Chapter 6. BUFFER MEMORY CONFIGURATION AND FUNCTIONS

The thermocouple-input module has the PLC CPU and the buffer memories for data communications.

6.1 Buffer Memory Configuration

The followings describe buffer memory configuration.

6.1.1 G3F-TC4A Buffer Memory

Address (Decimal)	Function	Description	Default Setting	Read / Write
0	Channel enable/disable Specification	Bit On(1): Enable, Bit Off(0) : Disable	Disable	R/W
1	Specifying the type of thermocouple for channel 0		Type K	R/W
2	Specifying the type of thermocouple for channel 1			
3	Specifying the type of thermocouple for channel 2			
4	Specifying the type of thermocouple for channel 3			
5	Specifying the type of thermocouple for channel 4			
6	Specifying the type of thermocouple for channel 5			
7	Specifying the type of thermocouple for channel 6			
8	Specifying the type of thermocouple for channel 7			
9	Specifying the type of thermocouple for channel 8			
10	Specifying the type of thermocouple for channel 9			
11	Specifying the type of thermocouple for channel 10			
12	Specifying the type of thermocouple for channel 11			
13	Specifying the type of thermocouple for channel 12			
14	Specifying the type of thermocouple for channel 13			
15	Specifying the type of thermocouple for channel 14			
16	Specifying the type of thermocouple for channel 15			
17	Temperature conversion value of the channel 0		—	Read Only
18	Digital conversion value of the channel 0			
19	Error code of the channel 0			
20	Temperature conversion value of the channel 1			
21	Digital conversion value of the channel 1			
22	Error code of the channel 1			
23	Temperature conversion value of the channel 2			
24	Digital conversion value of the channel 2			
25	Error code of the channel 2			
26	Temperature conversion value of the channel 3			
27	Digital conversion value of the channel 3			
28	Error code of the channel 3			
29	Temperature conversion value of the channel 4			
30	Digital conversion value of the channel 4			
31	Error code of the channel 4			

Description for addresses 1-16:

Input specification No.	Sensor type	Temperature range
0	K	-200.0 to 1200.0 ℃
1	J	-200.0 to 800.0 ℃
2	E	-150.0 to 600.0 ℃
3	T	-200.0 to 400.0 ℃
4	B	400.0 to 1800.0 ℃
5	R	0.0 to 1750.0 ℃
6	S	0.0 to 1750.0 ℃

If a value outside the defined range is set, the bit of address 67 that corresponds to the channel turns on and the thermocouple type will be set to type K.

Description for addresses 17-31:

• Temperature conversion value
: 10 times of a real temperature is displayed.

• Digital conversion value
  If a temperature conversion value is converted into a value within 0 to 16000, that value is a digital conversion value.
  It can be used as a process value of the PID control module.
  Expression
  Digital conversion value = (16000/ measuring temperature range) × (temperature conversion value – minimum measuring temperature)

• Error code
16 : Disconnection detection error
17 : Upper or lower overflow
18 : Reference junction compensation device error

