

## Chapter 20 Temperature Measurement of FB-PLC and PID Control

FB-PLC provides two kinds of modules with different outlook and size for temperature measurement. One kind of the modules is called slim module with 2 points of general purpose analog input & 4 points of temperature input, named by FB-2AJ4 (for J-type thermocouple), FB-2AK4 (for K-type thermocouple), FB-2AH4 (for PT-100) and FB-2AT4 (for PT-1000). They can be expanded up to 8 modules, with 32 temperature inputs in total at the most. The other kind has a built-in 4 points analog input module with large number of temperature measuring points, named by FB-4AJxx or FB-4AKxx (the xx could provide 12, 18, and 24 totally 3 kinds of measuring points). This module with large number of points can only be used alone and can not be installed together with other temperature measuring module or with other analog input modules.

Both of the above-mentioned temperatures measuring modules have their properly convenient instructions that are used for multiplexing temperature measurement. FB-2AJ(K)4/FB-2AH(T)4 employs FUN72(TP4) while FB-4AJ(K)xx employs FUN85(TPSNS) to get the engineering value of temperature measurement. As to the temperature control, it also has its properly convenient PID instructions. FB-2AJ(K)4/FB-2AH(T)4 employs FUN73(TSTC) while FB-4AJ(K)xx employs FUN86(TPCTL) to perform the PID operation to control the heating or cooling of the temperature process.

### 20.1 Specifications of temperature measuring modules of FB-PLC

#### 20.1.1 FB-2AJ(K)4 : with 4 points of J(K) thermocouple input and 2 points of analog input

Specifications Items				Module			
				FB-2AJ4		FB-2AK4	
Analog Input	Input points			2 (1 <sup>st</sup> & 2 <sup>nd</sup> analog inputs as the general purpose input) + 1 (3 <sup>rd</sup> analog input for temperature measurement)			
	Resolution			12 bits			
	Span	*Bipolar	*10V	1.Voltage	−10V ~ 10V	5.Current	−20mA~20mA
			5V	2.Voltage	− 5V ~ 5V	6.Current	−10mA~10mA
		Unipolar	10V	3.Voltage	0V ~ 10V	7.Current	0mA~20mA
			5V	4.Voltage	0V ~ 5V	8.Current	0mA~10mA
Temperature Input	Input points			4 ( Multiplexing via 3 <sup>rd</sup> analog input )			
	Expansion allowed			32 points ( 8 modules )			
	Sensor			J-type thermocouple		K-type thermocouple	
	Valid range	*Bipolar	*10V	−200~ 750°C (−328~ 1382°F)		−200~ 900°C (−328~ 1652°F)	
			5V	−200~ 420°C (−328~ 788°F)		−200~ 450°C (−328~ 842°F)	
		Unipolar	10V	0°C~ 750°C (32°F~ 1382°F)		0°C~ 900°C (32°F~ 1652°F)	
			5V	0°C~ 420°C (32°F~ 788°F)		0°C~ 450°C (32°F~ 842°F)	
	Resolution			1°C			
	Compensation			Built-in cold junction compensation			
	Update rate			2 Sec. (Adjustable)			
Accuracy			Within ±1% of full scale				
Insulation			Photocouple isolation				
Power supply			24VDC±10%、5VA				

\* : It means default setting.

20.1.2 FB-4AJ(K)12/18/24: with 12/18/24 points of J(K) thermocouple input and 4 points of analog input

Specifications Items				Module							
				FB-4AJ(K)12		FB-4AJ(K)18		FB-4AJ(K)24			
Analog Input	Input points			4 (1 <sup>st</sup> ~4 <sup>th</sup> analog inputs as the general purpose input) + 4 (5 <sup>th</sup> ~8 <sup>th</sup> analog inputs for temperature measurement)							
	Span	*Bipolar	*10V	1.Voltage		-10V ~ 10V		5.Current		-20mA~20mA	
			5V	2.Voltage		-5V ~ 5V		6.Current		-10mA~10mA	
		Unipolar	10V	3.Voltage		0V ~ 10V		7.Current		0mA~20mA	
			5V	4.Voltage		0V ~ 5V		8.Current		0mA~10mA	
Temperature Input	Input points ( Fixed )			12		18		24			
	Sensor			J-type thermocouple ( K-type thermocouple )							
	Valid range	*Bipolar	*10V	-200°C~750°C/-328°F~1382°F ( -200°C~900°C/-328°F~1652°F )							
			5V	-200°C~420°C/-328°F~788°F ( -200°C~450°C/-328°F~842°F )							
		Unipolar	10V	0°C~750°C/32°F~1382°F ( 0°C~900°C/32°F~1652°F )							
			5V	0°C~420°C/32°F~788°F ( 0°C~450°C/32°F~842°F )							
	Resolution			1°C							
	Compensation			Built-in cold junction compensation							
	Update rate			2 Sec. (Adjustable)							
	Accuracy			Within ±1% of full scale							
Insulation			Photocouple isolation								
Power supply			24VDC±10%、5VA								

\* : It means default setting.

