POWER THERMISTOR

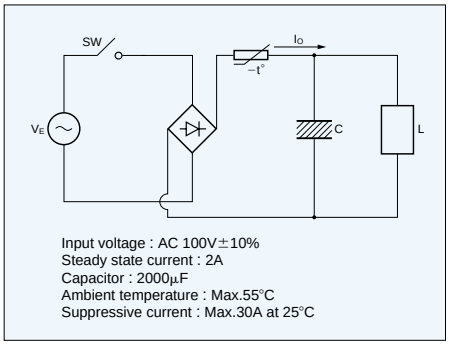
The POWER THERMISTOR is a device for suppressing inrush current to an electric circuit. Circuits including electric bulbs or capacitors induce a inrush current more than 100 times the normal current when the circuit switch is turned on. The POWER THERMISTOR in the circuits protects electric equipments from being damaged by limiting the inrush current.

MARK Ⅱ is a NEW POWER THERMISTOR featuring smaller size and larger energy capacity to meet severe requirements in inrush current suppression.
There is the tendency of miniaturization in low power switching power supply, and MARK Ⅱ is effectively applicable for the needs, though the comparatively larger sized fixed resistors (ceramic coat) are used now.

Application

The power thermistor will suppress inrush current which is caused by a capacitor, filament for a bulb, inverter for fluorescent lamp, a heater and etc., also will control fan motor speed of cooler for electric circuit.
Especially MARKⅡ was developed to use for power supply of TV, VCR instead of cement resistor.

How to use the power thermistor



Input voltage : AC 100V±10%
Steady state current : 2A
Capacitor : 2000μF
Ambient temperature : Max.55°C
Suppressive current : Max.30A at 25°C

The most suitable power thermistor for the above circuit is required to fulfill the following terms and conditions.

1. The permissible current at ambient temperature of 55°C should be over 2A.
2. The thermistor resistance for suppressive current which becomes below 30A should be over 4.2 ohm from the under-mentioned formula.

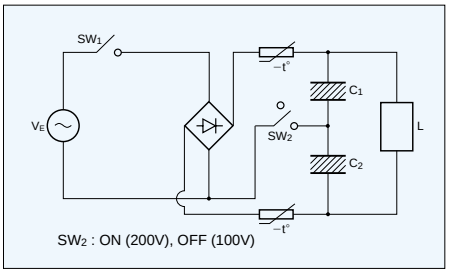
$$\frac{\sqrt{2}\,V_E \times 1.1}{R_C + R_{25}} \leqq 30$$

R_C : Internal resistance value in the circuit is 1 ohm (100V/100A)
R_{25} : Rated zero-power resistance at 25°C

3. Max. capacitance shall be over 2000μF at AC 100V.

Accordingly, suitable thermistors are 6D-22, 5D-18 and 8D-18, and if we consider in the points of small time constant which means a small size and large effect for suppressive current which means large rated zero-power resistance, 8D-18 is the most suitable one.

Use the following circuit in the power supply for 100V and 200V.



SW_2 : ON (200V), OFF (100V)

Thermal time constant

If ambient temperature of a thermistor is changed to T_1 from T_2 suddenly, temperature of the thermistor changes slowly.
The time constant means the time when temperature of the thermistor reaches 63% of the temperature difference.

Residual resistance

If current is flowed through a thermistor, any heat will be generated in the thermistor by which its resistance will be decreased, however, a decrease of a resistance will be stabilized at a saturation resistance value which is determined by impressed electric power and a dissipation constant. The residual resistance value means maximum saturation resistance value when the maximum permissible current is flowed through the thermistor.

Temperature coefficient

The temperature coefficient of a thermistor is expressed by the following equation ;

$$-\frac{B}{T_2}\ (\%/^\circ C)$$

Dissipation factor

If small voltage is applied to a thermistor, small current will flow which produce enough heat in the thermistor. Dissipation factor is electric power which make 1°C raise by heat in a thermistor.

