

Chapter 2. SPECIFICATIONS

2.1 General Specifications

Table 2.1 shows general specifications of the MK series.

No	Items	Specifications						Standard	
1	Operating ambient temperature	0 ~ 55℃							
2	Storage ambient temperature	-25 ~ 70℃							
3	Operating ambient humidity	5 ~ 95%RH, non-condensing							
4	Storage ambient humidity	5 ~ 95%RH, non-condensing							
5	Vibration	Occasional vibration						IEC 1131-2	
		Frequency		Acceleration		Amplitude			Sweep
		10≤f∠57 Hz		-		0.075 mm			10 times in each direction for X, Y, Z
		57 ≤f≤150 Hz		9.8 m/s² {1G}		-			
		Continuos vibration							
		Frequency		Acceleration		Amplitude			
		10≤f∠57 Hz		-		0.035 mm			
		57≤f≤150 Hz		4.9 m/s² {0.5G}		-			
6	Shocks	*Maximum shock acceleration: 147 m/s² {15G} *Duration time :11 ms *Pulse wave: half sine wave pulse(3 times in each of X, Y and Z directions)						IEC 1131-2	
7	Noise immunity	Square wave impulse noise		±1,500 V					
		Electrostatic discharge		Voltage :4 kV(contact discharge)				IEC 1131-2 IEC 801-2	
		Radiated electromagnetic field		27 ~ 500 MHz, 10 V/m				IEC 1131-2 IEC 801-3	
		Fast transient burst noise		Severity Level	All power modules	Digital I/Os (Ue ≥ 24 V)	Digital I/Os (Ue < 24 V) Analog I/Os communication I/Os	IEC 1131-2 IEC 801-4	
				Voltage	2 kV	1 kV	0.25 kV		
8	Operating atmosphere	Free from corrosive gases and excessive dust							
9	Altitude for use	Up to 2,000m							
10	Pollution degree	2 or lower							
11	Cooling method	Self-cooling							

[Table 2.1] General specifications

REMARK

- 1) IEC(International Electrotechnical Commission)
: The international civilian organization which produces standards for electrical and electronics industry.
- 2) Pollution degree
: It indicates a standard of operating ambient pollution level.
The pollution degree 2 means the condition in which normally, only non-conductive pollution occurs.
Occasionally, however, a temporary conductivity caused by condensation shall be expected.

2.2 Performance Specifications

Table 2.2 shows performance specifications of the thermocouple input module.

Item	Specifications				
	K7F-TC4A			K4F-TC2A	
Connectable thermocouple	Type K, J, E, T, B, R or S thermocouple				
Digital output	Digital conversion value : 0 to 16,000 Temperature conversion value : (thermocouple measuring temperature range × 10)				
Temperature input range	Thermo-couple type	DIN Spec.	BS Spec.	Measuring temp. range(°C)	Measuring voltage range(μV)
	K	NiCr-Ni	NiCr-NiAl	-200.0 ~1200.0	-5981~48828
	J	-	Pe-CuNi	-200.0 ~800.0	-7890~45498
	E	-	NiCr-CuNi	-150.0 ~600.0	-7297~45085
	T	-	Cu-CuNi	-200.0 ~400.0	-5602~20869
	B	-	PtRh30-PtRh6	400.0 ~1800.0	786~13585
	R	-	PtRh13-Pt	0.0 ~1750.0	0~21006
	S	PtRh-Pt	PtRh10-Pt	0.0 ~1750.0	0~18612
Reference junction compensation	Automatic compensation				
Burn-out detection	Every channel has detected.				
Accuracy	±[Full scale × 0.3 % + 1°C (Reference junction compensation tolerance)]				
Maximum conversion speed	50 ms per channel				
Number of temperature input channel	16 channels per module			4 channels per module	
Insulation method	Photo-coupler insulation between the input terminal and the PLC power supply (non-insulation between channels)				
Connection terminal block	38-point terminal block			20-point terminal block	
Internal current consumption	0.45 A			0.45 A	
Weight	640 g			640 g	

