



# Murata's Posistor Addresses Overheating in Various FETs

The company promotes Posistor to become a standard protection circuit, which is able to rapidly increase its resistance value to 1,000 times at specific temperature.

The electronic circuits of the latest notebook personal computers as well as other equipment use distributed power supplies that require power supply circuits to be immediately installed close to every circuit. The switching field effect transistor (FET) operating in each of these power circuit blocks often generates heat. Therefore, it is necessary to provide a method to detect overheating at multiple locations on a single large printed circuit board (PCB).

The method of using the Posistor, a chip positive temperature coefficient (PTC) thermistor manufactured by Murata Manufacturing Co., Ltd., for sensing abnormal heat in parts is being described in this article. The Posistor product guarantees temperature sensing at two points. The application of the above method to easily sense abnormal heat at multiple locations is also presented.

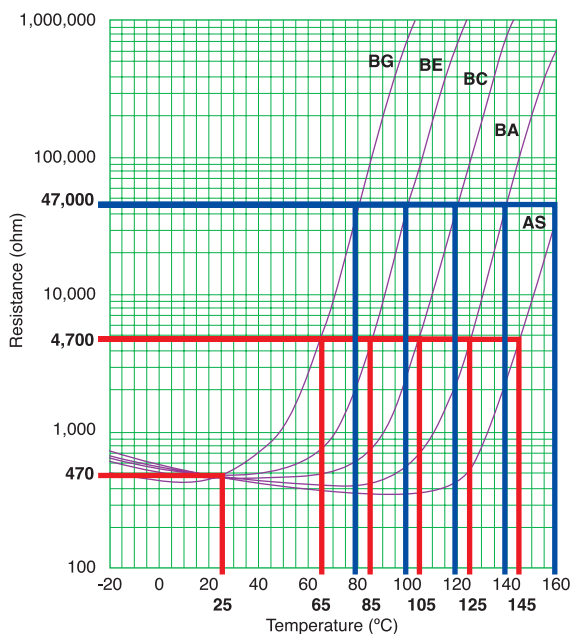


Fig. 1: Resistance temperature characteristic of Posistor PTC thermistor

Table 1: Specifications of a Posistor PTC thermistors

| Part No.        | Resistance value (at +25°C) | Sensing temperature (1) at 4.7k ohms | Sensing temperature (2) at 47k ohms | Maximum operating voltage | Operating temperature range |
|-----------------|-----------------------------|--------------------------------------|-------------------------------------|---------------------------|-----------------------------|
| PRF18AS471QB5RB | 470Ω ± 50%                  | 145 ± 5°C                            | —                                   | 32Vdc                     | -20 - +160°C                |
| PRF18AR471QB5RB |                             | 135 ± 5°C                            | 150 ± 7°C                           |                           | -20 - +160°C                |
| PRF18BA471QB5RB |                             | 125 ± 5°C                            | 140 ± 7°C                           |                           | -20 - +150°C                |
| PRF18BB471QB5RB |                             | 115 ± 5°C                            | 130 ± 7°C                           |                           | -20 - +140°C                |
| PRF18BC471QB5RB |                             | 105 ± 5°C                            | 120 ± 7°C                           |                           | -20 - +130°C                |
| PRF18BD471QB5RB |                             | 95 ± 5°C                             | 110 ± 7°C                           |                           | -20 - +120°C                |
| PRF18BE471QB5RB |                             | 85 ± 5°C                             | 100 ± 7°C                           |                           | -20 - +110°C                |
| PRF18BF471QB5RB |                             | 75 ± 5°C                             | 90 ± 7°C                            |                           | -20 - +100°C                |
| PRF18BG471QB5RB |                             | 65 ± 5°C                             | 80 ± 7°C                            |                           | -20 - +90°C                 |

## Senses Overheating at Multiple Locations

Murata's Posistor, a ceramic thermistor with a positive temperature coefficient, is able to rapidly increase its resistance value more than 1,000 times at a specific temperature.

A conventional PTC thermistor guarantees sensing points at the temperature where the resistance value becomes 10 times higher than the resistance value at room temperature.

The Posistor PTC thermistor multiple series circuit is being introduced as a method to sense overheating in multiple FETs installed in equipment using a simple circuit. This process could prevent the equipment from catching fire or causing accidents.

In the introduction of the multiple series circuit, Murata Manufacturing set the resistance value of the Posistor to become 100 times higher as a guarantee value at sensing points

in addition to conventional sensing points at which the resistance value of the PTC thermistor becomes 10 times higher than the resistance values at room temperature.

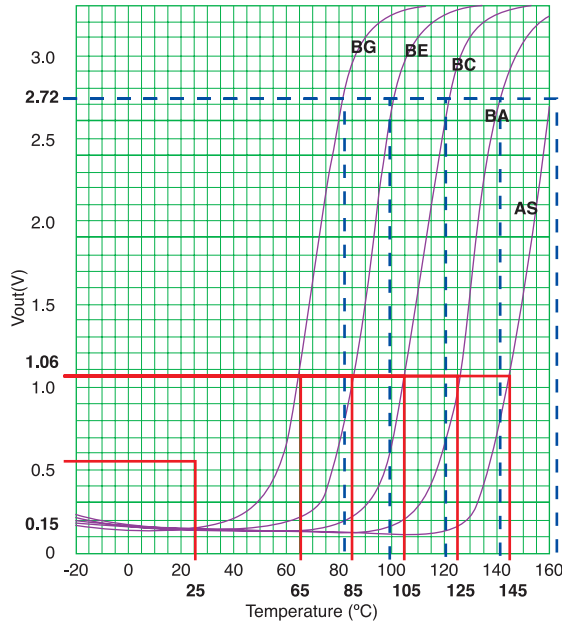
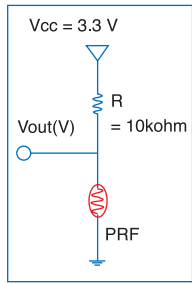
Figure 1 shows the resistance temperature characteristics of the Posistor PTC thermistor while Table 1 indicates the Posistors' specifications.

