1.PTC Thermistor

PTC Thermistors are made of polycrystalline ceramic on a base of Barium Titanate by doping a small amount of rare earth elements.
Semiconduction and thus a low resistance are achieved by doping a small amount of rare earth elements. (Y, La, etc.)
According to the phase transition at specified temperatures the resistance is abruptly increase.
The resistance-temperature characteristics show symmetry to the NTC thermistors.
PTC thermistors are used for current limiter elements, isothemal heaters, temperature sensors other applications because of their simple construction.

2.Typical types for PTC.

PTC thermistors are classified as Fig-1 by product dimensions.
Various shapes of elements, disks, slabs, and washers are available for compression into dies or cutting and grinding after sintering.
Leaded types use high-temperature coatings for mechanical protection, electrical insulation, humidity-resistance and environment stability.
Other constructions and shapes are available, depending application requirements.

PTC Types
- Elements ···· disk, plate, cylinder etc.
- Lead, dip type ···· painted, non-painted
- Case type ···· plastic/ceramic case
- Assembly type ···· unit product

Fig-1 Types of thermistor

3.Typical characteristics of PTC Thermistors

(1) Resistance-Temperature Characteristic

An example of a typical resistance/temperature characteristic is shown in figure 2. The resistance is measured at the ambient temperature of the PTC at a voltage sufficiently low that it does not generate self-heating. The temperature at which the resistance begins to increase rapidly is called "curie temperature (TC)", which is defined as the temperature at which the resistance value. As a voltage applied to a PTC thermistor is increased, the temperature of the PTC will slowly rise by self heating. When the temperature approaches and surpassed the curie temperature, the current will begin to decrease. An example of this characteristics is show in figure 3. This is also influenced by the ambient temperature.

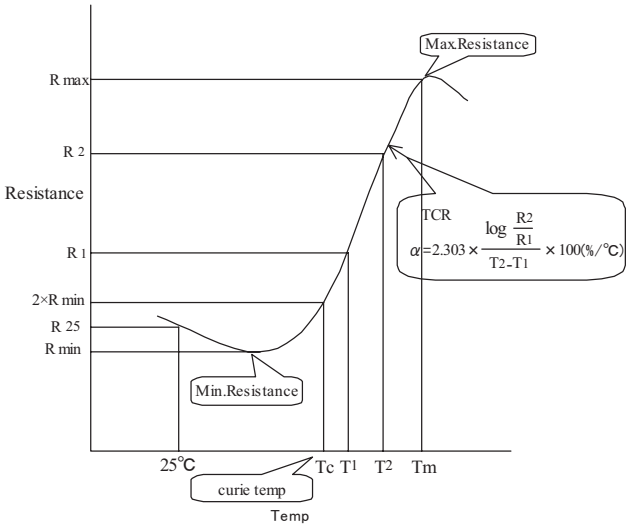


Fig-2 Resistance-temperature Characteristics,(R-T)

(2) Voltage-Current Characteristic

Gradually inclease voltage of PTC thermistor, the temperature of PTC will slowly rise by self generated heat of joule energy and when it reached around the curie temperature, it shows the negative current characteristic (current decreased by increased voltage) that is shown in Fig-3. It is influenced by ambient temperature.

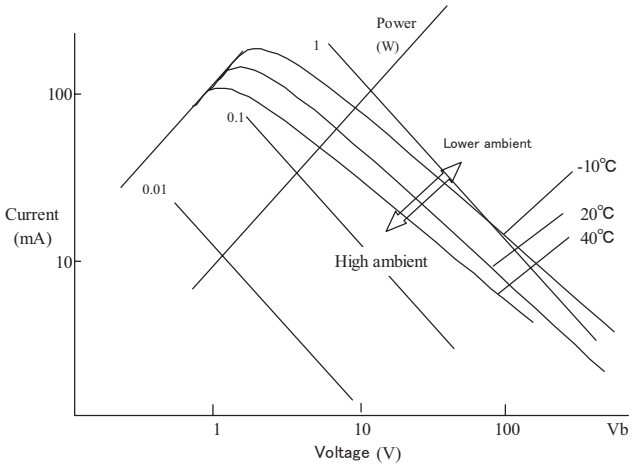


Fig-3 V- I Curve

(3) Current attenuation characteristic

When voltage is applied to a PTC, the current will be attenuated. An example is shown in figure 4. Initially, a relatively large current will flow through the PTC. If the time of voltage application is extended, the current will decrease sharply until it reaches a minimum level, where it will remain constant.

