



## Fuse Clip Recommendations

Ensure optimal performance, longevity, and safety of fuse clips

This application guide provides recommendations for printed circuit board layout, proper soldering, and cleaning of fuse clips. Recommendations for a fuse clip's operating environment and storage environment and fuse insertion and extraction are also provided.

### Printed Circuit Board Layout

Designers should follow the recommended mounting dimensions for fuse clips. This information is documented in the fuse clip datasheets. Depending on the style of the fuse clip, its datasheet will define the mounting dimensions for fuse clips with straight leads, bowed leads, or rivets. Failure to follow these recommendations can lead to excessive fuse contact resistance and result in a fuse that opens or even melts due to excessive heat build-up in the fuse clip.

### Soldering Methods

Littelfuse recommends two methods for soldering its through-hole-technology fuse clips. The two methods are wave soldering and hand soldering. Using reflow soldering is not recommended. Contact Littelfuse for guidance before implementing a specific flow process.

For wave soldering, the recommended maximum temperature of the solder should be  $245 \pm 5^{\circ}\text{C}$ . When using lead-free solder, the maximum solder temperature can reach a maximum of  $260^{\circ}\text{C}$ . Ensure that the allowable maximum temperature is not exceeded for the solder that will be used. The standard wave soldering process includes the preheat ramp-up temperature phase, the peak temperature, soldering phase, and the cooling ramp-down phase. By keeping the solder temperature within the maximum recommended temperature and keeping the fuse clip in the solder wave for no longer than the recommended duration, the wave soldering process will avoid causing cosmetic changes to the fuse clip surface.

Tin- and silver-plated fuse clips can exhibit discoloration after soldering. Tin-plated fuse clips can exhibit a yellow discoloration. Tin has a melting temperature of  $231.89^{\circ}\text{C}$ . Exceeding this temperature or exceeding the recommended duration time in the solder wave will cause yellowing of the surface. Subjecting the fuse clips to extreme conditions can cause an "orange peel" effect. Silver-plated fuse clips can exhibit a yellow/black discoloration after soldering. Also, silver reacts easily with sulfur in the environment, and the silver-plated surface will turn yellow over time. This is a natural phenomenon, but the chemical reaction will not affect the form, fit, or function of the fuse clip.

As an alternative to wave soldering fuse clips, they can be manually hand soldered. Littelfuse recommends a maximum soldering iron temperature of  $350 \pm 5^{\circ}\text{C}$ . Solder should be applied for no longer than 5 seconds. The fuse clip can be hand soldered no more than three times.

### Cleaning

A water wash process is sufficient for removing excess flux from a fuse clip. Use of a corrosive solvent such as toluene or any solvent containing a sulfide is not recommended. Ultrasonic cleaning is also not a recommended cleaning method for plated fuse clips. Manufacturing and process engineers should contact Littelfuse for suggestions on proper cleaning of any Littelfuse product including fuse clips.

### Fuse Insertion and Extraction

Use of the correct fuse type and not using excessive force to insert or extract the fuse will avoid damage to the fuse and the fuse holder. Forcing a fuse to the bottom of the fuse clip will result in the deformation of the fuse clip.

## Operating Environment

Fuse clips can operate over a wide temperature range, typically, from -55°C to +125°C. The temperature range of the fuse clip should be no less than the operating temperature range of the fuse that will be used in the fuse clips. Unlike a fuse, fuse clips are not subject to a de-rating factor at temperatures outside of 23°C ( $\pm 5^\circ\text{C}$ ).

Fuse clips can operate without degradation in a 0 – 70% relative humidity range. Protect the electronics, including the fuse clips from environments containing sulfur, ammonia, sulfuric acid, nitric acid, and acetic acid. These environments will accelerate the aging of the fuse clips. Brass-plated clips, for example, can develop cracks from stress corrosion.

## Fuse Clip Application (Operating) Environment

Fuse clip operating temperature should match recommended fuse type, normally is around (-55°C to +125°C), the fuse clips (open holders) do not require a de/re-rating at different ambient temperatures, the de-rating will be driven by the fuse used. Customer can assess the operating temperature condition with consideration of fuse + clip combination.

Fuse clip operating humidity, normally 0 – 70% RH, customer should avoid operating environment such as atmosphere affected by sulfur, ammonia, sulfuric acid, nitric acid, steam and acetic acid citric acid aqueous solution, ammonia, those atmosphere with chemicals humidity will accelerate aging of the fuse clip especially for Brass clips with stress corrosion cracking natural symptom.

Customer can assess the operating temperature/environmental condition before selecting the proper fuse clip for application.

## Storage

Store fuse clips in a temperature range of 0 – 60°C and at a relative humidity in the range of 0 – 75%. If the fuse clips are silver-plated, use them soon after opening a package. Extended exposure to the environment can result in oxidation of the surface. The oxidation negatively impacts how well solder will flow onto the clip.