Address (Decimal)	Function	Description	Default Setting	Read / Write
32	Temperature conversion value of the channel 5			
33	Digital conversion value of the channel 5			
34	Error code of the channel 5			
35	Temperature conversion value of the channel 6			
36	Digital conversion value of the channel 6			
37	Error code of the channel 6			
38	Temperature conversion value of the channel 7			
39	Digital conversion value of the channel 7			
40	Error code of the channel 7			
41	Temperature conversion value of the channel 8	• Temperature conversion value : 10 times of a real temperature is displayed.		
42	Digital conversion value of the channel 8			
43	Error code of the channel 8	• Digital conversion value If a temperature conversion value is converted into a value within 0 to 16000, that value is a digital conversion value.		
44	Temperature conversion value of the channel 9			
45	Digital conversion value of the channel 9			
46	Error code of the channel 9	It can be used as a process value of the PID control module.		
47	Temperature conversion value of the channel 10	Expression Digital conversion value = (16000/ measuring temperature range) × (temperature conversion value − minimum measuring temperature)		Read Only
48	Digital conversion value of the channel 10		—	
49	Error code of the channel 10			
50	Temperature conversion value of the channel 11			
51	Digital conversion value of the channel 11			
52	Error code of the channel 11	• Error code 16 : Disconnection detection error 17 : Upper or lower overflow 18 : Reference junction compensation device error		
53	Temperature conversion value of the channel 12			
54	Digital conversion value of the channel 12			
55	Error code of the channel 12			
56	Temperature conversion value of the channel 13			
57	Digital conversion value of the channel 13			
58	Error code of the channel 13			
59	Temperature conversion value of the channel 14			
60	Digital conversion value of the channel 14			
61	Error code of the channel 14			
62	Temperature conversion value of the channel 15			
63	Digital conversion value of the channel 15			
64	Error code of the channel 15			
65	SET data	Bit On(1) : New setting values are set for the contents of address 0 to 16. Bit Off(0) : The existing values of address 0 to 16 remains.	No setting	R/W
66	Run channel information	Bit On(1) : Running, Bit Off(0) : Stop	—	Read only
67	Setting Error information	Bit On(1) : if other value than 0 to 6 is set for specifying the type of thermocouples in the address 1 to 16. Bit Off(0) : If 0 to 6 is set for specifying the type of thermocouples in the address 1 to 16.	—	Read only

6.1.2   G4F-TC2A / G6F-TC2A Buffer Memory

Address (Decimal)	Function	Description	Default Setting	Read / Write
0	Channel enable/disable Specification	Bit On(1): Enable, Bit Off(0) : Disable	Disable	R/W
1	Specifying the type of thermocouple for channel0			
2	Specifying the type of thermocouple for channel 1		Type K	R/W
3	Specifying the type of thermocouple for channel 2			
4	Specifying the type of thermocouple for channel 3	If a value outside the defined range is set, the bit of address 19 that corresponds to the channel turns on and the thermocouple type will be set to type K.		
5	Temperature conversion value of the channel 0	• Temperature conversion value : 10 times of a real temperature is displayed.		
6	Digital conversion value of the channel 0			
7	Error code of the channel 0	• Digital conversion value		
8	Temperature conversion value of the channel 1	If a temperature conversion value is converted into a value within 0 to 16000, that value is a digital conversion value.		
9	Digital conversion value of the channel 1	It can be used as a process value of the PID control module.		
10	Error code of the channel 1	Expression		Read Only
11	Temperature conversion value of the channel 2	Digital conversion value = (16000/ measuring temperature range) × (temperature conversion value – minimum measuring temperature)		
12	Digital conversion value of the channel 2			
13	Error code of the channel 2			
14	Temperature conversion value of the channel 3	• Error code		
15	Digital conversion value of the channel 3	16 : Disconnection detection error 17 : Upper or lower overflow 18 : Reference junction compensation device error		
16	Error code of the channel 3			
17	SET data	Bit On(1) : New setting values are set for the contents of address 0 to 4. Bit Off(0) : The existing values of address 0 to 4 remains.	No setting	R/W
18	Run channel information	Bit On(1) : Running, Bit Off(0) : Stop	—	Read only
19	Setting error information	Bit On(1) : if other value than 0 to 6 is set for specifying the type of thermocouples in the address 1 to 4. Bit Off(0) : If 0 to 6 is set for specifying the type of thermocouples in the address 1 to 4.	—	Read only

Thermocouple input specification table (shown within rows 1–4 Description):