This feature is very effective for the reliability required in solid state switches for heater protection, high current protection, degaussing circuits for color televisions, and motor starters.

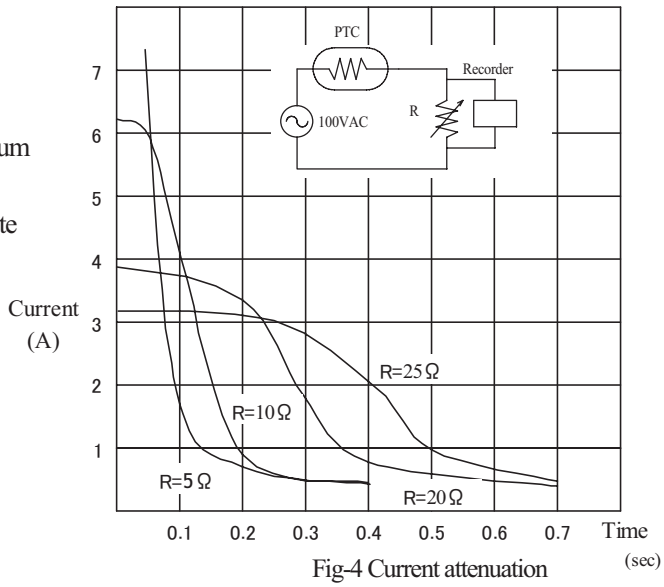


Fig-4 Current attenuation

4.Application for PTC Thermistor

(1) Temperature sensors

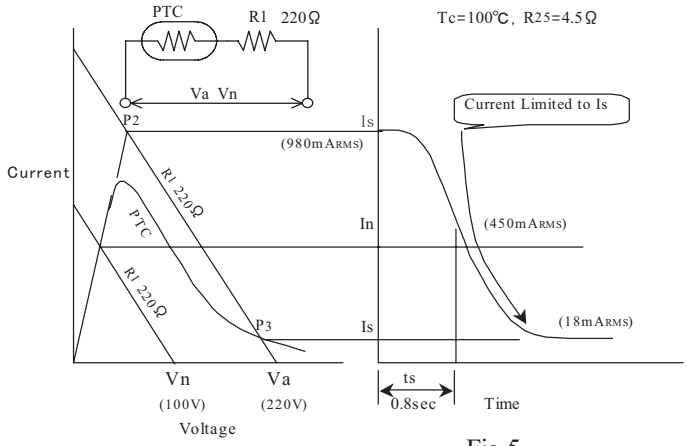
When used for temperature sensors, the self heating of the PTC is neglected. The resistance of the PTC is observed to be a function of ambient temperature around the steep region of the R/T curve (near Tc).

(2) Current Limiters

These thermistors protect the circuit against overload, over current, and over heating. Once the circuit protection is activated, the protector function can be restored immediately by turning off the electricity.

(2)-1 Over voltage protection

The circuit will be protected from voltage exceeding the rated voltage. Figure 5 shows the operating state of a PTC in an overload protect application.



