POLY-FUSE® and PolySwitch® SMD PPTC Application

PURPOSE: This document leverages Littelfuse manufacturing experience and technical expertise in the correct use of Resettable Surface Mount Polymeric Positive Temperature Coefficient (PPTC) for optimal performance, longevity, and safety. Use this application quick reference guide to properly integrate PPTCs in your Printed Circuit Board (PCB) designs.

PPTC Theory

There are two main types of PPTC applications:

1. Safety regulation (USB port, power supply, battery, motor control, etc.) and
2. Risk prevention (e.g. I/O port).

For other types of applications, please contact Littelfuse Sales Technical Support for consultation or joint development.

During certain abnormal conditions such as overcurrent, overload, and overtemperature, PPTC resistance will increase. This limits the power supply in order to protect circuit components. Customers need to eliminate these conditions immediately after PPTC activation because the PPTC cannot act as a protective device if these conditions happen more than once or occur for an extended period of time.

SMD PTC Soldering Methods

Littelfuse recommends an industrial one-time lead-free reflow soldering process when using PPTC. For reference, R1max refers to the maximum resistance of a device at 20˚ C, measured one hour after tripping or a one-time reflow soldering per our datasheet recommended profile.

Multiple Soldering Risks

Since PPTC is very sensitive to high temperatures, you run the risk of damage when soldering the same unit multiple times. When customers do the Printed Circuit Board Assembly (PCBA) process, multiple Dual In-line Package (DIP)/Surface Mount Device (SMD) components are on the same PCB. When using two reflow soldering and one wave soldering, it is recommended to place PPTC components and DIP components on the same side of the PCB board, and only apply the PPTC on the second reflow soldering process. Avoid exposing PPTCs to multiple high-temperature soldering processes.

In special applications, customers will use PPTC in a variety of different high-temperature processes. Design of Experiments (DOEs) are required to ensure that the characteristics of the PPTC components will still be able to meet the customer's needs after undergoing these processes.

Solder Pad Layout Design

Solder pad design should include the through-hole (semicircle) area, which can help to ensure the electrical connection and keep the PTC properly latched during soldering (after solder climbing). The Automated Optical Inspection (AOI)/Charge-Coupled Device (CCD) of the Surface-Mount Technology (SMT) machine can determine the solderability quality through the hole solder climbing status.

Coating Material or Clean Solvent Risk to PPTC

For PPTC operations, it is not recommended to use any coating material that contains silicon-based oils, solvents, electrolytes, acids, or any other materials with similar permeability. Customers should assess the application risk by themselves or contact the Littelfuse sales technical team before applying a coating material.

PPTC Circuit Operating Parameters

- Normal operation current (Ihold)
- Maximum circuit voltage (Vmax)
- Maximum interrupt current (Imax)
- Normal operating temperature surrounding device (Thermal derating effect, min ˚C/max ˚C)

Other Items Critical to PPTC Type Selection

When selecting a type of PPTC, the maximum voltage of the circuit cannot exceed the PPTC Vmax specification.

On the Ihold circuit, for the maximum normal operating current, it is best to leave a 10–20% margin of error.

Selecting a PPTC type should be based on the thermal derating compensation of the customer's ambient temperature.

For additional information, please reference:

- POLY-FUSE® PTC Selection Guide
- PolySwitch® Device Selection Guide
- Product Catalog and Design Guide (PTC)

If you experience any application issues not addressed in these documents, you can contact Littelfuse Global Support directly for help and technical guidance.

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