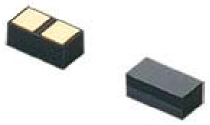
FTP Series

PTC Thermistor "Micro Heater"

(Flat Thin head Insulated Type)

FTP Series



Features

- Self-Temperature Control by PTC characteristics.
- Low voltage operation
- Top surface insulated SMD part
- Compact light design
- Fastest time heating operation
- Small spot heating
- Design free heating layout

Applications

- Heating Electric Device for Temperature compensation
- Removal of dew condensation or freeze (Camera, Mirror etc.)
- Beauty and Health-Care application (Massager etc.)
- Paper dryer for PPC printer
- Several Accessory warmer

Overview

The FTP series generate heat at specified temperature when voltage is applied and also serve to control temperature.
The FTP series are mounted PTC ceramics, so high reliability and quick heating up are available.
Also outer size is small, so the FTP series can heat required small part only. And electricity loss can be minimized as for heating.
In addition to the above, the FTP series can be operated with low voltage battery.
These help the customer downsize heating construction and high performance.

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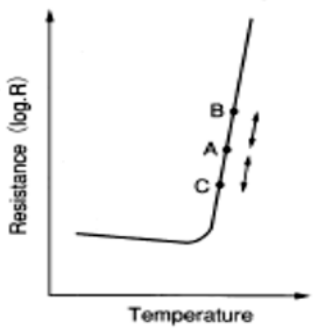
1. Principles of Ceramic PTC Thermistor

1.1 Operating in Ceramic PTC (Temperature-Resistance Characteristic)

Ceramic PTC (positive temperature coefficient) device is one of Thermistor products, and it realizes some kind of function involving “Resettable Fuse as Overcurrent Protector” and “Current Control Device”. PTC indicate Temperature-Resistance characteristic which PTC resistance value is steady during at normal operation, but resistance increase exponentially from a given temperature (it’s called Curie-Temperature). Its unique characteristic is genarated by electorinic property of Ceramic grain boundary. Resistance of grain boundary keeps steady at lower temperature. But, Resistance of grain boundary rises up when the devices temperature increase.



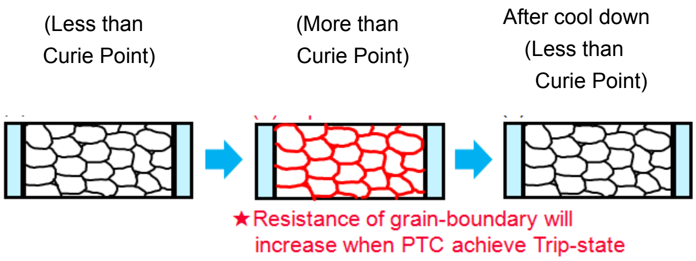


Figure 1.1 PTC temperature-resistance characteristic and its origin

1.2 The definition of Temperature-Resistance Characteristic

Until the voltage reaches a certain value, the current follows the constant resistance line.

Thus PTC current increase with increasing applied voltage.

When the voltage exceeds this value, however, the current follows the constant power line.

Thus the temperature of PTC device start to warm up by its self-heating because of Wattage = I^2R. After temperature of PTC device achieve Curie-Temperature, PTC current will decrease with increasing applied voltage.

The maximum current is called the V-I peak.

Voltage - Current Characteristic is showed in Figure 1.2.

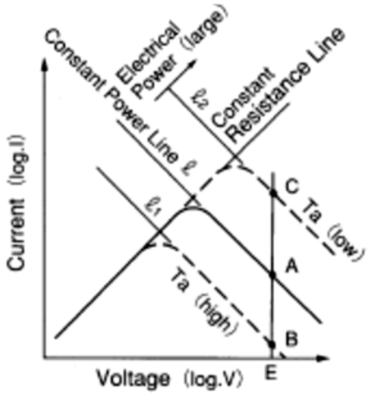


Figure 1.2 Voltage-Current Characteristic

1.3 Current - Time Characteristic, or dynamic characteristics

This is the relationship between current and time when voltage is applied. Current is fairly large immediately after voltage is applied but later decreases and stabilizes.

Maximum current is called inrush current.

This Operating Time is depending on Inrush current value and ambient temperature. In detail, decreasing time will be less time when ambient temperature is set higher or bigger Inrush current is applied.

