

PROGRAMMABLE CONTROLLER
FP0 Thermocouple Unit
Technical Manual

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 Usage

- Accuracy

- Connecting/disconnecting the Thermocouple input terminal block while the Thermocouple Unit is ON will lower an accuracy temporarily. Accordingly, use the temperature data obtained 15 minutes after its action.
- When a high-accurate temperature data is required, use the temperature data obtained 15 minutes after turning ON the Thermocouple Unit. (However, the temperature data within 15 minutes is also within the Total accuracy range.)
- A rapid temperature change in the Thermocouple Unit might change the temperature data temporarily.
- The direct air (wind) from the cooling fan built in the control panel etc. to the Thermocouple Unit will lower an accuracy. Prevent a direct air.

- Programming

- From the Power-ON to the converted data Ready, the digital value will be K8001 or K16001. Create a ladder program not to use the data obtained during that period.
- When the thermocouple is broken, the digital value will change to K8000 or K16000 within 70 seconds. Practice in the ladder program a process for avoiding a risk, would be resulting from a broken thermocouple, and exchange the thermocouple.
- When the Input range setting switch is set for 4 channels or more, use a program described in "7.2 Program>, without fail.

1 Unit Outlines

1.1 Functions

1. Thermocouple input unit for FP0/FPΣ Control Unit

The temperature data obtained using the thermocouple is converted to the digital value to be read into the FP0/FPΣ Control Unit.

2. Thermocouple types K, J, T and R are available.

3. 3 temperature measurement ranges are available.

-100.0 to +500.0 (Thermocouple types: K and J)
-100.0 to +400.0 (Thermocouple type : T)
0.0 to +1500.0 (Thermocouple type : R)

4. The data can be converted to the degree Celsius or the degree Fahrenheit.

The temperature data measured using the sensor is converted to the degree Celsius or the degree Fahrenheit inside the Thermocouple Unit.

5. The averaging function is installed.

The converted data (degree Celsius or Fahrenheit) is averaged, so that even unstable input signals can be properly read.

6. The broken-thermocouple detector is attached.

A thermocouple, broken, can be detected.

1.2 Model

- Thermocouple Unit

Part number	Thermocouple input points	Product number
FP0-TC4	4 points	AFP0420
FP0-TC8	8 points	AFP0421

1.3 Unit Connection Limit

- Number limit

Up to 3 expansion units can be connected with the Control Unit.

- Position limit

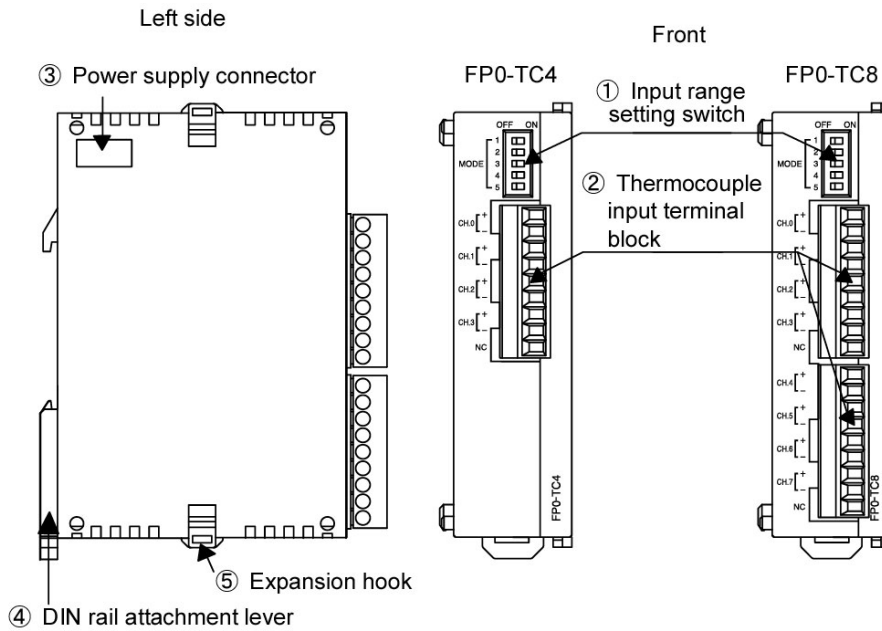
Install the thermocouple unit on the right side of other expansion unit. If it is installed on the left side, the total precision will deteriorate.



Reference: "7.1 I/O No."