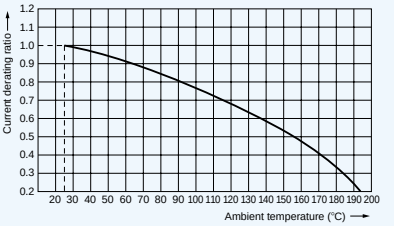
$$\delta = \frac{P}{\Delta t}\ (mW/^\circ C)$$

P is applied electric power.
Δt is rised temperature of the thermistor.

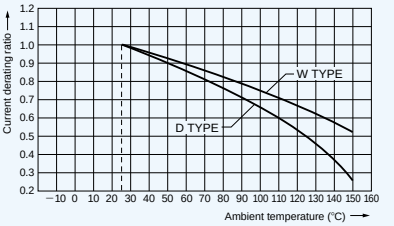
Maximum permissible current

If the maximum permissible current flows to a thermistor at 25°C, temperature of the thermistor rises to 200°C, (160°C). When ambient temperature is above 25°C, the maximum permissible current shall be over reduced as the maximum permissible current reduction curve.

New Power Thermistor MARKⅡ



Power Thermistor



Reliability tests

MARKⅡ

Dry heat test

Test sample is exposed in air at 200°C for 1,000 hours. ΔR25/R25≦±20%

Damp heat test

Test sample is exposed in atmosphere of 95%RH at 40°C for 1,000 hours. ΔR25/R25≦±10%

Load test

Test sample is applied the maximum rating current in air at 25°C for 1,000 hours. ΔR25/R25≦±20%

Change of temperature

Test sample is given 10 times of the following temperature cycle,
→ −40°C for 30 minutes → room temperature for 5 minutes →
→ 200°C for 30 minutes → room temperature for 5 minutes.
ΔR25/R25≦±10%

POWER THERMISTOR

Dry heat test

Test sample is exposed in air at 160°C for 1,000 hours. ΔR25/R25≦±10%

Damp heat test

Test sample is exposed in atmosphere of 95%RH at 40°C for 1,000 hours. ΔR25/R25≦±10%

Load test

Test sample is applied the maximum rating current in air at 25°C for 1,000 hours. ΔR25/R25≦±10%

Change of temperature

Test sample is given 10 times of the following temperature cycle,
→ −30°C for 30 minutes → room temperature for 5 minutes →
→ 160°C for 30 minutes → room temperature for 5 minutes.
ΔR25/R25≦±10%

Resistance-temperature characteristics

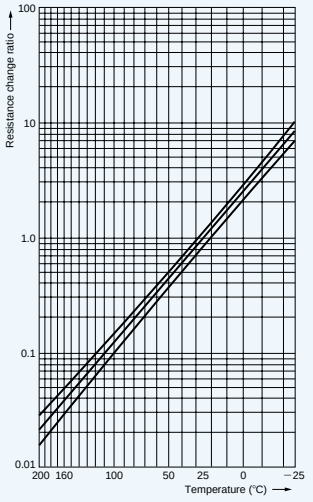
The theoretical characteristics of a thermistor is expressed by following equation.

$$R_1 = R_2 \exp\left\{B\left(\frac{1}{T_1} - \frac{1}{T_2}\right)\right\}$$

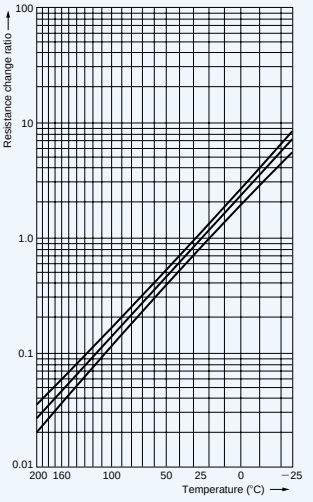
R_1 is the zero-power resistance at absolute temperature T_1
R_2 is the zero-power resistance at absolute temperature T_2

B is constant which depends on the material used to make the thermistor. Unless otherwise specified, all values of B are determined from measurements made at 25°C and 85°C.

MARK Ⅱ B : 3150K



MARK Ⅱ B : 2900K



Power Thermistor B : 3250K