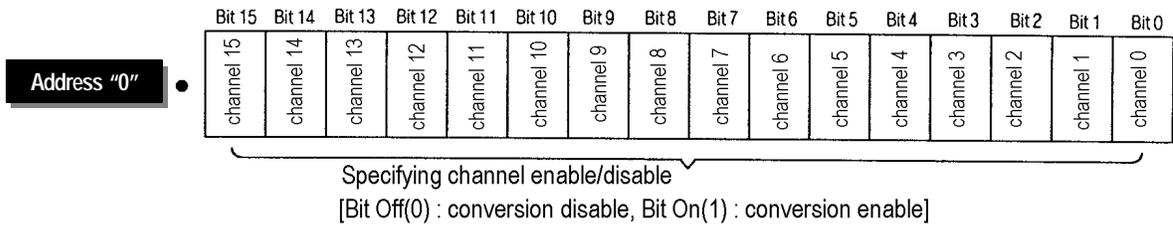| Input specification No.	Sensor type	Temperature range
0	K	-200.0 to 1200.0 ℃
1	J	-200.0 to 800.0 ℃
2	E	-150.0 to 600.0 ℃
3	T	-200.0 to 400.0 ℃
4	B	400.0 to 1800.0 ℃
5	R	0.0 to 1750.0 ℃
6	S	0.0 to 1750.0 ℃

6.2 Buffer Memory Functions

▶ Each address in the buffer memory occupies one word and it is represented with 16 bits.
▶ In the 16 bits which compose an address, every bit can be set to either "1" when it should be turned On or "0" when Off in order to implement the function of each bit.

6.2.1 Specifying Channel Enable/Disable

(G3F-TC4A : Address 0,   G4F-TC2A / G6F-TC2A : Address 0)
1) Temperature conversion enable/disable specification is possible on every channel.
2) Disabling unused channels makes the sampling cycle short.
3) No specification means that all channels are disabled.
4) The followings show temperature conversion enable/disable for each channel.

(1) G3F-TC4A

	Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Address "0"	channel 15	channel 14	channel 13	channel 12	channel 11	channel 10	channel 9	channel 8	channel 7	channel 6	channel 5	channel 4	channel 3	channel 2	channel 1	channel 0

Specifying channel enable/disable
[Bit Off(0) : conversion disable, Bit On(1) : conversion enable]

(2) G4F-TC2A/G6F-TC2A

	Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Address "0"	—	—	—	—	—	—	—	—	—	—	—	—	channel 3	channel 2	channel 1	channel 0

Ignored

Specifying channel enable/disable
[Bit Off(0) : Conversion disable,
Bit On(1) : Conversion enable]

6.2.2 Specifying the Type of Thermocouple

(G3F-TC4A : Address 2 to 16, G4F -TC2A/G6F-TC2A : Address 1 to 4)

1) Type specifying the thermocouple that is connected to each channel of the thermocouple input module is possible by the channel.
2) Default is type K.
3) The followings show the number of specification for each channel.

Specification No.	0	1	2	3	4	5	6
Thermocouple type	K	J	E	T	B	R	S

4) Other value than the defined values is set for specifying the type of a thermocouple, the G3F-TC4A displays error code at the corresponding bit in the address 67 and the G4F-TC2A/G6F -TC2A in the address 19 with the type being specified to "0", that is, type K thermocouple.

6.2.3 Temperature Conversion Value

1) This area performs sampling processing of the temperature value that is inputted through the thermocouple connected to the terminal block of a channel and stores the value of 10 times of the real temperature value.

REMARK

If a real temperature is 123.4°C the stored value is 1234.

2) The followings show the configuration of each address.

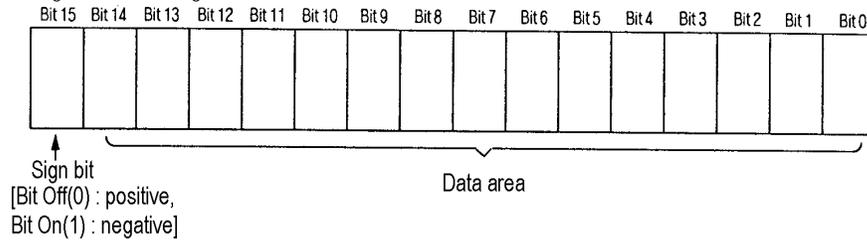| Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0

Sign bit
[Bit Off(0) : positive,
Bit On(1) : negative]

Data area

3) If the temperature conversion specifying a channel is changed from temperature conversion enable into temperature conversion disable, the temperature conversion value just before the change remains.

