

## Recommendations for Soldering Terminal Leads to MOV Varistor Discs

### Introduction

The CA and NA series of MOV varistor discs with silver electrodes are specifically designed for custom assembly and packaging. To take advantage of the excellent performance and reliability of Littelfuse varistor technology, it is important that the correct materials and processes be used when soldering terminal leads to the disc.

### Solder Fixtures

Where varistor discs are custom assembled and packaged, fixturing is normally employed to maintain disc and terminal alignment during solder reflow. Soldering fixtures should be of lightweight design to reduce their thermal mass and, hence, the time necessary to bring them to reflow temperature.

Disc and terminal lead should be pressed together lightly during the whole soldering process to help expel flux residues and excess solder from the interface. Trapped flux residue can result in bubbling of the solder, which leaves voids between silver electrode and terminal. Excess solder will enhance the tendency of the silver electrode to leach.

### Soldering Ovens

Box, convection, and conveyor belt ovens are suitable for reflow solder processes using fixtures. Box ovens should have forced air circulation with sufficient ventilation to remove flux vapors. It is important that every fixture position in the oven be subjected to the same heating conditions. Therefore, fixture positions should be limited to locations within the oven where uniform air flow and temperature can be maintained.

Convection ovens employ carefully designed exit baffles to facilitate close control of the soldering environment. Air is the best environment for soldering varistors. An inert gas (nitrogen) or reducing atmosphere is sometimes employed to

reduce oxidation in these ovens, but neither of these is recommended for the processing of unpassivated varistors.

A very repeatable temperature profile can be achieved with a conveyor belt oven. The profile is determined by the temperature of the heated zone(s) and the speed of the belt. A fixed loading pattern also helps in achieving uniform results.

### Fluxes

Fluxes are used for chemical cleaning of disc and terminal surfaces. There are three basic types:

R - These unactivated fluxes are less effective than the others in reducing oxides of copper or palladium/silver metallizations, but are the ones recommended for MOV varistors. All other fluxes increase leakage, reduce long term reliability, and can promote leaching of the silver electrode. Non-charring, non-activated R type fluxes such as Alpha 100 or its equivalent are best.

RMA - These are mildly activated fluxes, and the most commonly used in the mounting of electronic components. They may be used with varistors, but are not recommended.

RA - These fully activated fluxes are corrosive, difficult to remove, and can lead to varistor failure. They must not be used to flux varistor discs.

### Solders and Solder Temperature

Solders in the form of pastes or preforms can be used with varistors. Preforms are solder shapes premanufactured to specific sizes. Upon melting, they provide highly reproducible volumes of solder for joining. Preforms can be prefluxed, eliminating the need for any additional fluxing.

Heat should not be applied to a varistor too quickly, as the flux will not have sufficient time to activate and clean the joining

surfaces. The result will be poor solderability. On the other hand, no varistor should be held longer than necessary at an elevated temperature. If heat is applied too slowly or maintained above reflow temperature for too long, leaching of the silver electrode into the solder will occur, reducing the disc to terminal bond strength. To avoid leaching, only solders with at least 2% silver content (e.g., 62Sn/36Pb/2Ag or equivalent) should be used; see Table 1.

It is equally important to observe processing time and temperature limits. Failure to do so can result in excessive leakage and alterations of the varistor's V-I characteristic.

### Cleaning and Cleaning Fluids

Cleaning is an important step in the soldering process. It prevents electrical faults such as the high current leakage caused by ionic contamination, absorbed organic material, dirt films, and resins.

A wide variety of cleaning processes can be applied to varistors, including water based, solvent based or a mixture of both, tailored to specific applications. Littelfuse recommends I.I.I trichloroethane for the removal of flux residues after soldering.

Defluxing in a solvent bath with ultrasonic agitation, followed by a solvent vapor wash, is a very effective cleaning process. After cleaning, the low boiling point solvent completely evaporates from the disc, and will not harm solder joints.

ALLOY	MELTING TEMPERATURE
62SN/36PB/2Ag	179°C
96.5SN/3.5Ag	221°C
96SN/5Ag	221°C - 245°C
10SN/88PB/2Ag	268°C - 302°C
5SN/92.5PB/2.5Ag	280°C
97.5PB/2.5Ag	305°C

Table 1. Silver Bearing Solders (Alpha Metals)

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