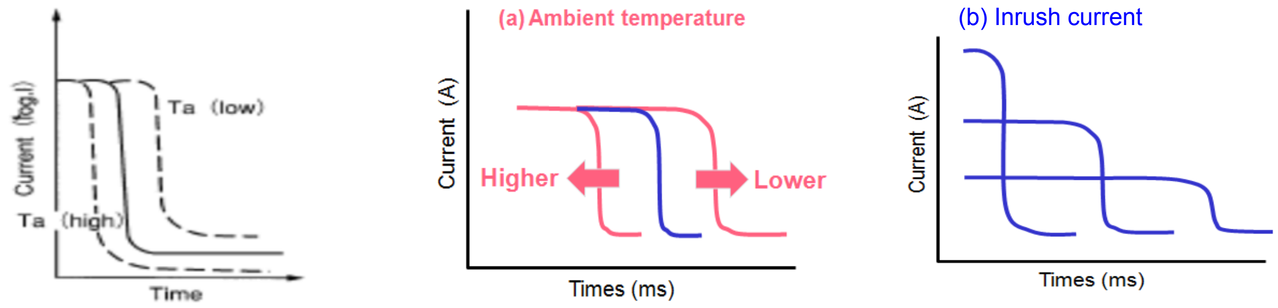


Figure 1.3 Current-Time characteristic

1.4 Feature of Ceramic PTC

Ceramic PTC has Temperature-Resistance characteristic caused by resistance change of Ceramic grain boundary origicagted from electronic proerty. Because of using its behavior, Ceramic PTC indicate non-hysteresis resistance change when PTC operation returns from Trip-state to Inisial-state in its repeatability. Therefore, resistance change of PTC device after soldering and On-Off load test, results in very small value. These behavier promises reliable peformance in its operation.

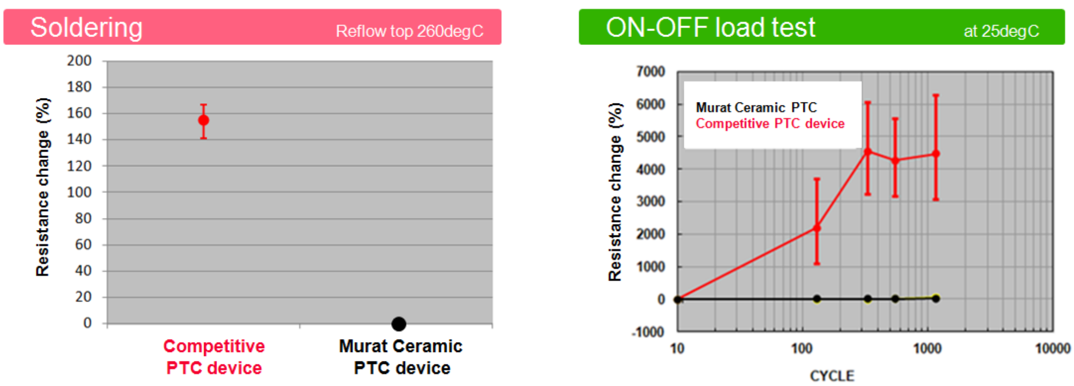


Figure 1.4 Comparison of Murata Ceramic PTC and competitive PTC device

1.5 Usage of FTP series as Micro Heater
Self-Temperature Control using FTP series

The Temperature-Resistance characteristic is one way in which FTP works to control temperature. (see Fig.1.1)

For example, if FTP is operating at point A and the voltage increases, FTP's temperature rises to point B. However, as temperature rises, the FTP's resistance also increases so that current decreases, and this lowers temperature and returns the FTP's operation to point A.

In the opposite way, if temperature decreases, FTP's operation shift from A to C. However, the resistance decreases, the current flows more and the temperature rises, returning the FTP's operation to point A.

FTP's voltage-current characteristic also aids in controlling temperature. (see Fig.1.2). FTP has constant power beyond a specified voltage (V-I peak). Even if the voltage surpasses the V-I peak, the power and temperature remain almost unchanged. When the ambient temperature (Ta) changes, FTP's heating operation changes. That is, if the ambient temperature (Ta) rises, the constant power line (ℓ) shift to ℓ_1 and the operation point A shift to point B.

Then as the power decreases, the operation point automatically is moved back to point A. When ambient temperature decreases, however, the constant power line (ℓ) shift to ℓ_2 and operation point A (at voltage E) shifts to point C. Then, as the power becomes larger, it automatically moves back to point A. In this way, FTP maintains temperature at a specified level.

When considering factors which change temperature, the ambient temperature, applied voltage, and load are taken into account. Load is considered in terms of ambient temperature.

That is, the heavier the load, the lower the ambient temperature. The lighter the load, the higher the ambient temperature. Fig.1.5.1 shows the relationship between ambient temperature and power, and Fig.1.5.2 shows the relationship between FTP load and consumed power.