20.1.3 FB-2AH(T)4: with 4 points of 3-wires PT-100 (PT-1000) RTD input and 2 points of analog input

Specifications Items				Module			
				FB-2AH4 (PT-100)		FB-2AT4 (PT-1000)	
Analog Input	Input points			2 (1 <sup>st</sup> & 2 <sup>nd</sup> analog inputs as the general purpose input) + 1 (3 <sup>rd</sup> analog input for temperature measurement)			
	Resolution			12 bits			
	Span (Bipolar)	*10V		*1.Voltage	-10V ~ 10V	3.Current	-20mA~20mA
			5V	2.Voltage	-5V ~ 5V	4.Current	-10mA~10mA
Temperature Input	Input points			4 (Multiplexing via 3 <sup>rd</sup> analog input)			
	Expansion allowed			32 points (8 modules)			
	(Bipolar) Valid range	DIN	*10V	-49.8°C ~ 146.6°C / -57.6°F ~ 295.9°F			
			5V	-12.3°C ~ 83.6°C / 9.9°F ~ 182.5°F			
		JIS	*10V	-48.9°C ~ 143.9°C / -56.0°F ~ 291.0°F			
			5V	-12.0°C ~ 82.1°C / 10.4°F ~ 179.8°F			
	Resolution			0.1°C			
	Update rate			2 Sec. (Adjustable)			
Accuracy				Within ±1% of full scale			
Insulation				Photocouple isolation			
Power supply				24VDC±10%、5VA			

\* : It means default setting.

※ Temperature input of FB-2AH4-3/FB-2AT4-3 : -49.1°C ~ 286.2°C / -56.4°F ~ 547.2°F ( DIN )

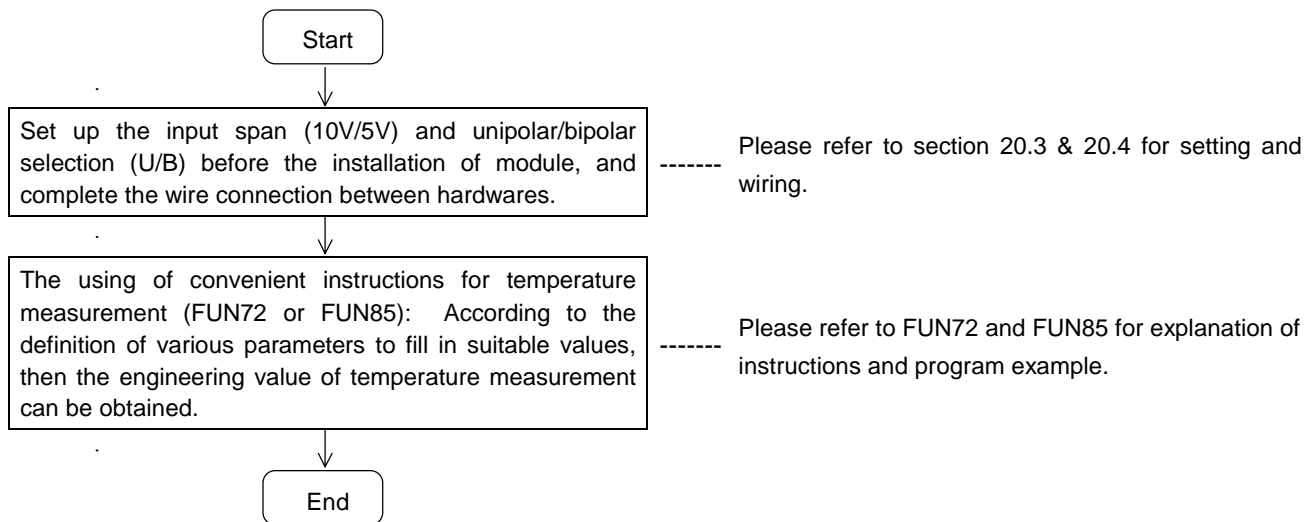
Note: The temperature modules mentioned above all with built-in general purpose analog inputs and dedicated analog input for temperature measurement, the memory mapping of these modules as followings:

Addressing of FB-2AJ(K)4 and FB-2AH(T)4 : The 1<sup>st</sup> and 2<sup>nd</sup> analog inputs are the general purpose input by accessing R3840 and R3841; and the 3<sup>rd</sup> analog input is dedicated for 4 points of temperature measurement (by multiplexing method) by accessing R3842 (if this module is the 1<sup>st</sup> analog input expansion module).