2 Part Names and Functions

- Thermocouple Unit



① Input range setting switch

changes between the input ranges (thermocouple types). Only the same range setting is available for all the 8 channels. (The setting can not be specified per channel.)



Reference: "4 Input Range Setting Switch".

② Thermocouple input terminal block (9-pin)

is made by Phoenix. Model No. is MC1.5/9-ST-3.5 (Part No.: 1840434)

Suitable wires

Size	Nominal cross-sectional area
AWG# 28 to 16	0.08 mm ² to 0.25mm ²



Reference: FP0 Hardware Manual "Wiring the Terminal Type".
FPΣ User's Manual "Wiring of Terminal Block Type".

③ Expansion connector

Connects the expansion unit to the internal circuit of the Control Unit.



Reference: FP0 Hardware Manual "Adding Expansion Units".
FPΣ User's Manual "Expansion Method of Units for FP0 and FPΣ".

④ DIN rail attachment lever (One-touch hook)

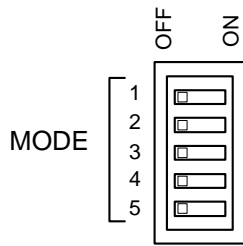
The unit can be installed to the DIN rail through one-touch operation.
This is also used for installing the unit to the FP0 Slim Type Mounting Plate (AFP0803).

⑤ Expansion hook

Fixes the expansion unit with the Control Unit.

3 Input Range Setting Switch

- Input range setting switch



(The following switch settings are read once when the Control Unit is turned ON. Any change will not be reflected even if made while ON.)

1) Input range setting switch

		OFF	ON	OFF	ON	OFF	ON	OFF	ON
MODE SW	1	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	2	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Thermocouple type		K		J		T		R	

2) Temperature unit switch

		OFF	ON	OFF	ON
MODE SW	3	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Unit		°C		°F	

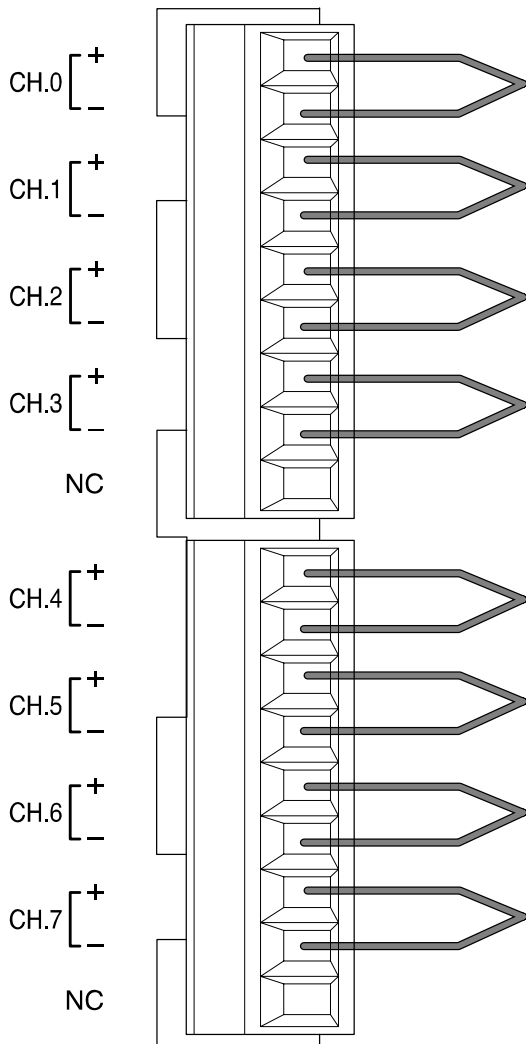
3) Input channel selection switch

		OFF	ON	OFF	ON	OFF	ON	OFF	ON
MODE SW	4	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	5	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Input channel		CH0, 1		CH0 to CH3		CH0 to CH5		CH0 to CH7	
Number of input channels		2		4		6 *		8 *	

* Do not specify it for the FP0-TC4.

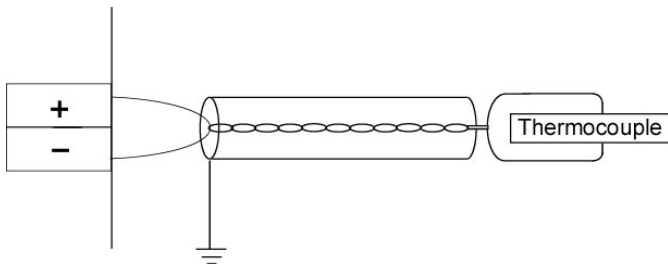
4 Wiring

- Wiring method



- Input line wiring

- Keep the space more than 100mm between the input line and the power line/high-voltage line.
- It is recommended grounding the unit using the insulated compensating wire.