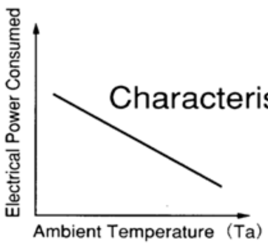


Figure 1.5.1 Relationship between Ambient Temperature and

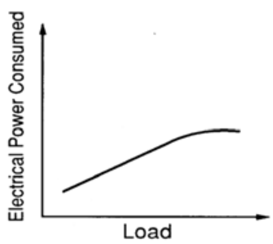


Figure 1.5.2 Relationship between Load and Power

[Remarks]

When multiple pieces of FTP are used, please connect power to FTP with parallel connection.

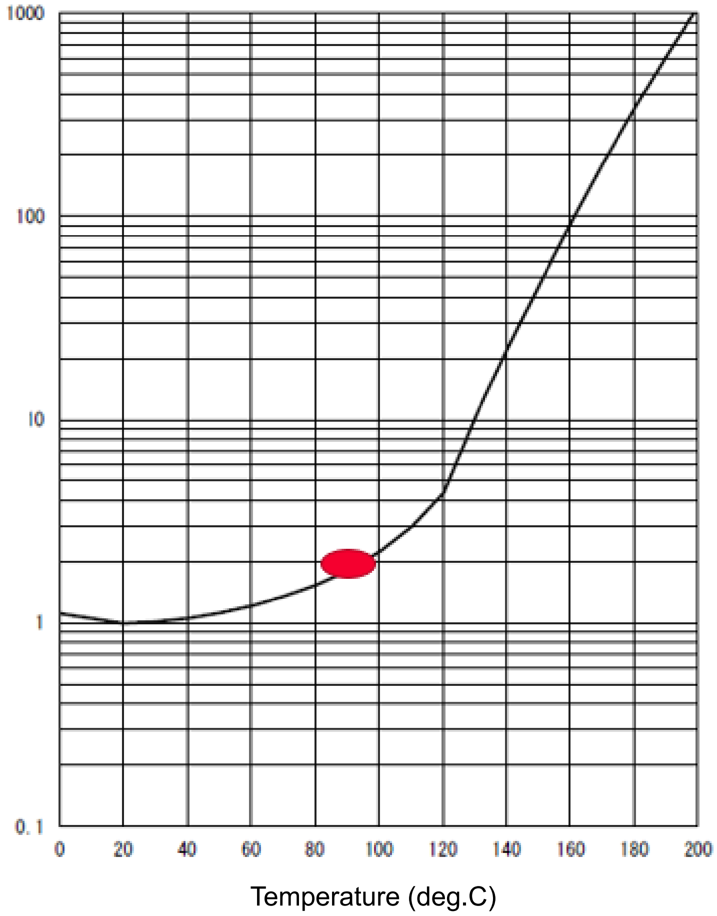
FTP series can be used with lower voltage than the voltage at V-I peak point which is described in above item 1.2. In this case, please note that FTP is operated like constant resistance. So the temperature control function is required separately.

1.6 Characteristic (Resistance v.s Temperature)

Figure 1.6 shows Characteristic (Resistance v.s Temperature).

Below temperature is defined as curie point.

The temperature is the point that Change resistance is twice from that of 25 deg.C.



(Caution)

Temperature of Curie point is 80-100deg.C.

But this is not equal to temperature of the object to be noted.

Figure 1.6 Characteristic (Resistance v.s Temperature)

2. Usage of FTP series as Micro Heater

2.1 Method of selecting product number

Table 2.1 shows PART No. and Rating.

Please select product with reference to Table2.1 & 2.2 Fundamental Data (Next page).

Table 2.1 PART No. and Rating

Part Number	Resistance Value at 25deg.C[ohm](*1)	Curie Temp. [deg.C](*2)	Max. Operating Voltage [V]	Operating Temperature Range [deg.C]
FTP18BC2R2Q03RT	2.2ohm +35/-20%	T2R25 = 85～105	DC 2.0	0～+40
FTP18BC3R3Q03RT	3.3ohm +35/-20%	T2R25 = 85～105	DC 3.0	0～+40
FTP18BC4R7Q03RT	4.7ohm +35/-20%	T2R25 = 85～105	DC 3.6	0～+40
FTP18BC180Q03RT	18ohm +35/-20%	T2R25 = 85～105	DC 6.0	0～+40
FTP18BC330Q03RT	33ohm +35/-20%	T2R25 = 85～105	DC 6.0	0～+40
FTP18BC470Q03RT	47ohm +35/-20%	T2R25 = 85～105	DC 6.0	0～+40
FTP18BC680Q03RT	68ohm +35/-20%	T2R25 = 85～105	DC 6.0	0～+40

*1 : After applying maximum voltage for 3 min. at 25 deg.C in still air, keeping at 25 deg.C in still air for more than 24 Hr.
And measure resistance by 4 terminal method with less than 10mA (less than 0.1VDC) of DC voltage.

