PPTC THERMISTOR "Resettable Fuse"

The physics of polymeric PTC

The PPTC Thermistor device is mainly composed of specially treated Polymer and Conductive particles. Under normal operation, Polymer closely confines the conductive particle inside crystalline structure, produce a low resistant chain. Because the resistant is low, therefore current pass through the PPTC thermistor device produce very small heat energy and will not change the Polymer's crystalline structure. However, when surge current accurse, the heat on the conductive material will change the crystalline structure of the Polymer into amorphous state. Under this condition, the conductive material encased in the Polymer will separate; increase the resistant immediately, therefore blocks the irregular current to pass through the PPTC thermistor device. Once the irregular element dissipates, the conductive chain will reconstruct itself and return to low resistant mode.

Installation Method

The PPTC Thermistor device is used in series circuit. It can be used on both AC and DC current, no positive or negative polarity. Installation mode can also be Radial-leaded type or surface-mounted type. When the PPTC Thermistor device is used in series with other overvoltage protection device like Zener Diode, the device can stop higher current continuously flow into overvoltage protection device, prevent damage. Therefore, the PPTC Thermistor device can not only protect overvoltage protection device, it enables the possibility to choose smaller voltage clamp component, reduce cost and space.

Principles of operation– PTC effect

PPTC Thermistor device is a Polymer based PTC. The basis for its action is an energy balancing act. When current pass through the PPTC Thermistor device, due to the I^2R relation, heat will be produced, and the produced heat will all or partially dissipate into the environment, the excess heat then will increase the device's temperature.

In Figure 1, at Point 1 the temperature is low. The heat produce and dissipate ratio are balanced. But when current pass through the device increases or the environment's temperature increases, the device will produce more heat and therefore raise the temperature of the PPTC Thermistor device. However, if the current or environment temperature changes are not significant, the heat produced by the device can dissipate into the environment and reach a balance at Point 2. When current or environmental temperature increases again, the device will reach a higher balanced temperature as Point 3 in the image. If the current or environmental temperature keeps increasing, the heat produced will be larger than the heat dissipated, therefore increase the temperature of the device dramatically. In this period, even the slightest temperature change will let the resistance rise exponentially. This phenomenon can be seen from the Point 3 and 4. At this time, the PPTC Thermistor device is in the tripped state, the increased resistance blocks the flow of the current; therefore protect the equipment from damage.

When the PPTC Thermistor device is in tripped state, as long as the applied voltage is high enough for the power to supply the loss, the device will remain in the tripped state at Point 4, the heat reach a balanced point, When the voltage is decreased to the point, the device will reset.

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Thermal Derating (Temperature effect for PPTC Thermistor device)

Once the environmental temperature increases more than 20°C, it will cause the PPTC Thermistor device current flow to decrease. As shown in line I_H in Figure2, when environmental temperature reached 85°C, the current pass through reduced to half. When environmental temperature at 20°C; 100% of the current can pass through the PPTC Thermistor device. However, if the flow of current is higher than double the rating current, the device will trip shown as line I_T. I_H and I_T both decrease as the temperature goes up.

Trip Time and Temperature Relation

The PPTC Thermistor trip speed is related to surge current, type of devices and environmental temperature has definite relationship. The higher temperature and the larger current result in faster of trip time of the PPTC Thermistor device. See Figure 3.

Reset Time Characteristic

After a trip event, once the surge current disappears, the temperature of the device will drop within few seconds, and therefore the resistance recovery to a quasistable value rapidly. See Figure 4.