6.2.4 Digital Conversion Value

1) A temperature value that is inputted through the thermocouple connected to the terminal block of a channel is converted into a value between 0 to 16000, and then the converted value is stored. That conversion is called digital conversion.

2) The digital conversion value converted to a value between 0 to 16000 can be used as a process value of the PID control module.

3) The digital conversion value and the detected temperature value have the following arithmetic relation.

$$\text{Digital conversion value} = (16000/\text{overall measuring temperature range})$$
$$\times (\text{temperature conversion value} - \text{minimum measuring temperature})$$

REMARK

If a real temperature is 123.4°C when using a type K thermocouple, since the temperature conversion value is 1234, overall temperature range is 14000 and minimum measuring temperature is –2000, then the digital conversion value is

$(16000/14000) \times [1234-(-2000)]$, and it is equal to 3696 (round off at the first digit of fraction) .

Thermocouple type	K	J	E	T	B	R	S
overall measuring temperature range	14000 (-2000 to 12000)	10000 (-2000 to 8000)	7500 (-1500 to 6000)	6000 (-2000 to 4000)	14000 (4000 to 18000)	17500 (0 to 17500)	17500 (0 to 17500)
Minimum measuring temperature	-2000	-2000	-1500	-2000	4000	0	0

4) If the temperature conversion specifying a channel is changed from enable into disable, the digital conversion value before the change remains

6.2.5 Error Code

1) Disconnection that can occur between the thermocouple and the thermocouple input module is detected by its type, and also error information is stored when the detected temperature is outside the defined range.
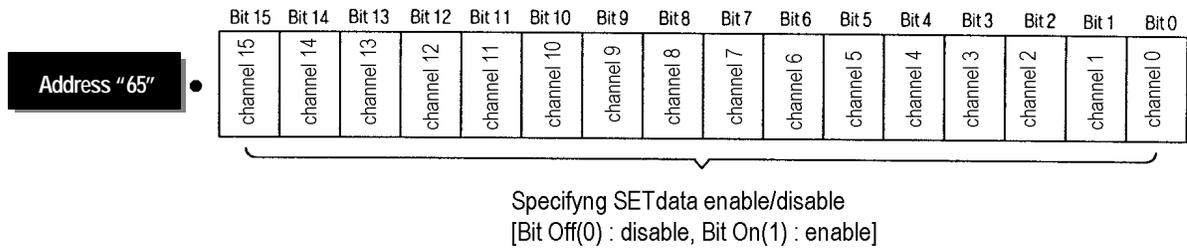
2) The following shows the types of error code.

Error Code (Decimal)	Error	Data processing at an error occurrence	RUN LED
16	Disconnection	The temperature conversion value and digital conversion value before an error occurrence is retained.	1 sec cycle flickering
17	Out-of-range temperature		
18	Reference junction compensation device error		

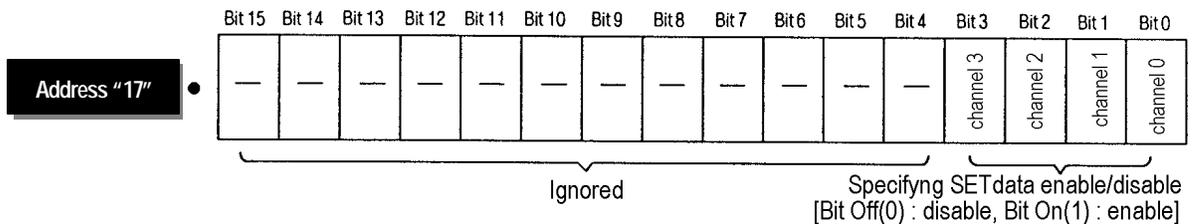3) If two or more errors are detected, the priority order is 18, then 17 and then 16.