*2 : After changing ambient temperature in air oven, the resistance is measured by 4 terminal method with less than 10mA (less than 0.1VDC) of DC voltage.
Curie temperature is specified the temperature when the resistance becomes twice of the resistance at 25 deg.C.

2.2 Fundamental Data

2.2.1 Experimental Setup

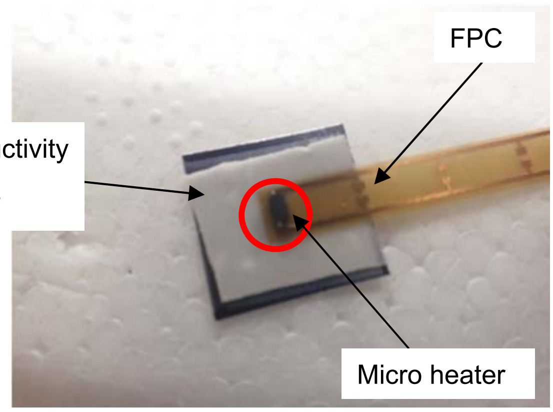
Figure 2.1 shows experimental setup.

Aluminum plate (10mm*10mm*0.1mm) is used as standard material.

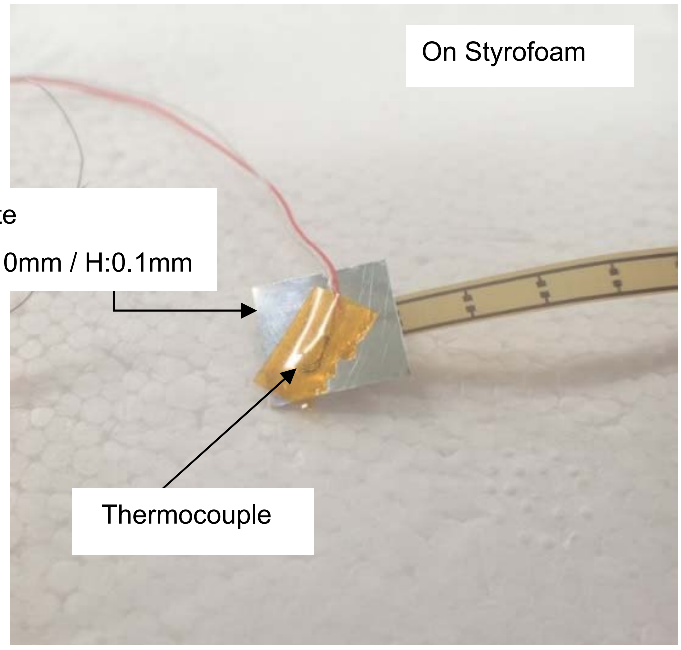
Micro heater is mounted on FPC.

FPC is put on Aluminum plate by thermal conductivity double side tape,

Ambient temperatures are room temperature at 26 deg.C / 15deg.C / 5 deg.C .



Input Voltage: 3V/5V



Note: Experiment setup is surrounded by cardboard box.

Figure 1 Experimental Setup

Attention:

