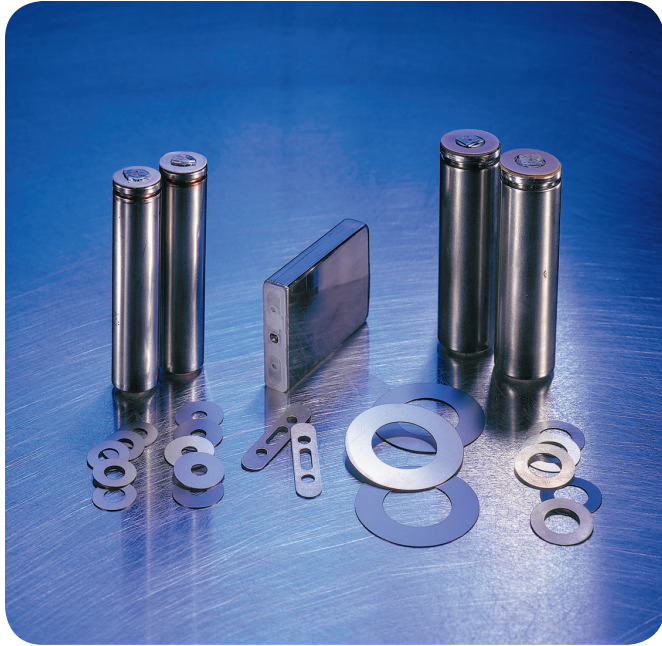


Circuit Protection Solution for Lithium Cells



Primary lithium cells (i.e., AA and 2/3A) and rechargeable lithium cells (i.e., 18650, 17500, and prismatic) are used in many portable electronics applications, such as laptop or notebook computers. Their popularity is based on the fact that they offer high energy density, high capacity and long cycle life, with no memory effect.

Lithium cells are sensitive to faults caused by overcurrent and overtemperature conditions that may result from accidental shorting of the cell terminals and, in the case of rechargeable lithium cells, abusive charging or charger failure. For this reason, lithium cells generally require individual protection.

Their unique electrical characteristics and thin, flat form factor have made PolySwitch PPTC (Polymeric Positive Temperature Coefficient) annular disc devices the circuit protection device of choice in a wide range of lithium cell applications.

Typical Protection Requirements

Lithium cells typically require a protection device with a rating of 15V and 40A minimum. Primary and rechargeable lithium cell protection is covered under the UL1642 Standard for lithium batteries and the UL2054 standard for household and commercial batteries.

Technology Comparison and Design Considerations

The industry standard for protecting individual lithium cylindrical cells from overcurrent conditions is the PPTC device, in the form of an annular disc located inside the lid assembly of each cell. The PPTC device works in conjunction with other safety devices, such as separators and pressure vents. Because the design of top cap assemblies in lithium cells varies from manufacturer to manufacturer, PolySwitch annular disc devices are usually customized for each application.

PPTC circuit protection devices are made from a conductive polymer blend of specially formulated plastics and conductive

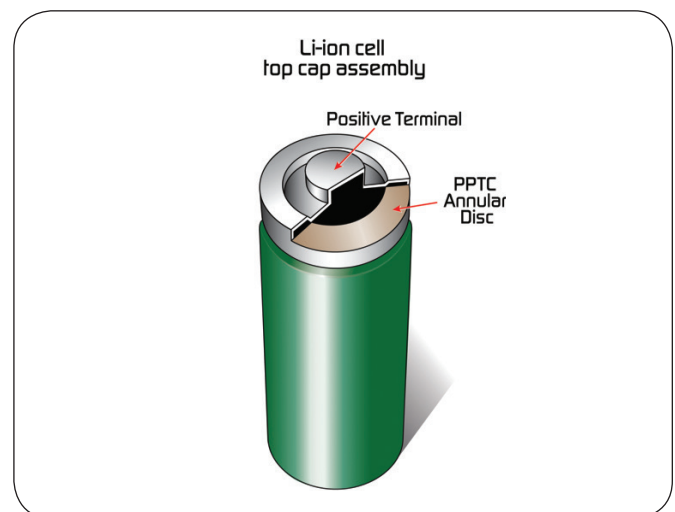


Figure 1. PPTC annular disc devices work in conjunction with other safety devices.

particles that are sandwiched between metal foils. At normal temperature, the conductive particles form low-resistance chains in the polymer. However, if the temperature rises above the device's switching temperature, the crystallites in the polymer melt and become amorphous. The increase in volume during the crystalline melting phase causes separation of the conductive particles and results in a non-linear increase in the resistance of the device. The heating can take place due to an increase in ambient or cell temperature, or can be generated by resistive heating, as in the case of an overcurrent condition.

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PolySwitch PPTC annular disc devices latch into a high-resistance state when a fault occurs. Once the fault is removed and power is cycled, the device automatically resets and the battery is restored to normal operating conditions.

Device Selection

The dimensions of the annular disc device are typically determined by the cell manufacturer and are based on how the device fits inside the cap assembly. As shown in Figure 2, the key measurements include: outside diameter (A), inside diameter (B) and thickness (C).

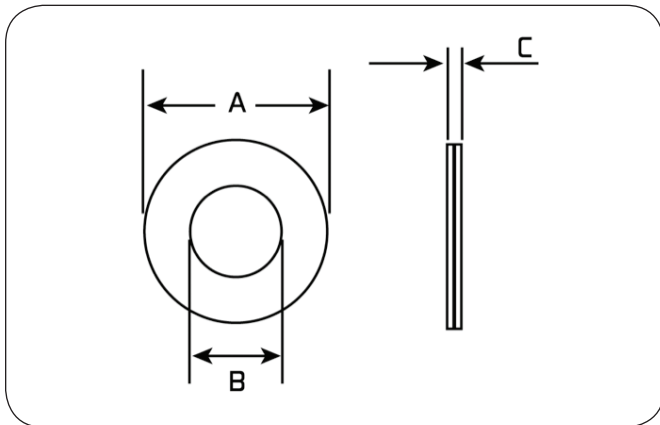


Figure 2. PPTC key measurements inside a cap assembly include (A) outside diameter, (B) inside diameter, and (C) thickness.

The PPTC material selection is based on the performance characteristics required (e.g., resistance, switch temperature, hold- and trip-current). The hold current, trip current, and time-to-trip parameters should be measured after the device is installed in the cell.

Most disc devices are installed into the cell through a crimping process that must be well controlled. Placing excessive pressure on the disc during crimping may result in the device failing to trip during an overcurrent event. Additionally, precautions should be taken to prevent solvent contact with the disc, as such contact can corrode the foil or cause the PPTC polymer to swell.

PolySwitch annular discs are custom designed according to each lithium cell manufacturer's individual requirements. Please contact Littelfuse for additional information about the PolySwitch circuit protection products.

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