In Fig. 2, an overheat sensing circuit using the Posistor PTC thermistor and its output voltage ( $V_{out}$ ) is shown. The overheat sensing circuit is an example where a 10kΩ fixed resistor is connected as partial pressure resistance and a rated voltage of 3.3V is applied.

The output voltage that is about 0.15V remains almost constant from the room temperature to the setting temperature. The voltage, however, suddenly increases near the setting temperature and becomes 1.06V near sensing temperature. This is the level of temperature at which the resistance value becomes 4.7kΩ, which is 10 times higher than the resistance value at room temperature.

Next, the output voltage becomes 2.72V near sensing temperature. This is the level of temperature at which the resistance value becomes 47kΩ, which is 100 times higher than the resistance value at room temperature. This voltage difference can be used to control transistors and FETs.

**Power Supply Parts**



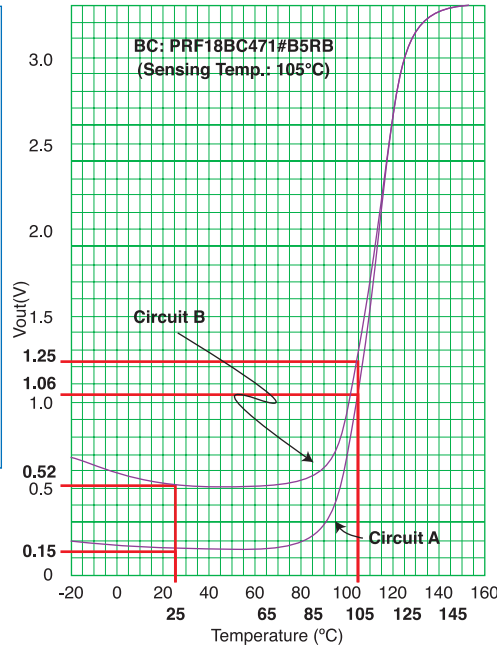
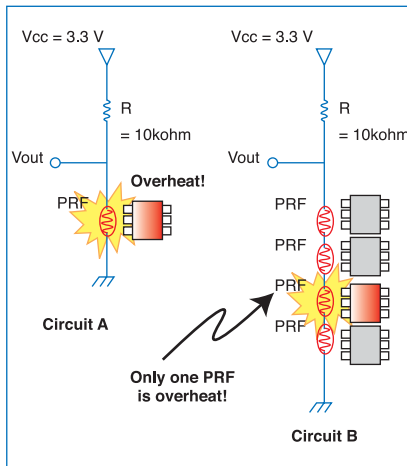
**Fig. 2: Overheat sensing circuit using Posistor PTC thermistor and its output voltage ( $V_{out}$ )**

**Easy circuit construction**

One of the features of the sensing method is that it enables the easy construction of a circuit. The big gain allows transistors and FETs to be turned On/Off directly without using a comparator. This method does not require a hardware, like an analog-to-digital (A/D) converter and ROM, and a control software.

**Easy setting of optimal temperature**

As shown in Fig. 2, the trigger voltage will become constant. In the above example, it is at 1.06V. Therefore, there is a high possibility that a problem can be corrected by changing the characteristics of the Posistor PTC thermistor but without changing the constant circuit.



**Fig. 3: Overheat sensing circuit for multiple locations using the Posistor PTC thermistor and its output voltage ( $V_{out}$ )**

Figure 3 shows an overheat sensing circuit for multiple locations, specifically at four locations, using the Posistor PTC Thermistor and its output voltage.

The sensing temperatures at location one of the PTC thermistor, PRF18BC471#B5RB, is 105°C, and 120°C at the second location with a resistance value of 4.7kΩ. When any one of the four Posistors reaches the first sensing temperature, the normal output voltage of 0.52V doubles to 1.25V. When any one of the four Posistors reaches the second sensing temperature, the normal output voltage of 0.52V becomes 2.72V, which is higher by more than five times.

Therefore, if engineers set the voltage threshold value of a circuit that receives the output voltage ( $V_{out}$ ) to a value close to second sensing temperature, at which the resistance value becomes 100 times higher than the resistance value of room temperature or 2.72V, engineers can design an overheat sensing circuit that is not affected even if the number of Posistor PTC thermistor to be placed in the series is increased or decreased, for example, about one to 10 thermistors.

Figure 4 shows the conceptual diagram of an overheat sensing circuit for multiple locations using the Posistor, which is applied to a notebook personal computer. This multiple series sensing circuit has the following advantages:

**More sensing points, more cost effective**

When devices other than the Posistor PTC thermistor are used for sensing temperature, a control circuit such as a comparator is required for each sensing location. When the Posistor PTC thermistor is used, only a single control circuit and multiple PTC thermistors are required.

**Posistor of different sensing temperatures can be selected freely**

Because the output of the Posistor PTC thermistor is the same at any temperature, as is the case when a basic circuit is used, engineers can freely set different sensing temperatures for each of the Posistor PTC thermistor to be installed.

**Not required Posistor can be short circuited**

When it was found out that a suspected heat generating location during the initial product design phase has no heat prob-