2.2.2 Experiment Data (Temperature rise vs. Time)

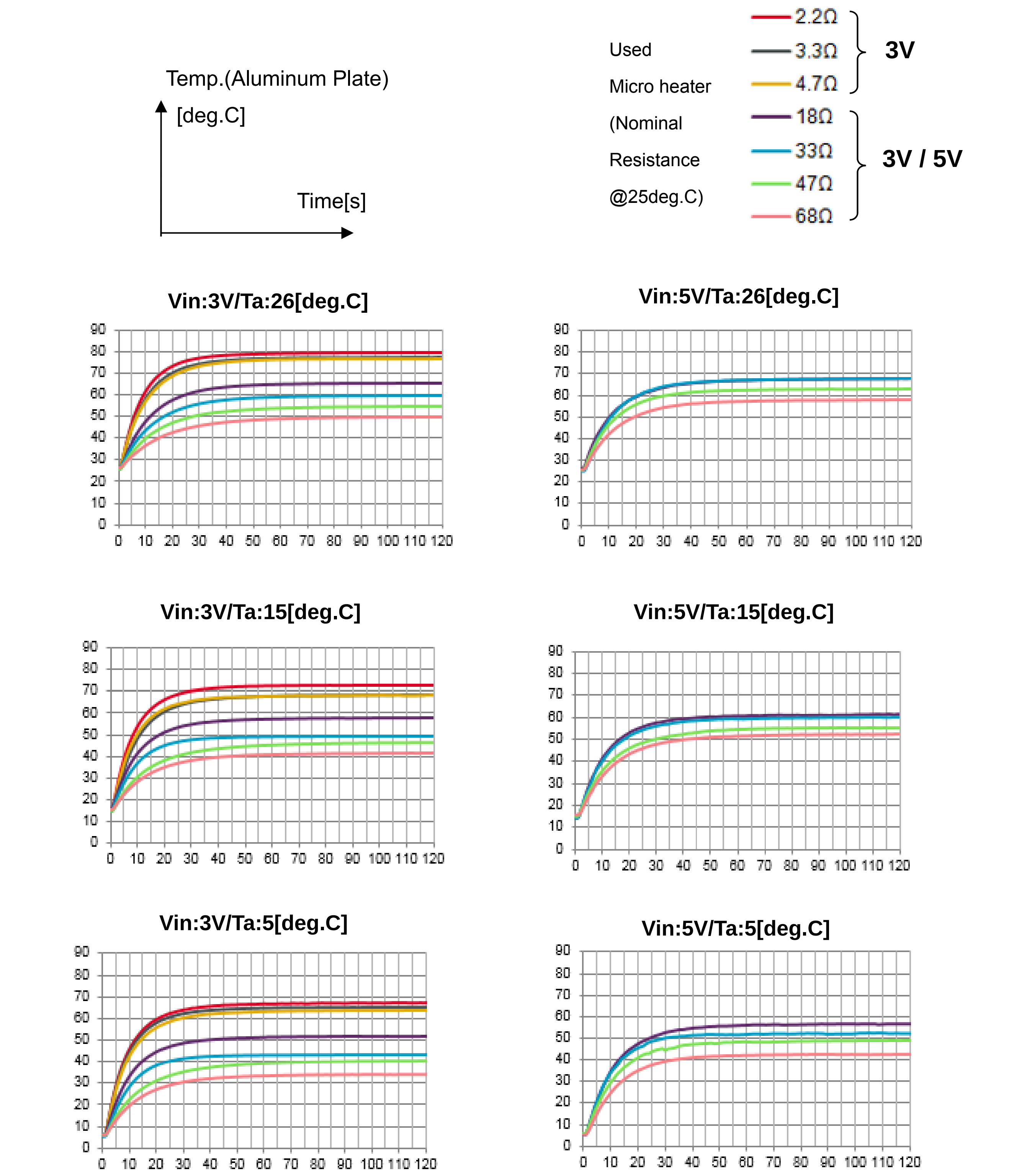


Figure 2.2.2 **Experiment Data (Temperature rise vs. Time)**

2.2.3 Experiment Data (Summary)

(*1)Calculated Value by nominal resistance

Table 2.2.3.1-(a) Vin:3V/Ta:26deg.C

Nominal Resistance[ohm]	Temp.(sat.)[deg.C]	Time (to 40deg.C)[s]	I(sat.)[mA]	Inrush Current[mA](*1)
2.2	80	3	69	1364
3.3	78	4	65	909
4.7	77	4	64	638
18	66	6	48	167
33	60	8	40	91
47	55	10	32	64
68	50	15	27	44

Table 2.2.3.1-(b) Vin:3V/Ta:15deg.C

Nominal Resistance[ohm]	Temp.(sat.)[deg.C]	Time (to 40deg.C)[s]	I(sat.)[mA]	Inrush Current[mA](*1)
2.2	72	6	72	1364
3.3	68	7	68	909
4.7	68	7	65	638
18	58	10	51	167
33	50	13	44	91
47	47	25	36	64
68	42	43	29	44

Table 2.2.3.1-(c) Vin:3V/Ta:5deg.C

Nominal Resistance[ohm]	Temp.(sat.)[deg.C]	Time (to 40deg.C)[s]	I(sat.)[mA]	Inrush Current[mA](*1)
2.2	67	8	77	1364
3.3	65	9	75	909
4.7	64	9	69	638
18	52	15	55	167
33	43	24	48	91
47	41	84	38	64
68	34	-	31	44

Table 2.2.3.2-(a) Vin:5V/Ta:26deg.C

Nominal Resistance[ohm]	Temp.(sat.)[deg.C]	Time (to 40deg.C)[s]	I(sat.)[mA]	Inrush Current[mA](*1)
18	68	6	32	278
33	67	6	33	152
47	63	7	29	106
68	58	9	24	74