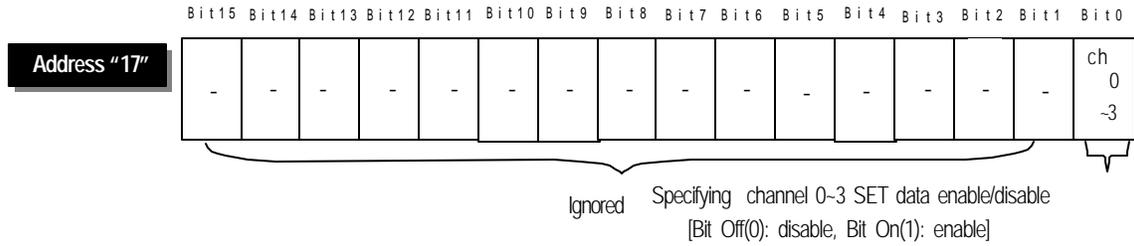### 6.2.6 Setting SET Data (G3F-TC4A : Address 65, G4F-TC2A/G6F-TC2A: Address 17)

1) If a bit corresponding to each channel in Set Data specification area is turned On(1), then the thermocouple input module executes the temperature conversion with user-defined setting data at the address 0 to 16 in the G3F-TC4A, and at the address 0 to 4 in the G4F-TC2A.

2) If the bit corresponding to each channel is not turned On(1), then the thermocouple input module executes the temperature conversion not with the new user-defined setting data at the address 0 to 16 in the G3F-TC4A and at the address 0 to 4 in the G4F-TC2A but with the previous setting data.

3) If a bit0 corresponding to all channel in set data specification area is turned on(1),then the thermocouple input module executes the temperature conversion with user-defined setting data at address 0 to 4 in the G6F-TC2A

4) The followings show the SET data enable/disable specification

(1) G3F-TC4A

	Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Address "65"	channel 15	channel 14	channel 13	channel 12	channel 11	channel 10	channel 9	channel 8	channel 7	channel 6	channel 5	channel 4	channel 3	channel 2	channel 1	channel 0

Specifyng SET data enable/disable
[Bit Off(0) : disable, Bit On(1) : enable]

(2) G4F-TC2A

	Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Address "17"	—	—	—	—	—	—	—	—	—	—	—	—	channel 3	channel 2	channel 1	channel 0

Ignored   Specifyng SET data enable/disable
[Bit Off(0) : disable, Bit On(1) : enable]

Bit15 Bit14 Bit13 Bit12 Bit11 Bit10 Bit9 Bit8 Bit7 Bit6 Bit5 Bit4 Bit3 Bit2 Bit1 Bit0

Address "17"

| - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | ch 0 ~3 |

Ignored — Specifying channel 0~3 SET data enable/disable
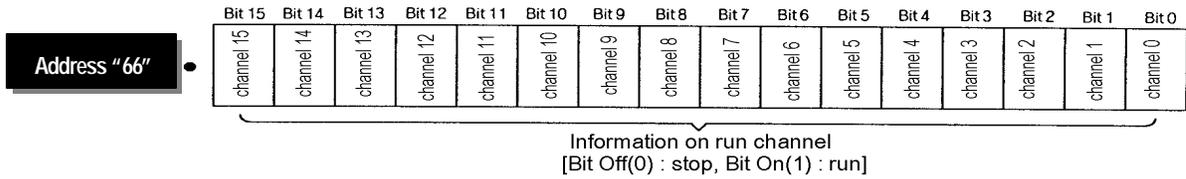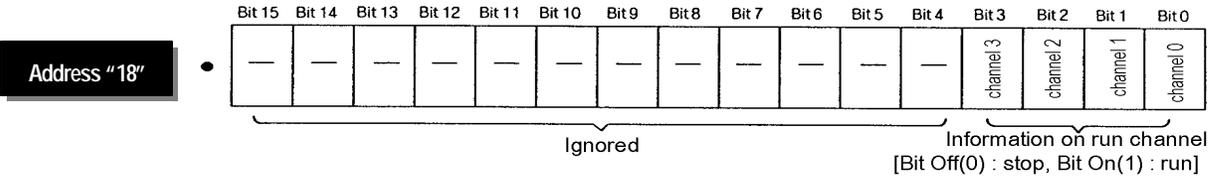[Bit Off(0): disable, Bit On(1): enable]

6.2.7 Information on Run Channel (G3F-TC4A : Address 66, G4F-TC2A/G6F-TC2A : Address 18)

This area stores information on run status of each channel.