Figure 1

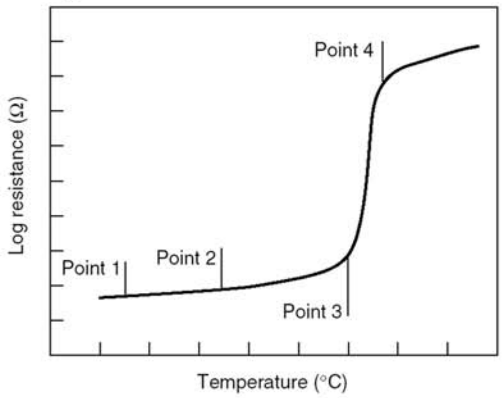


Figure 2

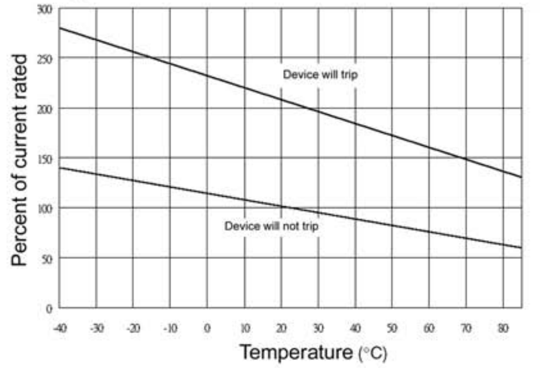


Figure 3

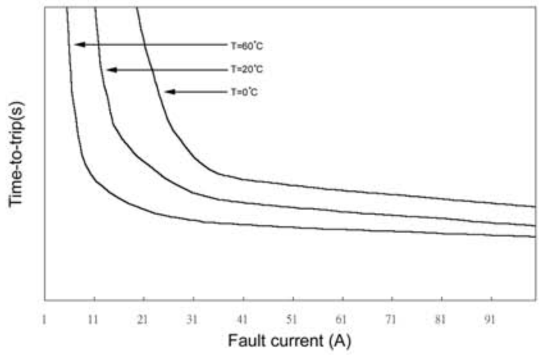
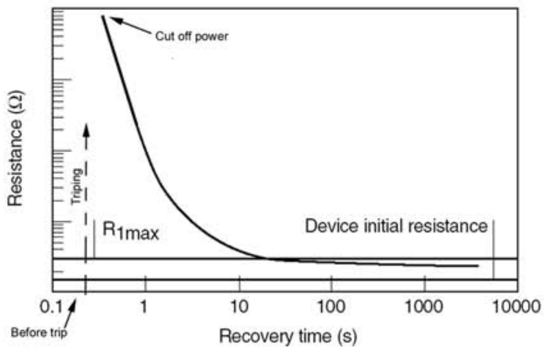
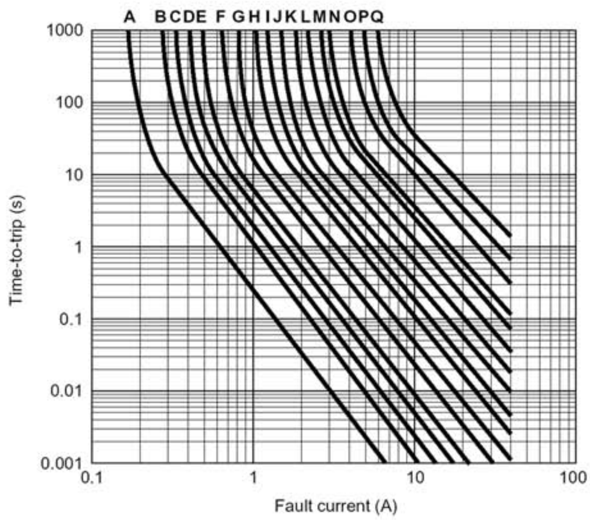