Table 2.2.3.2-(b) Vin:5V/Ta:15deg.C

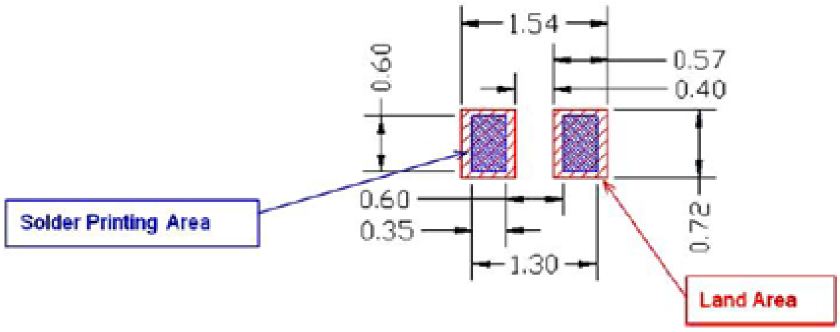
Nominal Resistance[ohm]	Temp.(sat.)[deg.C]	Time (to 40deg.C)[s]	I(sat.)[mA]	Inrush Current[mA](*1)
18	62	9	36	278
33	60	10	34	152
47	56	13	29	106
68	52	16	27	74

Table 2.2.3.2-(c) Vin:5V/Ta:5deg.C

Nominal Resistance[ohm]	Temp.(sat.)[deg.C]	Time(to 40deg.C[s])	I(sat.)[mA]	Inrush Current[mA](*1)
18	57	13	39	278
33	52	14	39	152
47	49	19	33	106
68	43	33	28	74

2.3 Recommendable Land Size

Please be careful that detention of land pattern may cause the inclination or lift of products mounting



2.4 Example of Usage

The simple parallel connection works as heater for each place or area you should heat up almost uniformly.

Heat of Micro heater can be spread by copper (depend on heat conduction material).

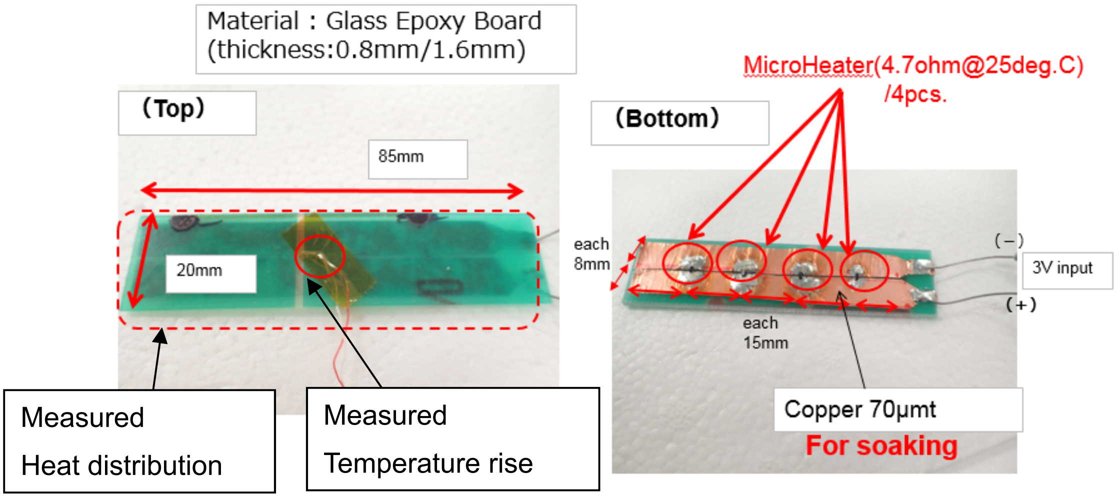
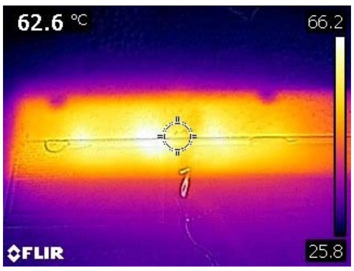


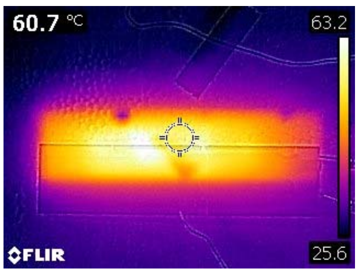
Figure 2.4.1 Experimental Setup

The below shows Heat distribution of Top side.

It shows that Glass Epoxy Board be heated almost equally.



(a)0.8mmt board



(b)1.6mmt board

Figure 2.4.2 Heat distribution

The below shows following.

