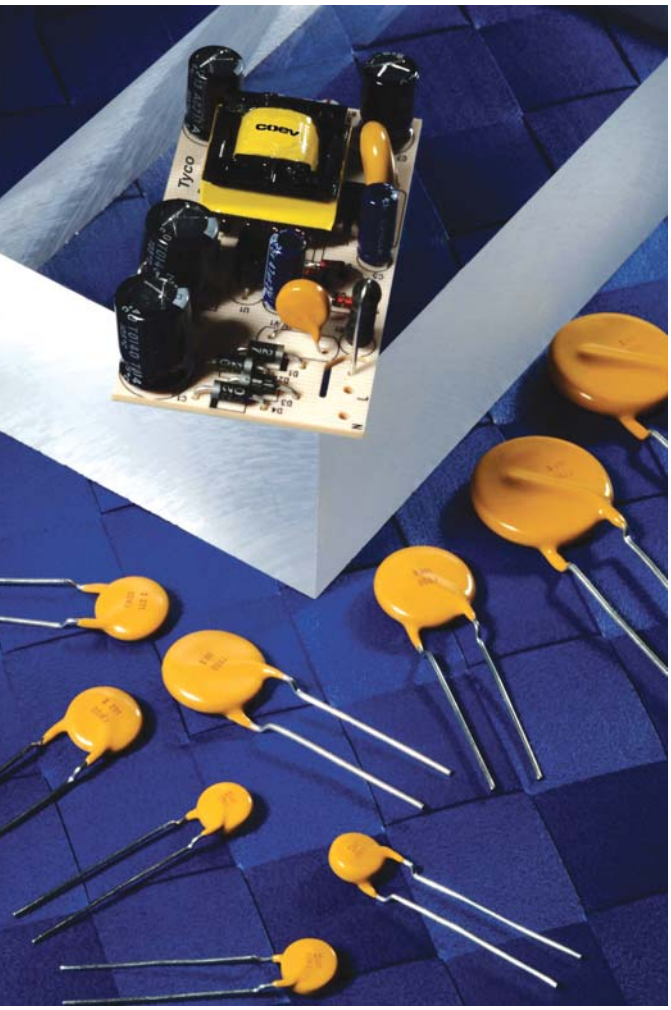
PolyFuse
A New Standard For Circuit Protection



Radial-leaded metal-oxide varistor devices from Raychem can be combined with PolySwitch devices to help provide protection for electric motors, telecom equipment and various other systems

Fuses work between life and death of a circuitry. Choosing the right fuse is important for prolonged protection of the circuitry from over-current and voltage spikes. Conventional fuse is either 'ok' or 'blown,' but PolyFuse is a resettable fuse by itself

T.A. BABU

A fuse is a one-time over-current protection device employing a fusible link that melts (blows) after the current exceeds a certain level for a certain length of time. Typically, a wire or chemical compound breaks the circuit when the current exceeds the rated value.

PolyFuse is a resettable fuse that doesn't need to be replaced like the conventional fuse. Many manufacturers also call it PolySwitch or MultiFuse. (PolySwitch and MultiFuse are registered trademarks of Raychem Corp. and Bourns Inc., respectively.)

Resettable fuses provide over-current protection and automatic restoration. Usually packaged in radial, axial, surface-mount, chip, disk or washer form, these are available in voltage ratings of 30 to 250 volts and current ratings of 20 mA to 100 amps.

The basics

Technically, PolyFuses are not fuses but polymeric positive-temperature coefficient thermistors. For thermistors characterised as positive temperature coefficient, the device resistance increases with temperature. These comprise thin sheets of conductive plastic with electrodes attached to either side.

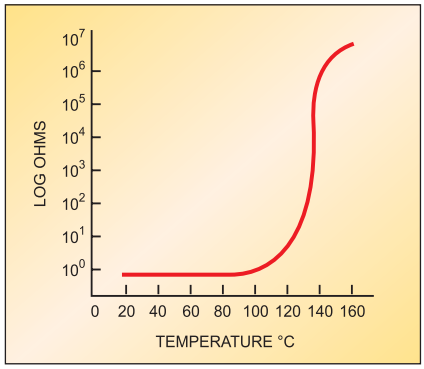


Fig. 1: Effects of ambient temperature on the resistance of a PolyFuse

The conductive plastic is basically a non-conductive crystalline polymer loaded with a highly conductive carbon to make it conductive. The electrodes

Edge Over Conventional Fuses

1. Over-current protection
2. Low base resistance
3. Latching (non-cycling) operation
4. Automatic resettability
5. Short time to trip
6. No arcing during faulty situations
7. Small dimensions and compact design
8. Internationally standardised and approved
9. No accidental hot plugging
10. Withstand mechanical shocks and vibrations and comply with the safety norms
11. Lifetime up to ten times longer

Bourns 600V PPTC resettable MultiFuse

ensure even distribution of power throughout the device.