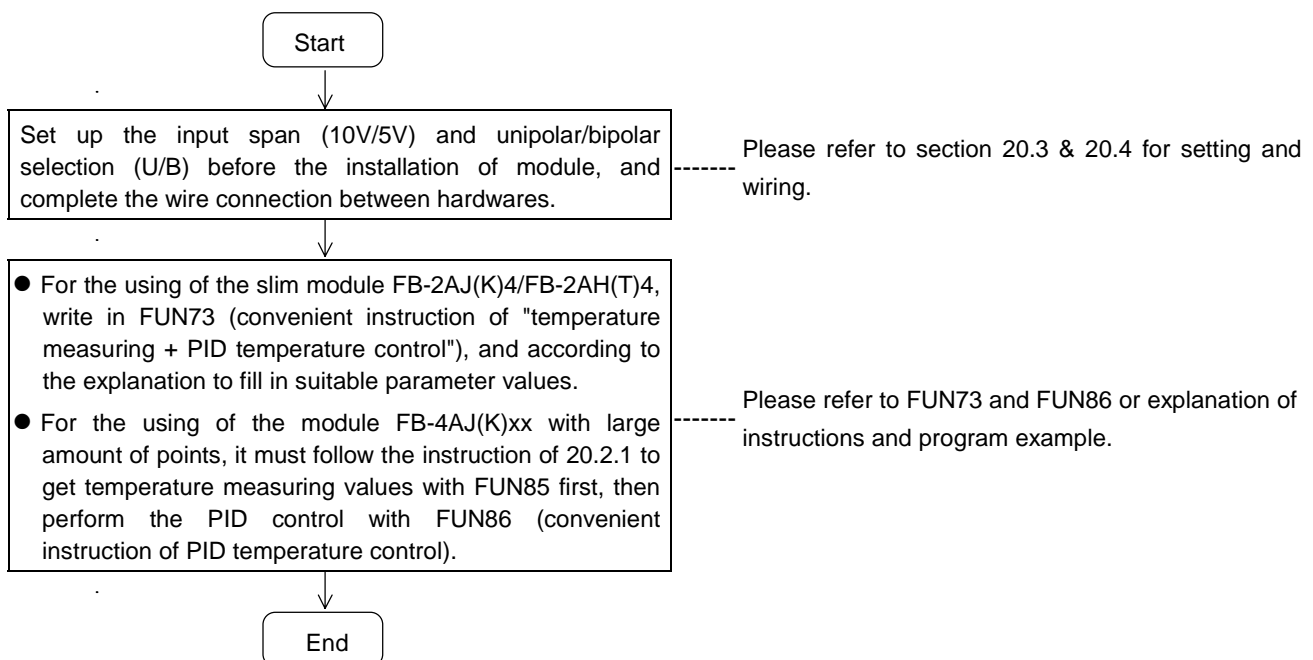
Addressing of FB-4AJ(K)xx : This kind of modules could only be installed alone, therefore, the 1<sup>st</sup> ~ 4<sup>th</sup> analog inputs are the general purpose input by accessing R3840 ~ R3843, and 5<sup>th</sup> ~ 8<sup>th</sup> analog inputs are dedicated for upto 24 points of temperature measurement (by multiplexing method, one analog input for 6 points of temperature measurement).