- ●Thermal response time concerns Thickness of Glass epoxy board.
  (Thermal response time concerns thermal capacitance.)
- ●Saturation temperature is almost equal in both of thickness of Glass epoxy board
  in this experiment.

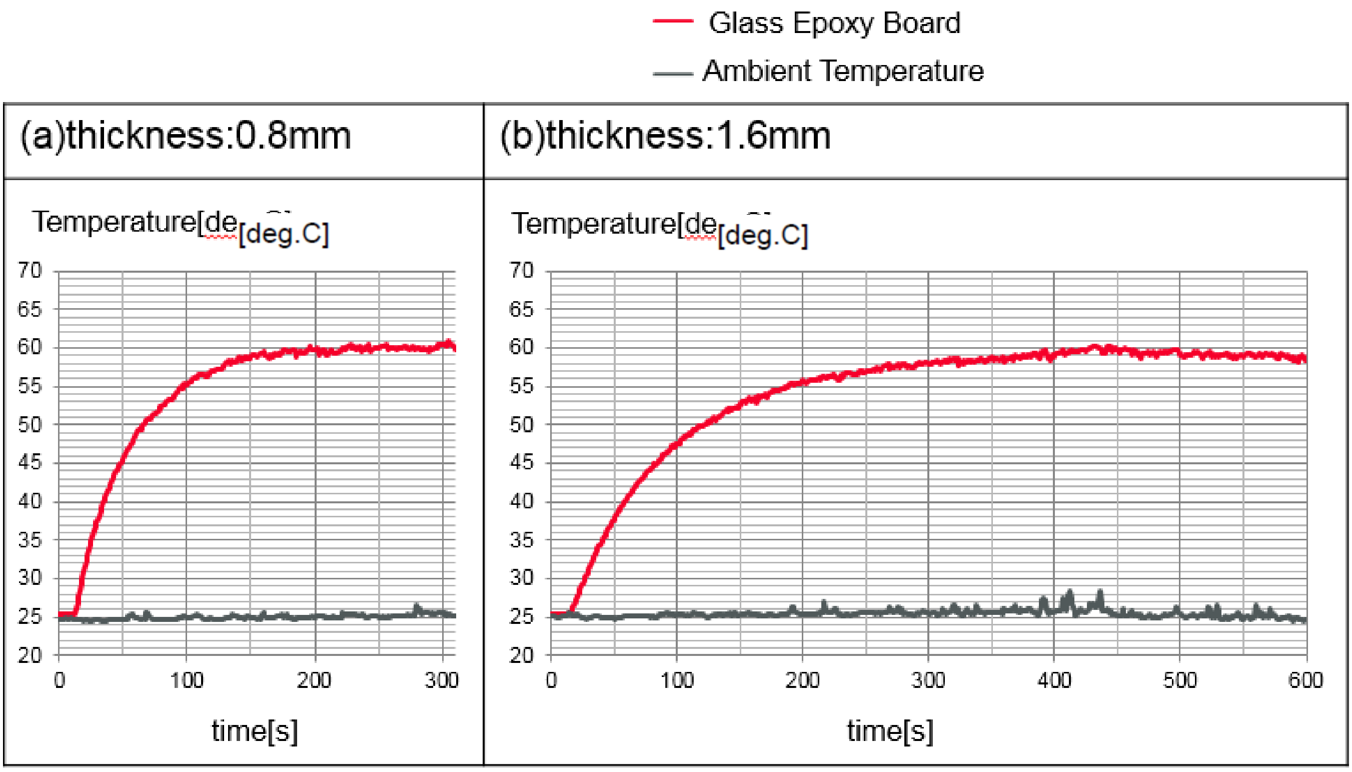


Figure 2.4.3 Temperature rise vs. time of Top side

2.5 Example of peripheral circuit
(Temperature control circuit)

If temperature of the object want to be stabilized, please use temperature controlled circuit.

This chapter introduces the example.

2.5.1 Operating Principle of Temperature control circuit

Figure2.5.1 shows operating principle of temperature control circuit.

(EX.) Controlled Temperature is 40[deg.C].

NTC is monitoring temperature of the object.

If NTC is less than 40 [deg.C] , → Q1 turn on. → the object is heated by PTC (Micro heater).

If NTC is more than 40 [deg.C] ,→ Q1 turn off. → the object is cool down.

Above operation continues repeatedly.

So wave shape of Voltage of PTC is pulse wave.