[Fig. 2.2] Performance Specifications

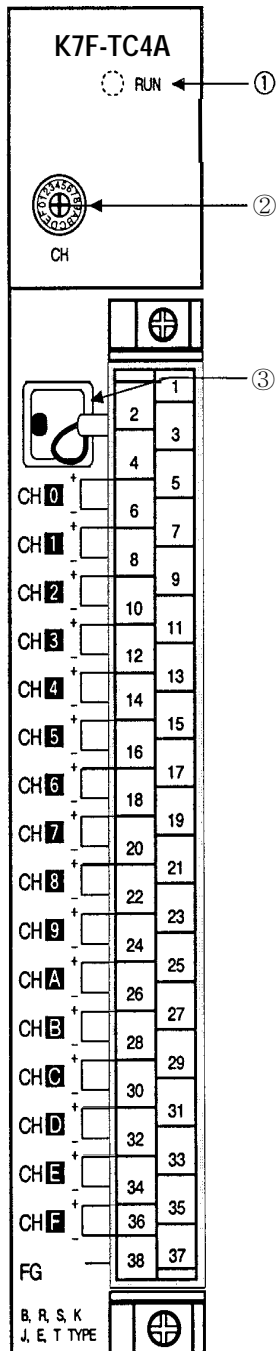
2.3 Names of Parts and Functions

The following gives names of parts :

2.3.1 K7F-TC4A

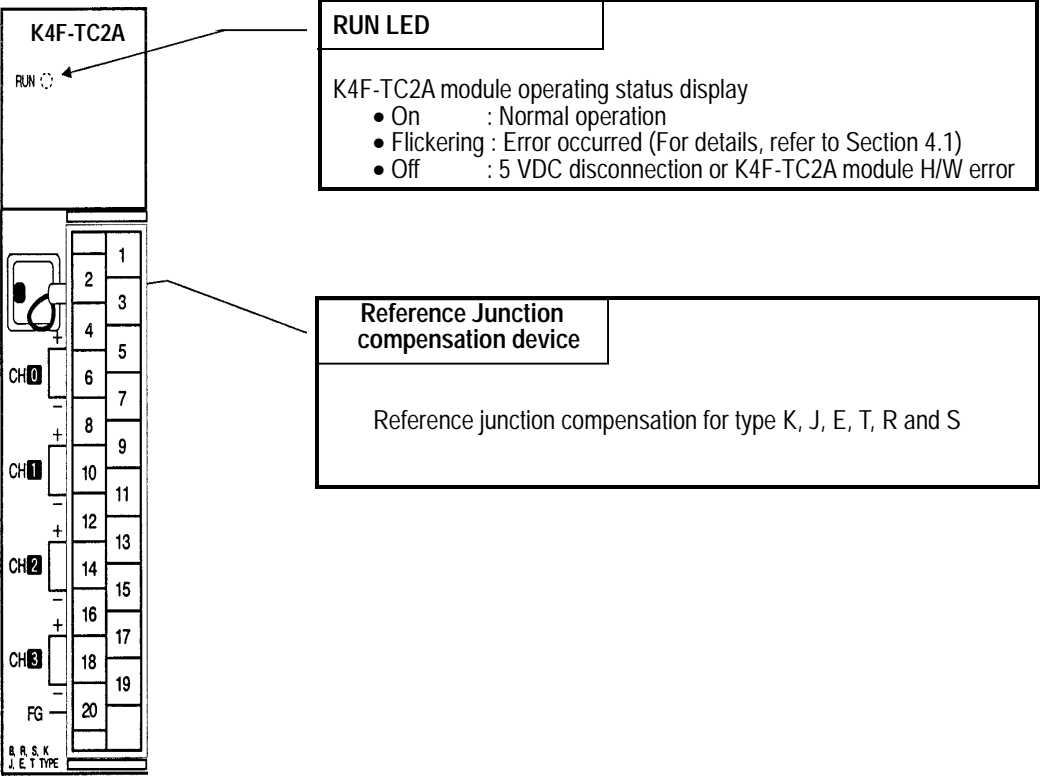
The following gives the names and unctions of each part of the K7F-TC4A.

No	Contents
①	RUN LED It displays the operating status of K7F-TC4A <ul style="list-style-type: none"> ● On : Normal Operation ● Flickering: Error occurred (For details, refer to Section 4.1) ● Off : 5 VDC disconnection or the K7F-TC4A module H/W error
②	Channel selection switch <ul style="list-style-type: none"> - Switch used to specify the channel for detected temperature value display. - Setting range : 0 to F
③	Reference junction compensation device <ul style="list-style-type: none"> - Reference junction compensation for type K, J, E, T, R or S.



