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.
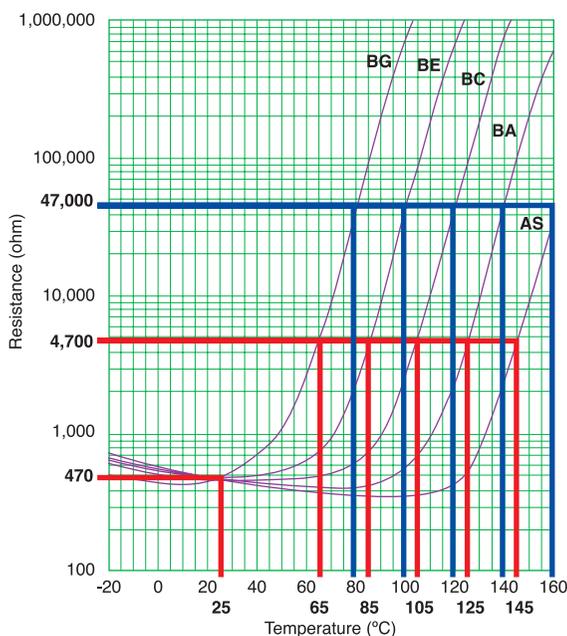
Table 1: Specifications of a Posistor PTC thermistors

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.

Fig. 1: Resistance temperature characteristic of Posistor PTC thermistor
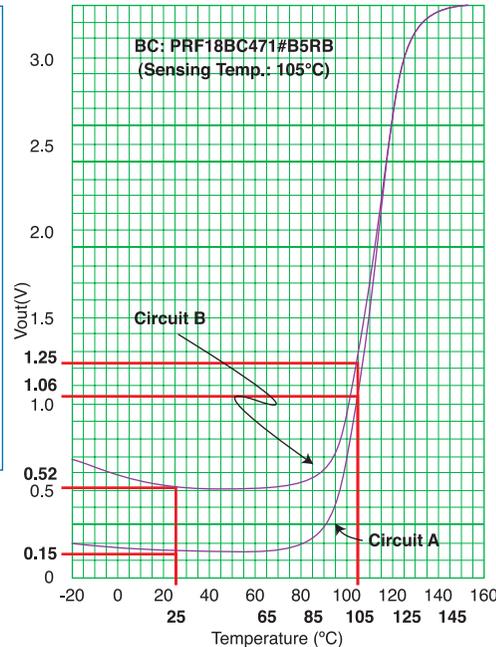
Power Supply Parts
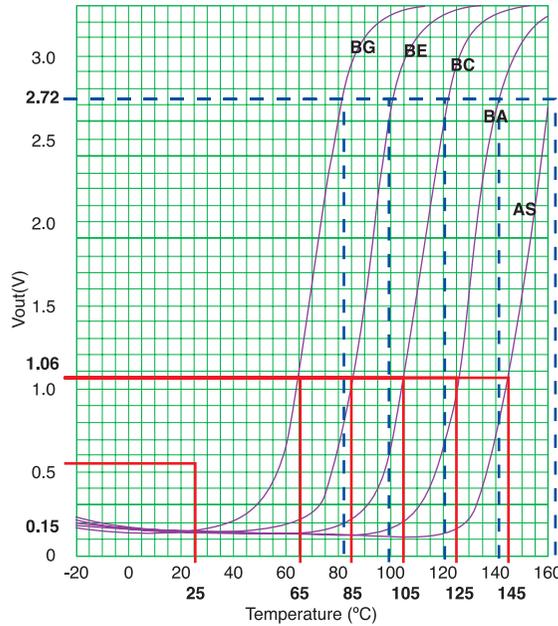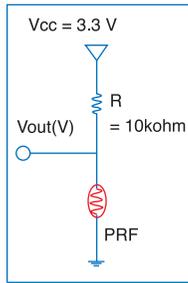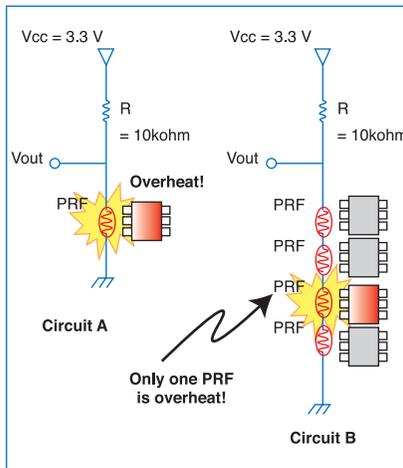

Fig. 2: Overheat sensing circuit using Posistor PTC thermistor and its output voltage (V$_{out}$)

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.

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:

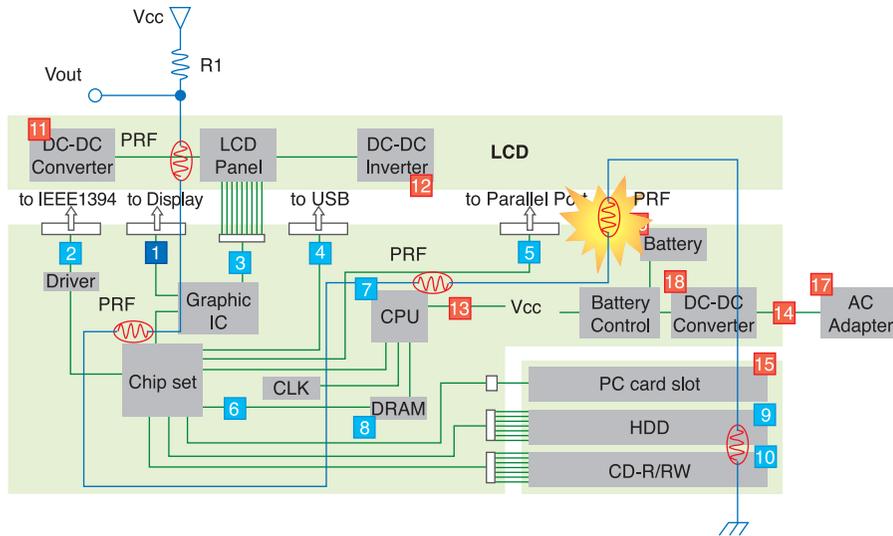### More sensing points, more cost effective

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-

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

Fig. 4: Conceptual diagram of an overheat sensing circuit for multiple locations using the Posistor PTC thermistor, which is applied in a notebook personal computer

cations. This aspect will allow them to significantly reduce the re-designing and board modification time as well as manpower.

Posistor as Standard Protection Circuit

Murata intends to propose methods on how to use as well as examples of circuit so that overheat sensing using the Posistor PTC thermistor will become a standard protection circuit. Murata will continue the development and improvement of its products through close and careful consultation with its customers so that its products can be used easily and freely.

About This Article:

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lem or when the actually generated heat is less than the presumed level, the sensing locations must be reviewed based on the track record in the market. If engineers are faced with such a situation, they can simply short circuit the relevant lo-