- Input terminal block

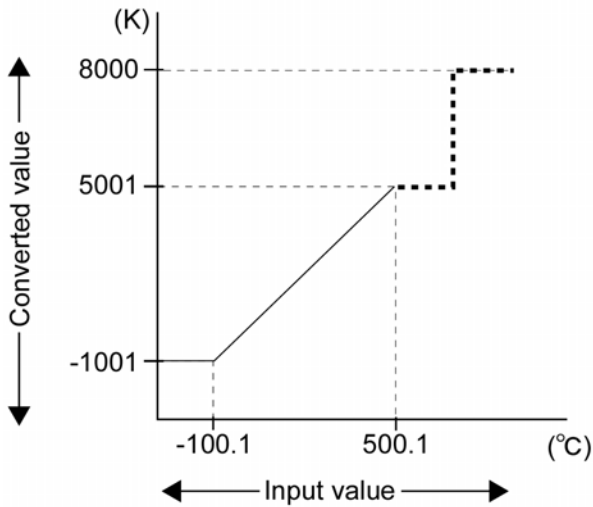
Pin No.	Name	Function
1	CH.0 +	CH0 + thermocouple input
2	CH.0 -	CH0 - thermocouple input
3	CH.1 +	CH1 + thermocouple input
4	CH.1 -	CH1 - thermocouple input
5	CH.2 +	CH2 + thermocouple input
6	CH.2 -	CH2 - thermocouple input
7	CH.3 +	CH3 + thermocouple input
8	CH.3 -	CH3 - thermocouple input
9	NC	no connection

1	CH.4 +	CH4 + thermocouple input
2	CH.4 -	CH4 - thermocouple input
3	CH.5 +	CH5 + thermocouple input
4	CH.5 -	CH5 - thermocouple input
5	CH.6 +	CH6 + thermocouple input
6	CH.6 -	CH6 - thermocouple input
7	CH.7 +	CH7 + thermocouple input
8	CH.7 -	CH7 - thermocouple input
9	NC	no connection

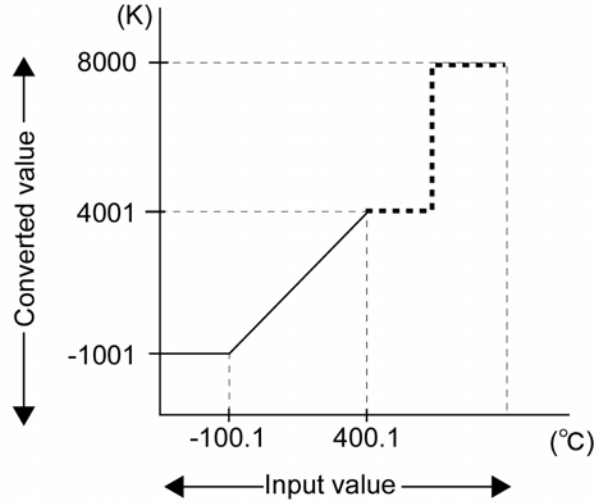
* Where between channels are insulated using the PhotoMos relay.

5 Conversion Characteristic

- K and J range (-100.0°C to 500.0°C)



- T range (-100.0°C to 400.0°C)



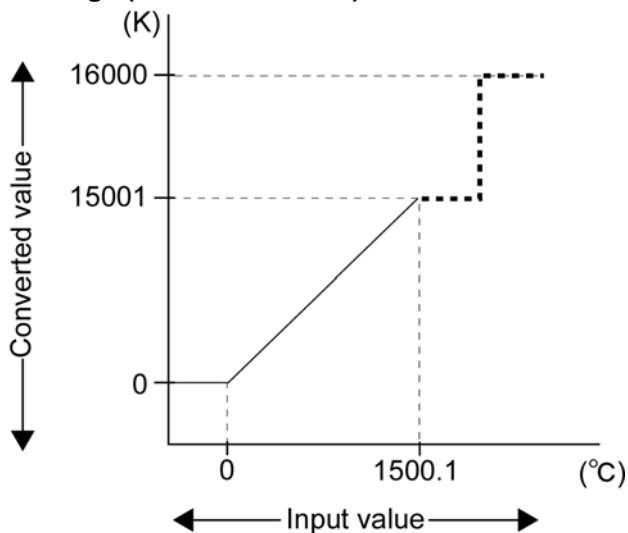
When the input out of the range is made

Input	converted to
-100.1°C Max.	K -1001
500.1°C Min.	K 5001 or K 8000
When the thermocouple is broken	K 8000