2.3.2 K4F-TC2A

The following gives the names and functions of each part of the K4F-TC2A.



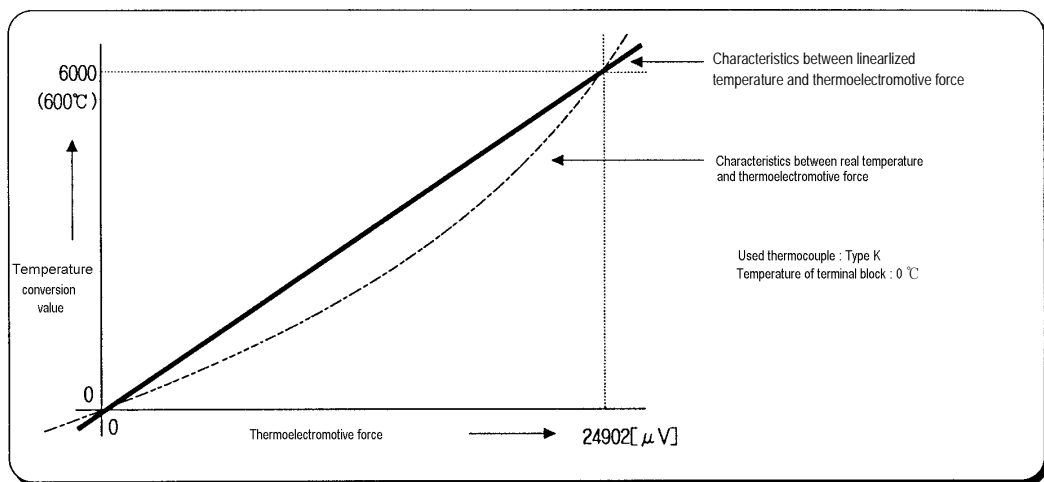
2.4 I/O Conversion Characteristics

The temperature that the thermocouple detected is input to each channel as a thermoelectromotive force. Every channel is scanned at every measuring cycle and each input voltage is output as a temperature conversion value through A/D conversion.

2.4.1 Temperature Conversion Characteristics

The thermocouple input module performs A/D conversion of the non-linear characteristic thermocouple input value and outputs the linear-processed temperature conversion value.

The following Fig. 2.1 shows an example of characteristics of the temperature conversion value to the thermocouple input value.



[Fig. 2.1] Temperature conversion characteristics

2.4.2 Conversion Speed

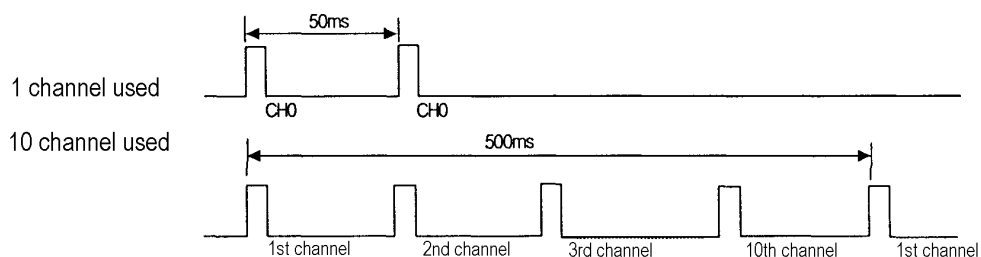
The conversion speed of the thermocouple input module is 50 ms per channel and its processing is processed sequentially, that is, one channel is processed and then another channel is processed.

Measuring cycle = 50 ms × (the number of conversion enabled channels)

Example) When 10 channels are used in the K7F-TC4A

Measuring cycle = 50 ms × 10 = 500 ms

That is, at every interval of 500ms, every thermocouple input value of every channel is A/D converted and output as a temperature conversion value