Operation. At room temperature, numerous carbon chains form conductive paths through the plastic material. In case an excessive current flows through the device, the temperature of the conductive plastic material rises. When the temperature exceeds its phase-transformation temperature, the crystalline structure suddenly changes into an expanded amorphous state. Now the conductive particles move apart from each other. A dramatic increase in resistance stops the flow of current through the device. The critical current level at which this happens is known as the trip current. However, a negligible leakage current continues to flow. The device remains latched until the fault is cleared, providing continuous protection.

Once the applied voltage disappears, the polymer particles rapidly return to their original structure. The resistance drops again and automatically resets within a few seconds. Thus a PolyFuse acts like a self-resetting solidstate circuit breaker, which makes it suitable for providing low-cost overcurrent protection.

The resistance of PolyFuse (expressed on log scale) at room temperature is a few ohms and rapidly increases above 110°C.

Operating Parameters for PolyFuses

1. ***Initial resistance.*** The resistance of the device as received from the factory
2. ***Operating voltage.*** The maximum voltage a device can withstand without damage at the rated current
3. ***Holding current.*** Safe current through the device
4. ***Trip current.*** Where the device interrupts the current
5. ***Time to trip.*** The time it takes for the device to trip at a given temperature and current
6. ***Tripped state.*** Transition from the low-resistance state to the high-resistance state due to an overload
7. ***Leakage current.*** A small value of stray current flowing through the device after it has switched to high-resistance mode
8. ***Trip cycle.*** The number of trip cycles (at rated voltage and current) the device sustains without failure
9. ***Trip endurance.*** The duration of time the device sustains its maximum rated voltage in the tripped state without failure
10. ***Power dissipation.*** Power dissipated by the device in its tripped state
11. ***Thermal duration.*** Influence of ambient temperature
12. ***Hysteresis.*** The period between the actual beginning of the signaling of the device to trip and the actual tripping of the device

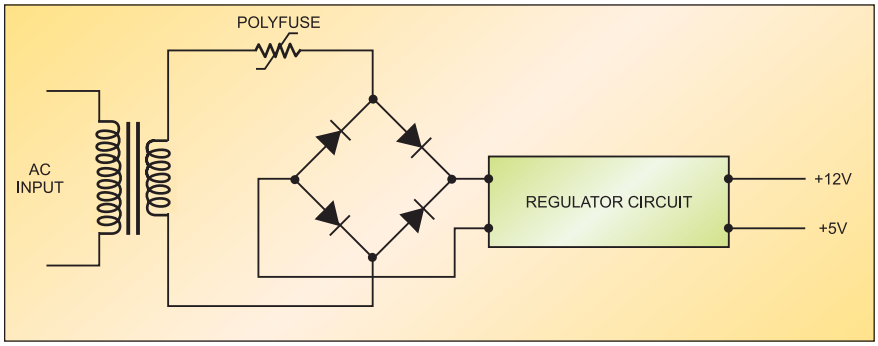


Fig. 2: Transformer protection by PolyFuse

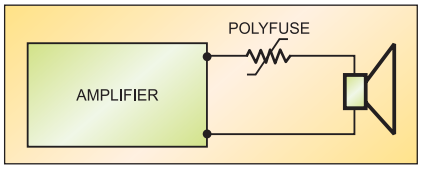


Fig. 3: Speaker protection by PolyFuse

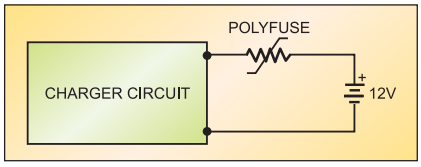


Fig. 4: Battery protection by PolyFuse

Applications

PolyFuses are used in automobiles, batteries, computers and peripherals, industrial controls, consumer electronics, medical electronics, lighting, security and fire alarm systems, telecommunication equipment and a host of other applications where circuit protection is required.

Figs 2, 3 and 4 show the use of a PolyFuse for transformer, speaker and battery protection, respectively.

The equipment powered by a transformer get overheated due to excessive current or short-circuit. A PolyFuse on the secondary side of the transformer will protect the equipment against overload.

Nowadays speakers are designed and sold independently of amplifiers. Therefore, there are possibilities of damage due to mismatches; for example, high-power amplifiers coupled with low-power speakers or a speaker coil driven with a high volume. The protection choices for loudspeaker systems are limited. Fuses protect the speaker, but a blown fuse is always a source of frustration.

Using a PolyFuse in series with the speaker will protect it from over-current/over-heating damage. Choosing a correct trip-current rated PolyFuse is important to match the power level of the speaker. However, a PolyFuse cannot protect against mechanical overload due to inadequate cabinet design.

Batteries are constantly charged and discharged over their life-cycle. Over-charge results in an increase in the temperature of the electrolyte. This could cause either a fire or an explosion. PolyFuse can play a vital role in the charging and discharging cycles of batteries.

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