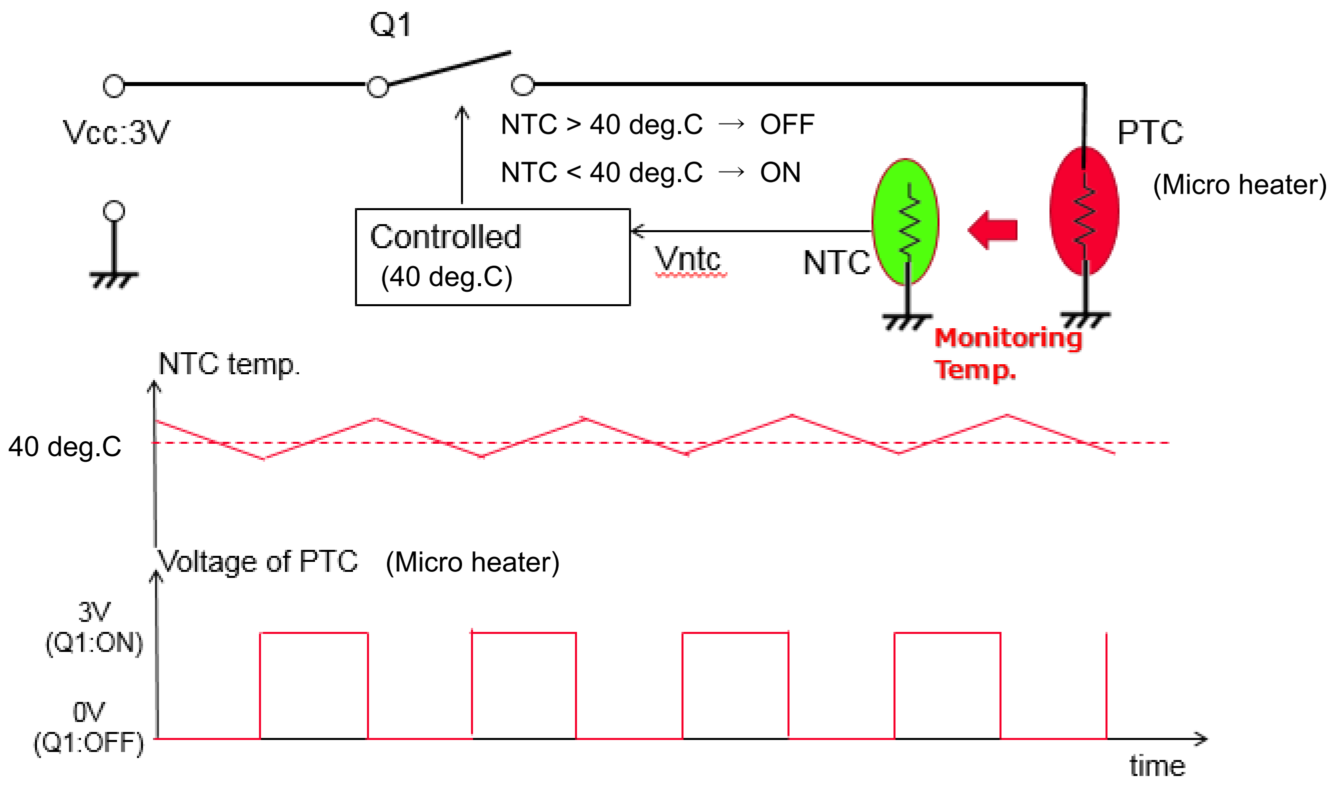


Figure 2.5.1 Operating Principle of Temperature controlled circuit

2.6 Caution

If micro heater is used in your set, please be careful of below things.
Please evaluate temperature of PCB (Printed circuit board) with consideration of heat-resisting of board material.

3. FAQ

(Q1)About Table2.2.3,
Why am I less than the value of current that is calculated by nominal resistance and input voltage?
(A1)Resistance of Micro PTC heater increases because of self-heating at energized.

(Q2)The data of Current and temperature is different from Murata's actual data?
What is the considerable factor.
(A2)Please confirm the installation condition.
We, sample is on the Styrofoam for thermal insulation, and it is surrounded by card board box.

(Q3)How many seconds it takes from energized to reach the Curie point?
(A3) It takes less than 1 second on the below condition.
(example of condition) Chapter 2.2 Fundamental data.(Vin:5V/Ta:26[deg.C]/Mico heater:33ohm)

(Q4)Does Curie temp. (T2R25) at Table2.1 mean temperature that Resistance of Micro heater is twice resistance value at 25[deg.C]?
(A4) Yes, it does.

(Q5)What is the advantage in case of using Micro PTC heater?
(A5)There is not fear of the heat reckless driving such as the fixed resistance.
In case of broken control circuit and overvoltage, a consumption electric current is smaller than fixed resistance, it becomes the energy saving.
The transient overshoot when it's starting, is smaller than fixed resistance.