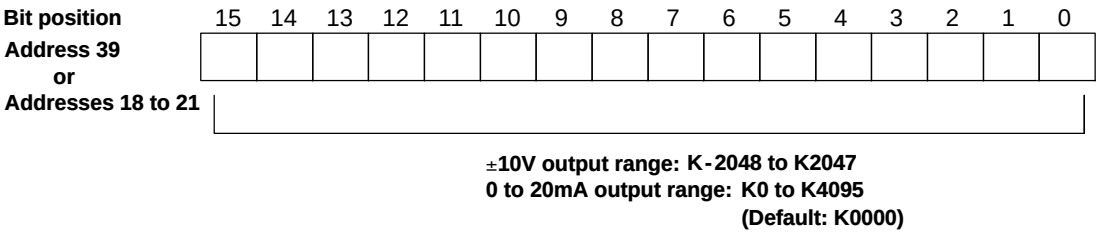
Sets either the non-hold, hold (final value during RUN mode), or hold (any value) for the analog output during the FP2 CPU unit PROG. mode.



If a value different from those above is set, then non-hold is set.

14.5.2 Analog Output Hold (any value) Data Setting (CPU unit with analog I/O: address 39) (Analog output unit: addresses 18 to 21)

As explained above, when a desired output is set for the hold setting, the analog output value is held corresponding to the data set at this address.



At the CPU unit with analog I/O

- address 39: analog output ch0

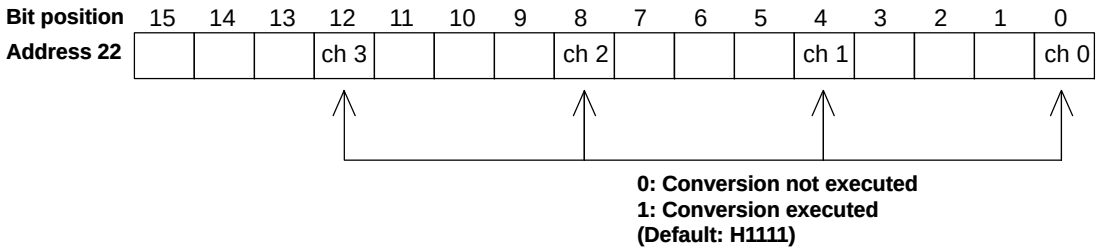
At the analog output unit

- address 18: analog output ch 0
- address 19: analog output ch 1
- address 20: analog output ch 2
- address 21: analog output ch 3

If a value different from those above is set, then the set value becomes disabled, and the final output value before moving to the PROG. mode is held.

14.5.3 No Execution of Analog Output Conversion Processing Setting (Analog output unit: address 22)

Specifies the output channel where conversion processing is not executed.



Record of changes

Manual No.	Date	Description of Changes
ARCT1F283E/ ACG-M283E	OCT. 1999	First edition
ARCT1F283E−1/ ACG-M283E−1	DEC. 1999	2nd edition Changes of section − 1.4 Restrictions → 1.4 Installation Restrictions → 1.5 Current Consumption − 14.4 Contents of Shared Memory → 14.4 Shared Memory for Analog Input Processing → 14.5 Shared Memory for Analog Output Processing,
ARCT1F283E−2/ ACG-M283E−2	JUL. 2002	3rd edition: PDF Only Additions: Restrictions of range setting
ARCT1F283E−3/ ACG-M283E−3	AUG. 2003	4nd edition: PDF Only − 1.6 Additions: Restrictions of range setting The contents are corrected.
ARCT1F283E−4/ ACG-M283E−4	OCT. 2004	5th edition: PDF Only Addition: Before You start
ARCT1F283E−5/ ACG-M283E−5	SEP. 2011	6th edition: PDF Only − Change in Corporate name

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