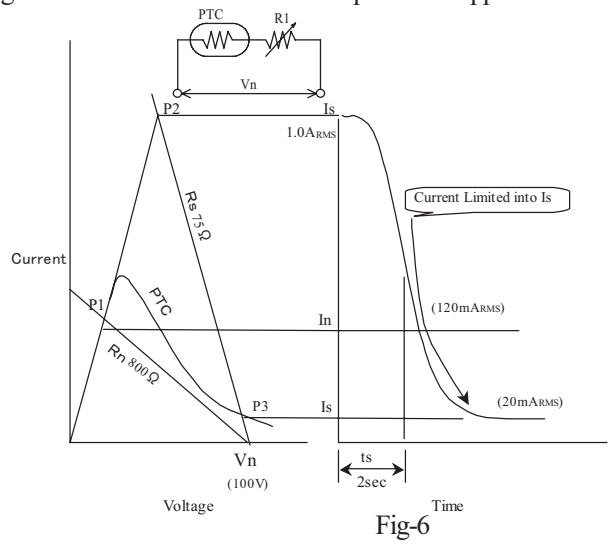
Vn : Rated V.
Va : Max.input V.
R1 : Load impeadance
P1・In : Normal state and current
P2・Is : Over voltage state and current
P3・Is : Stabilized state and current
ts : Attenuation time

Fig-5

When excess Voltage Va is applied, excess current (Ia) to refer to point P_2 flows, then joule heat limit the current into Is.

(2)-2 Overcurrent protection

The electric circuit will be protected from over current due to short circuit and irregular operation.
Fig-6 shows the operating states of a PTC in an over current protection/application.



Vn : Rated V.
Rn : Normal Load
Rs : Abnormal Load
P1・In : Normal state and current
P2・Is : Over Loading state and current
P3・Is : Stabilized state and current
ts : Attenuation time

Fig-6

In case of short circuit, overcurrent refer to P_2 flows to increase the PTC resistance to transfer to P_3 Then current is limited to lower Is level.

(3) Degaussing and Motor starter

PTC thermistor functions likes non-contact rush current limiting switch. By means of this characteristics, rush current applications like motor starting or CRT degaussing are utilized.

(4) Temperature sensor

If the operating of a transformer or motor over heated, the PTC senses the abnormal temperature and abruptly decreases the current, thus protecting the unit from burning or mechanical damage. Figure 7 shows the operating states of a PTC in a temperature sensor application. A relatively large current flows through the PTC at the initial start-up.

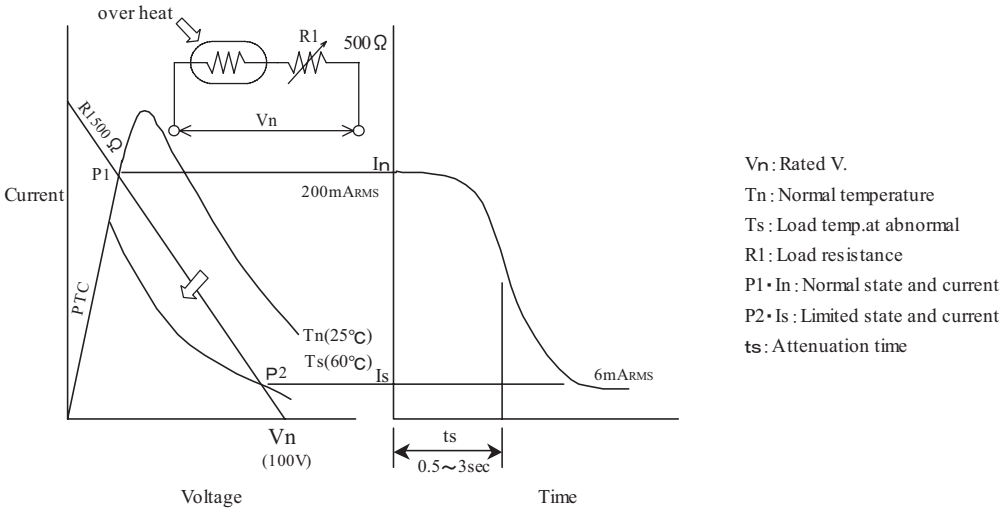


Fig-7

At the normal temperature PTC is stabilized at the point (P_1) with normal current (In), in case of abnormal temperature, characteristics move to the arrow direction to be stabilized at the point of (P_2) to limit into the small current (Is)

(5) Isothermal heater

PTC's Current limiting and voltage stabilizing characteristics as a heating element are utilized as a simple temperature controlled heaters for wide variety of applications.