When the input out of the range is made

Input	converted to
-100.1°C Max.	K -1001
400.1°C Min.	K 4001 or K 8000
When the thermocouple is broken	K 8000

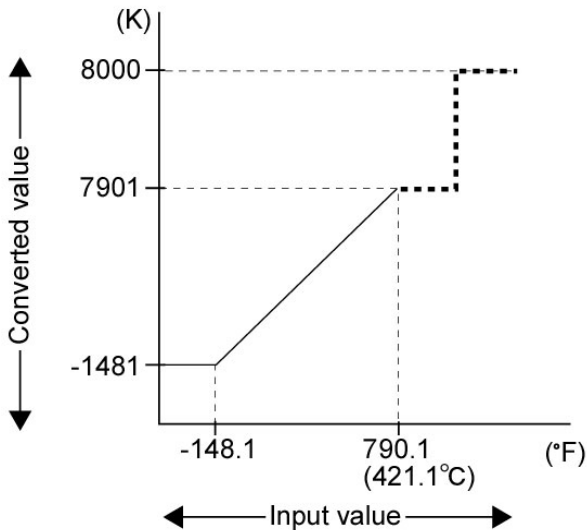
- R range (0.0°C to 1500.0°C)



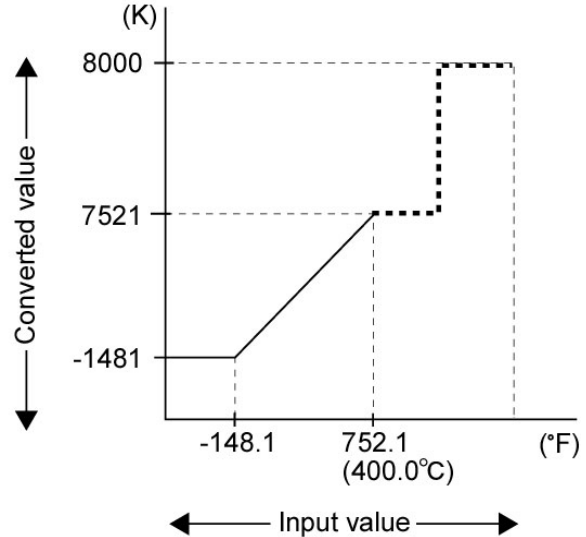
When the input out of the range is made

Input	converted to
0.0°C Max.	K 0
1500.1°C Min.	K 15001 or K 16000
When the thermocouple is broken	K 16000

- K and J range (-148.0°F to 790.0°F)



- T range (-148.0°F to 752.0°F)



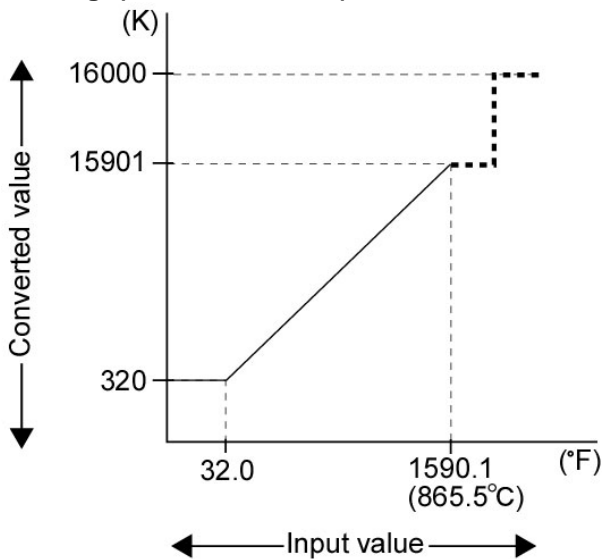
When the input out of the range is made

Input	converted to
148.1°F Max.	K -1481
790.1°F Min.	K 7901 or K 8000
When the thermocouple is broken	K 8000

When the input out of the range is made

Input	converted to
-148.1°F Max.	K -1481
752.1°F Min.	K 7521 or K 8000
When the thermocouple is broken	K 8000

- R range(32.0°F to 1590.0°F)



When the input out of the range is made

Input	converted to
32.0°F Max.	K 320
1590.1°F Min.	K 15901 or K 16000
When the thermocouple is broken	K 16000