## 20.2 The procedure of using temperature measuring module of FB-PLC Explanation

### 20.2.1 Temperature measurement only

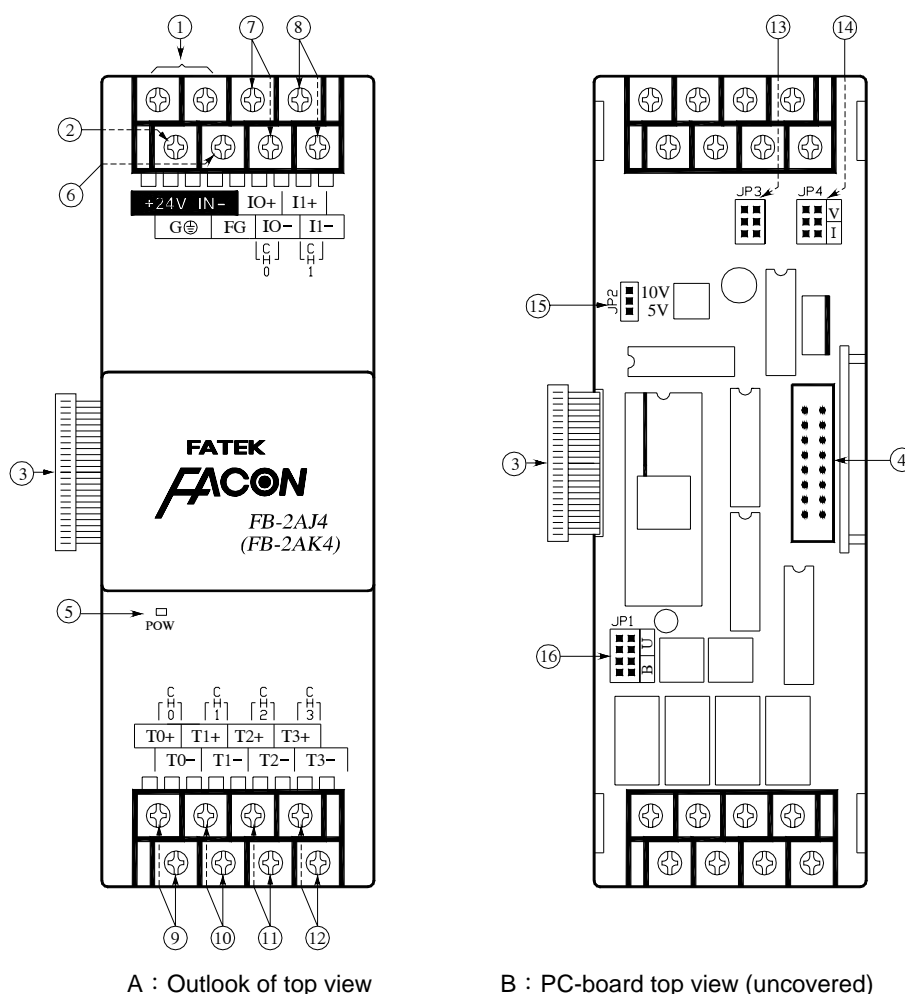


### 20.2.2 Closed loop PID temperature control



## 20.3 Explanation on the hardware of temperature measuring module

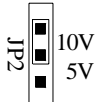
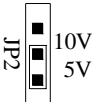
### 20.3.1 The outlook of FB-2AJ(K)4 and top view of PC-board



- ① : External power input terminal –  
Power supply for analogue circuit of FB-2AJ(K)4 module, supply voltage is 24VDC±20% °
- ② : Protection ground terminal –  
To connect to the safety earth ground of the power system.
- ③ : Expansion input cable –  
It must be connected to the front of expansion unit or main unit.
- ④ : Expansion output connector –  
Provide the connection for next expansion unit.
- ⑤ : Power indicator –  
Indicating the status of external power input and power supply of FB-2AJ(K)4 analogue circuit.
- ⑥ : Framing ground terminal –  
To connect to the shielding of the analog input wiring.
- ⑦ : Analog input terminal for AI0 –  
To connect to the 1<sup>st</sup> general purpose analog input.
- ⑧ : Analog input terminal for AI1 –  
To connect to the 2<sup>nd</sup> general purpose analog input.
- ⑨ ~ ⑫ : Temperature input terminals for CH0~CH3 – To connect to the corresponding thermocouple.
- ⑬ ⑭ Selection jumpers of voltage(V)/current(I) input for AI0 (JP3) and AI1 (JP4)

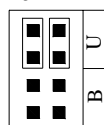
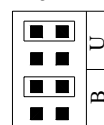
⑮ : Selection jumper of input span 10V/5V

The selection to define the input span of all analog inputs of this module. If setting the jumper at 10V position, it represents the measurement range of 10V/20mA/1000°C; if setting the jumper at 5V position, it represents the measurement range of 5V/10mA/500°C.

Jumper Setting				
Span of analog Input	Unipolar (U)	Voltage (V)	0V~10V	0V~5V
		Current (I)	0mA~20mA	0mA~10mA
	Bipolar (B)	Voltage (V)	-10V~10V	-5V~5V
		Current (I)	-20mA~20mA	-10mA~10mA
Span of Temperature input	Unipolar (U)		0°C~1000°C	0°C~500°C
	Bipolar (B)		-1000°C~1000°C	-500°C~500°C

⑯ : Unipolar (U)/Bipolar (B) selection

The selection to define the input polarity of all analog inputs of this module. These two jumpers must be inserted horizontally in pairs according to the U, B text direction (which is horizontally printed in its direction) to position B or U as following illustration.

○		×
Unipolar (U)	Bipolar (B)	<div>  or  </div> <p>Jumper vertically inserted or not inserted in pairs are all incorrect</p>
