# Polymer PTC Resettable Fuse: Introduction

## What is the Polymer PTC Resettable Fuse devices

The Polymeric Positive Temperature Coefficient (PPTC,also know as resettable fuse) device is a non-linear thermistor that limits current in electrical circuits, showing the non-linear PTC effect, made from a composite of polymer and conductive particles, rather than ceramics. At normal working conditions, the device shows low resistance as compared to the reminder of the circuit, and has little or no influence on the performance of the circuit. Under a fault condition, the resistance of the Polymer PTC Resettable Fuse device goes into a high resistance state, being called “tripping” the device. After the fault condition being eliminated, the Polymer PTC Resettable Fuse device allows the circuit to return to the normal operating condition.

## How does a Polymer PTC Resettable Fuse device work

At normal working conditions, such as rated current and ambient temperature, the conductive particles form low-resistance networks in the polymer (as showed in figure 1). However, as a fault event occurs, such as over-current through the device or an increase in the ambient temperature causing the device's temperature over its switching temperature, the crystallite in the polymer melt and become amorphous. The increase in volume during melting of the crystalline phase causes the conductive particles being separated by the polymer, and reduces the conductive path networks, resulting in a large non-linear increase in the resistance of the device (as showed in figure 2).

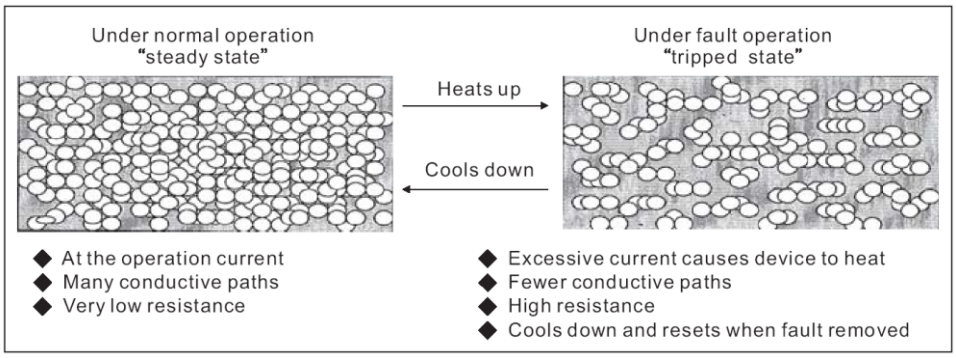



Figure 1

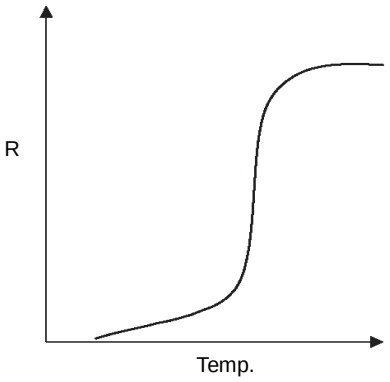
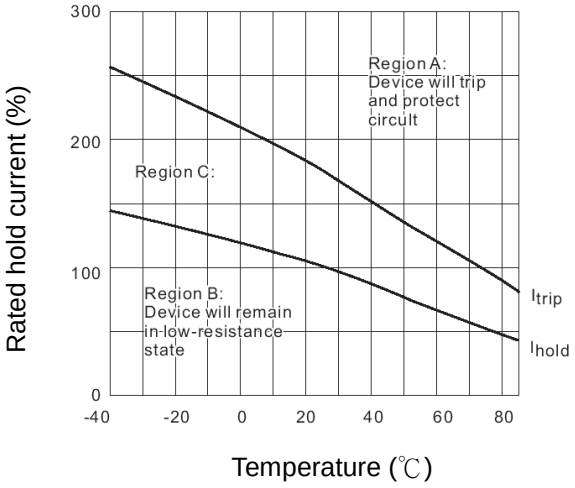



Figure 2

## Thermal derating

- Since the Polymer PTC Resettable Fuse is thermally activated, any fluctuation in ambient temperature will impact the performance of the device.
- Region A describes the current and temperature at which the Polymer PTC Resettable Fuse will trip (go into the high-resistance state) and protect the circuit. Region B describes the current and temperature at which the Polymer PTC Resettable Fuse device will allow for normal operation of the circuit. In Region C, it is possible for the device to either trip or remains in the low-resistance state (depending on device’s resistance and ambient temperature).

Figure 3



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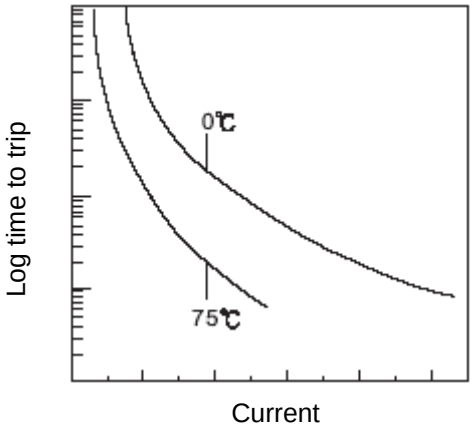
## ■ Trip time

- Figure 4 shows a trip time curves for a Polymer PTC Resettable Fuse at 0°C and 75°C. At 75°C, the heat input from the environment is substantially greater than it is at 0°C, so the additional $I^2R$ needed to trip the device is correspondingly less, resulting in a lower trip current at a given trip time (or a faster trip at given trip current).

- The larger over-current or ambient temperature, the less trip time.

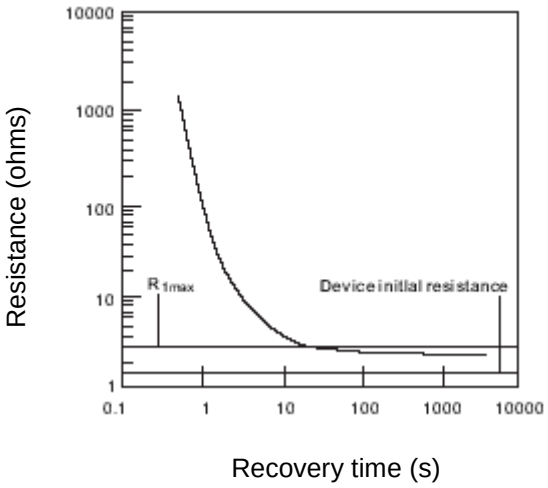
Figure 4




## ■ Reset

Figure 5 shows typical behavior of a Polymer PTC Resettable Fuse device that is tripped and then allowed to cool down. The device resistance is greater than the initial resistance after several trips. Over an extended period of time, device resistance will continue to fall and will eventually approach initial resistance. Therefore, R1MAX should be taken into consideration when determining hold current. R1MAX is the resistance of the device after one hour it had been tripped.

Figure 5




## ■ Related components comparison

| Item | Polymer PTC Resettable Fuse (PPTC) | Ceramic PTC (CPTC) | Bi-metal | Fuse |
|---|---|---|---|---|
| **Resettable** | Yes | Yes | Yes | No |
| **Size** | Small | Medium | Large | Variable |
| **Warranty cost** | Low | Low | High | High |
| **Power loss** | Low | High | Low | Low |
| **Resistance** | Low | High | Low | Low |
| **Response** | Slow | Slow | Fast | Very fast/fast |