（1） G3F-TC4A

Bit 15 Bit 14 Bit 13 Bit 12 Bit 11 Bit 10 Bit 9 Bit 8 Bit 7 Bit 6 Bit 5 Bit 4 Bit 3 Bit 2 Bit 1 Bit 0

Address "66"

| channel 15 | channel 14 | channel 13 | channel 12 | channel 11 | channel 10 | channel 9 | channel 8 | channel 7 | channel 6 | channel 5 | channel 4 | channel 3 | channel 2 | channel 1 | channel 0 |

Information on run channel
[Bit Off(0) : stop, Bit On(1) : run]

（2） G4F-TC2A/G6F-TC2A

Bit 15 Bit 14 Bit 13 Bit 12 Bit 11 Bit 10 Bit 9 Bit 8 Bit 7 Bit 6 Bit 5 Bit 4 Bit 3 Bit 2 Bit 1 Bit 0

Address "18"

| — | — | — | — | — | — | — | — | — | — | — | — | channel 3 | channel 2 | channel 1 | channel 0 |

Ignored — Information on run channel
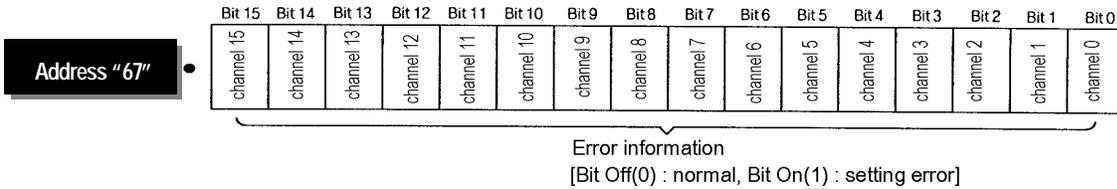[Bit Off(0) : stop, Bit On(1) : run]

6.2.8 Information on Thermocouple Type Specification Error
(G3F-TC4A : Address 67, G4F-TC2A/G6F-TC2A : Address 19)

1) If other value than "0" to "6" is set at the addresses (Address 1 to 16 in G3F-TC4A, Address 1 to 4 in G4F-TC2A/G6F-TC2A) used for specifying the type of the thermocouple which is connected to each channel of the thermocouple input module, error occurs.
2) If error occurs at a channel, then the channel runs with the type K as the type of the thermocouple.
3) The following shows indication of error information.

（1） （G3F-TC4A

Bit 15 Bit 14 Bit 13 Bit 12 Bit 11 Bit 10 Bit 9 Bit 8 Bit 7 Bit 6 Bit 5 Bit 4 Bit 3 Bit 2 Bit 1 Bit 0

Address "67"

| channel 15 | channel 14 | channel 13 | channel 12 | channel 11 | channel 10 | channel 9 | channel 8 | channel 7 | channel 6 | channel 5 | channel 4 | channel 3 | channel 2 | channel 1 | channel 0 |

Error information
[Bit Off(0) : normal, Bit On(1) : setting error]

（2） （G4F-TC2A/G6F-TC2A

Bit 15 Bit 14 Bit 13 Bit 12 Bit 11 Bit 10 Bit 9 Bit 8 Bit 7 Bit 6 Bit 5 Bit 4 Bit 3 Bit 2 Bit 1 Bit 0

Address "19"

| — | — | — | — | — | — | — | — | — | — | — | — | channel 3 | channel 2 | channel 1 | channel 0 |

Ignored — Error information
[Bit Off(0) : normal,
Bit On(1) : setting error]