2.4.3 Accuracy

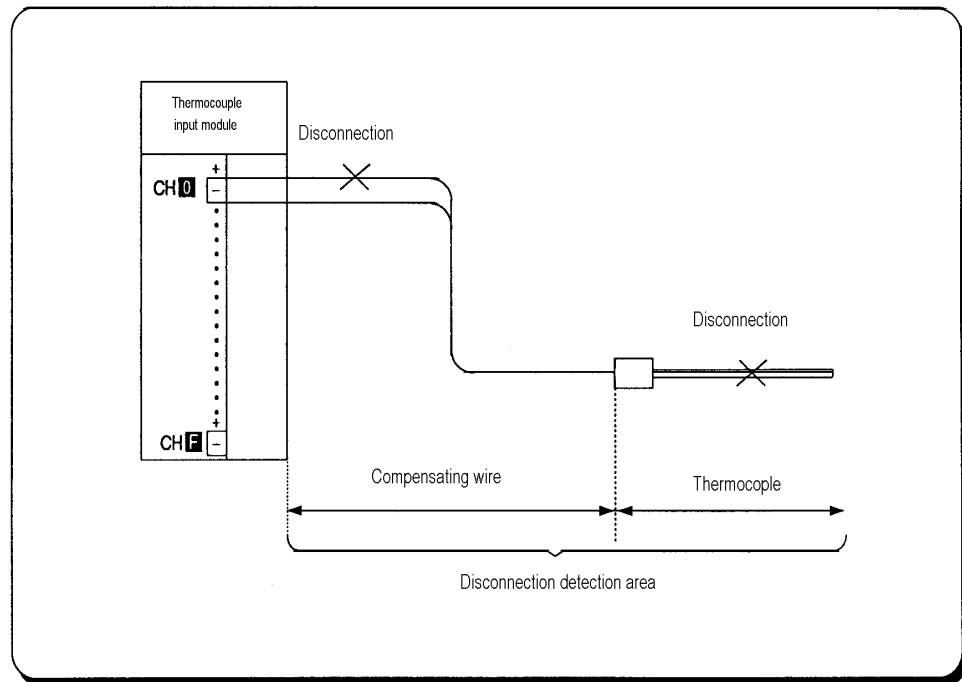
The accuracy of the thermocouple input module is within $\pm 0.3\%$ of all of the measuring temperature range and error ($\pm 1^\circ\text{C}$) from reference junction compensation is added.

Example) When a thermocouple type K is used, the detected temperature values to temperatures -200°C , 500°C and 1200°C are as below.

- Overall measuring temperature range of the K type: 1400°C (-200.0°C to 1200.0°C)
- Accuracy of the K type: $1400^\circ\text{C} \times \pm 0.003 = \pm 4.2^\circ\text{C}$
- Accuracy including the error of reference junction compensation : $4.2 \pm 1 = \pm 5.2^\circ\text{C}$
- Temperature conversion range : -205.2°C to -194.8°C when -200°C
 494.8°C to 505.2°C when 500°C
 1294.8°C to 1205.2°C when 1200°C

2.4.4 Burn-out Detection Function

This function detects disconnection of the thermocouple or compensating wire connected to the thermocouple input module. As shown in the Fig. 2.2, if disconnection occurs in the thermocouple or compensating wire, the internal disconnection detection circuit measures an out-of-range voltage and occurs disconnection error codes. Disconnection detection function is automatically performed on every channel.



[Fig. 2.2] Disconnection Detection Area

2.4.5 Displaying Temperature Conversion Value

The detected temperature value converted into through sampling processing of a thermocouple input value times by ten and that is displayed as a digital value, which is called temperature conversion value.

[Example] When a real temperature is 100.5°C

- Detected temperature value : 1005
(Digital value stored in the internal memory)

2.4.6 Displaying Digital Value

The thermocouple input module gives a digital value which has been calculated from a temperature value to be suitable for process control of the PID control module. This value can be used as an input value (Process Value) in the PID control module.

Thermocouple type	Type K	Type J	Type E	Type T	Type B	Type R	Type S
Overall measuring temp. 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

$$\text{Digital value} = \frac{16000}{\text{Overall measuring temperature range}} (\text{temperature conversion value} - \text{minimum measuring temperature})$$

[Example 1] Digital value when a real temperature is 400°C of thermocouple type J.

$$\begin{aligned} \text{Digital value} &= \frac{16000}{10000} [4000 - (-2000)] \\ &= 9600 \end{aligned}$$

[Example 2] Digital value when a real temperature is 700°C of thermocouple type K.

$$\begin{aligned} \text{Digital value} &= \frac{16000}{14000} [7000 - (-2000)] \\ &= 10285.71428571 \text{ (round off at first digit of fraction)} \\ &= 10268 \end{aligned}$$