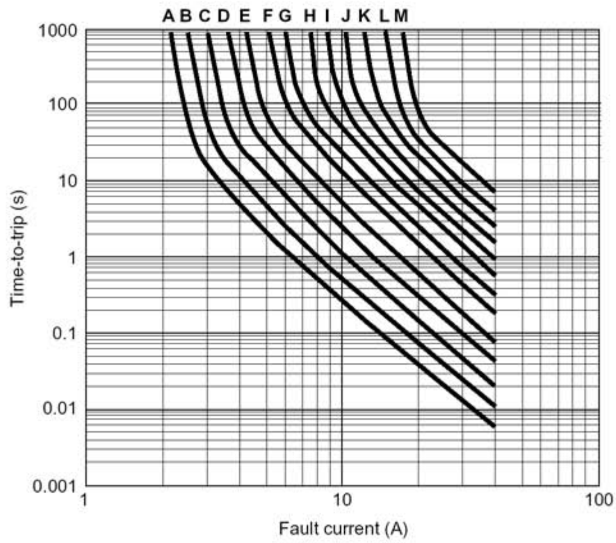
Figure 4



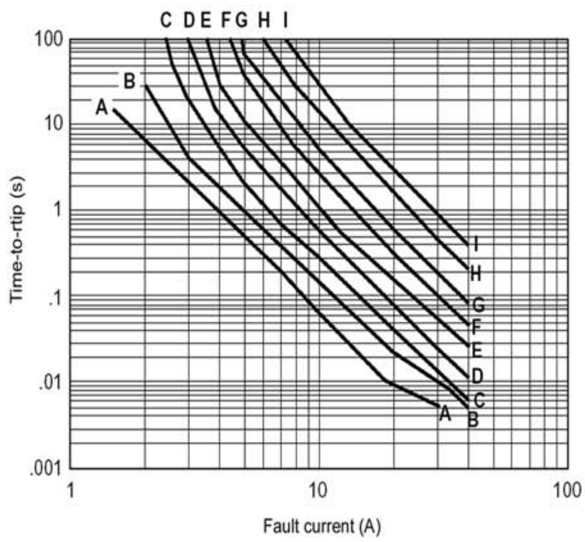
Typical Time-to-trip curves



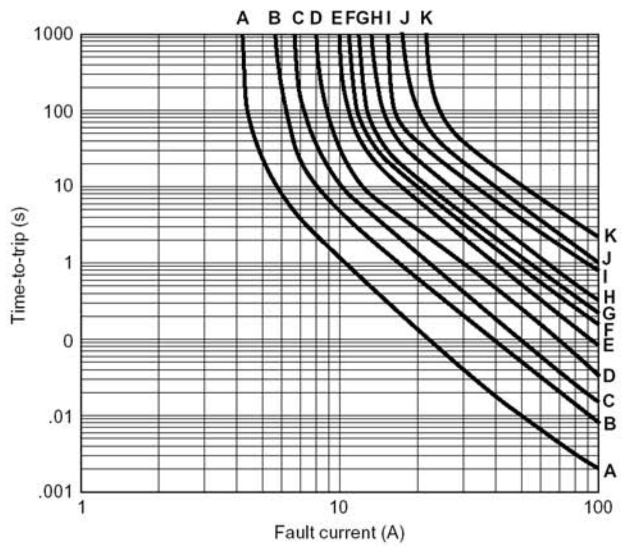
A=RF-RM010 B=RF-RM017 C=RF-RM020
D=RF-RM025 E=RF-RM030 F=RF-RM040
G=RF-RM050 H=RF-RM065 I=RF-RM075
J=RF-RM090 K=RF-RM110 L=RF-RM135
M=RF-RM160 N=RF-RM185 O=RF-RM250
P=RF-RM300 Q=RF-RM350



A=RF-RL090 B=RF-RL110 C=RF-RL135
D=RF-RL160 E=RF-RL185 F=RF-RL250
G=RF-RL300 H=RF-RL400 I=RF-RL500
J=RF-RL600 K=RF-RL700 L=RF-RL800
M=RF-RL900



A=RF-RB075 B=RF-RB090 C=RF-RB110
D=RF-RB120 E=RF-RB135 F=RF-RB155
G=RF-RB160 H=RF-RB185 I=RF-RB250



A=RF-RG300 B=RF-RG400 C=RF-RG500
D=RF-RG600 E=RF-RG700 F=RF-RG800
G=RF-RG900 H=RF-RG1000 I=RF-RG1100
J=RF-RG1200 K=RF-RG1400

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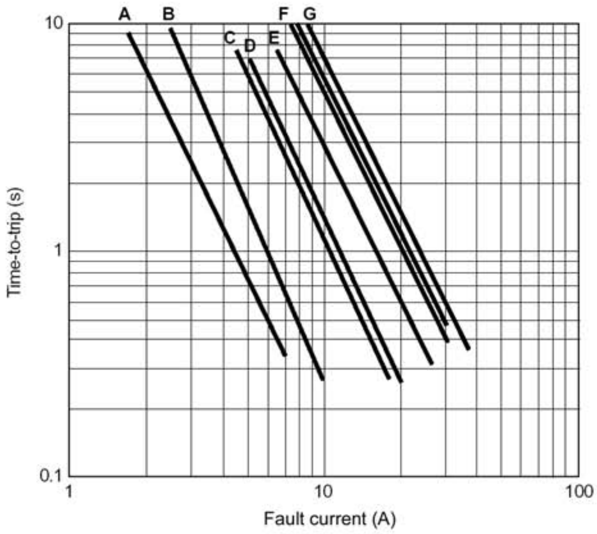
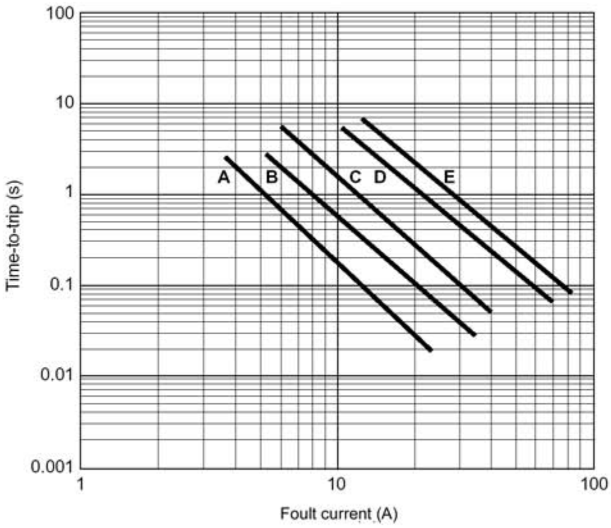
Typical Time-to-trip curves



A=HLT070 B=HLT100 C=HLT180
D=HLT190 E=HLT260 F=HLT300
G=HLT340



A=HSR120 B=HSR175 C=HSR200
D=HSR350 E=HSR420

Difinations

V max. = Maximum voltage the device can withstand without damage at rated current.
I max. = Maximum fault current the device can withstand without damage at rated voltage.
I_H = Hold current-maximum current at which the device will not trip at 20• •still air.
I_T = Trip current-minimum current at which the device will always trip at 20• •still air.
R min. = Minimum device resistance at 20• •prior to tripping.
R max. = Maximum device resistance at 20• •prior to tripping.
R_1 max. = Maximum device resistance at 20• •measured 1 hour post trip.
P_d= Typical power dissipation-Typical amount of power dissipated by the device when in tripped state in 20• •still air environment.

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Do you need more information ?

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