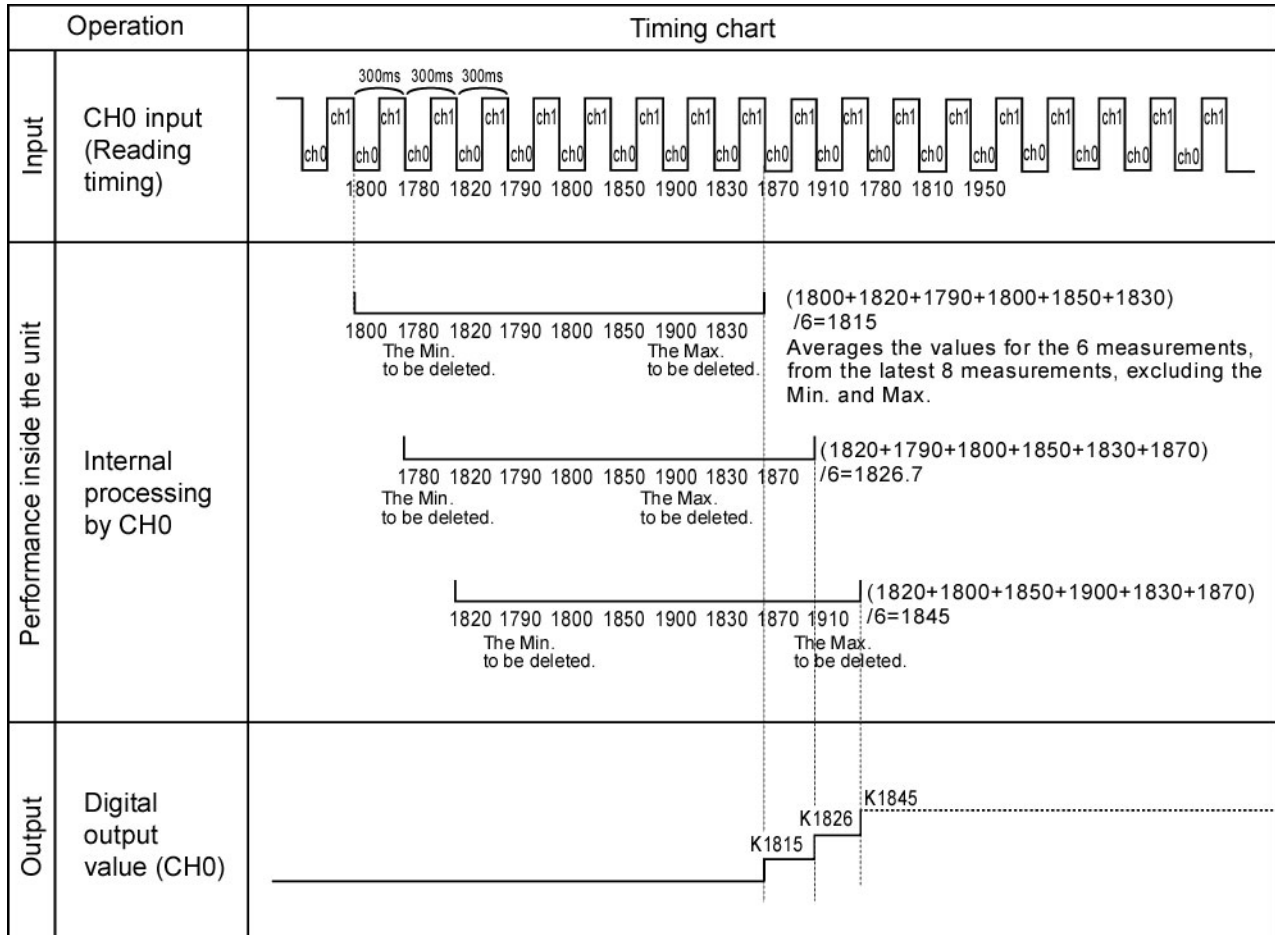


Note: The measurement range available for degree Celsius is not available for degree Fahrenheit, of which the upper-limit measurement is set lower than degree Celsius, since the digital value (temperature value displayed) for degree Fahrenheit is bigger than that for degree Celsius.

6 What is Averaging ?

The followings are processed inside the Thermocouple Unit.

The example below is for when the number of the input channels is 2. (The input range setting switches, No.4 and No.5, are OFF.)



The values for the 6-time measurements, from the latest 8-time measurements, excluding the Max. and the Min., are averaged and the newest average is always output to WX2 and WX3. (The decimal fractions are rounded off.)

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