

Recommended Solder Profiles for Cree Inc. Power Products

by Stuart Hodge Jr.

Introduction

Proper soldering of electronic components requires a good process for controlling the heating and cooling of your assembled printed wiring board (PWB) and components. Controlling the rise and fall of soldering temperatures can enhance product reliability by limiting component stresses and producing a strong solder connection. Referring to Figure 1, you can see that there are five zones for the reflow process. The time and transition rates that follow are guidelines for typical 63Sn/37Pb eutectic solder mixtures.

The Reflow Zones

Reflow soldering by infrared, convection or vapor phase methods are the most reliable methods of soldering SMT components. Basic heating and cooling guidelines are presented here to ensure acceptable results.

Referring to Figure 1, zone number 1 is the preheat stage. The time in this stage preheats the entire assembly to around 125°C. The rate of rise from 25°C to 125°C should be controlled to between 1°C and 4°C per second. A faster rise time would cause thermal stresses for small components that could cause cracking.

The second zone is the preflow stage. It's during this time that the solder paste is dried and any fluxes present are activated. This time is also used to allow all components, large and small, to stabilize thermally. The temperature in this zone is kept slightly below the melting point of the solder paste (183°C) and allowed to soak typically for 30-90 seconds. The larger the components involved, the longer the soak time required.

Zone number three is the reflow stage. During this time, the temperature is ramped from just below melting to a maximum temperature point. This maximum temperature is typically 240°C but could be as high as 260°C for soldering packages with lead-free finishes. The paste is in the liquidus state in this and the dwell zone. The total time for both the reflow and dwell zones where the temperature is above 210°C should be limited to less than 30 seconds. The ramp rate from just below 183°C to maximum should be less than 3°C per second and the total time above 183°C should be less than 180 seconds.

The last phase of the reflow process is the cooling stage. Proper cooling is vital in the soldering process and enhances the strength of the final solder joint. Fast cooling results in a stronger solder connection but too fast could result in thermal expansion stresses on the components. Cree recommends a cooling rate between 2°C and 4°C per second.

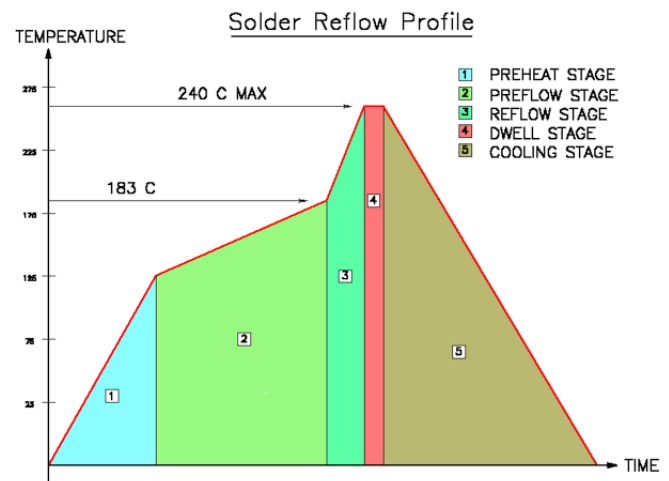


Figure 1. Reflow Thermal Profile

The Wave Zones

Soldering leaded components is usually done with a wave solder process. The wave process is very similar to reflow soldering in that the product goes through heating and cooling stages. Refer to Figure 2, which describes the wave profile visually.

The heating, soldering, and cooling profile is very similar to the reflow process. The preheating and soak environments perform the same functions and last about the same length of time. The actual soldering time is controlled by the feed rate over one or two solder waves.

Referring to Figure 2, the preheat rate from 25°C to about 125°C should be about 2-5°C per second. The soak time should be in the range of 30-120 seconds at a max temperature of less than 183°C. The wave portion of the process should have the component leads in contact with the wave/dual wave for less than 5 seconds.

As with the reflow process, cool down should be done fast enough to ensure a strong connection but slow enough to not cause thermal expansion stresses.

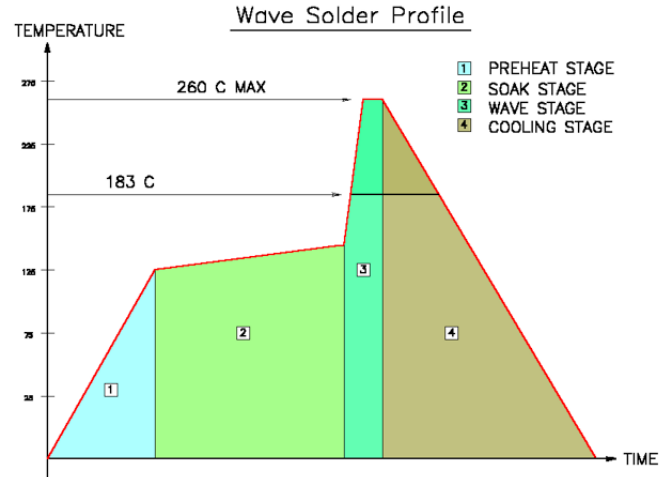


Figure 2. Wave Solder Profile

Hand Soldering

Hand soldering of Cree, Inc. Power products is quite acceptable as long as a few guidelines are followed. First, do not allow the lead temperature measured at the interface of the lead and the package to exceed 300°C. Soldering time above 250°C and below 300°C should be limited to less than 5 seconds.

Lead-Free Soldering

Lead-free devices or processes using lead-free solders such as Sn96.5Ag3.0Cu0.5 or Sn96.5Ag3.5 require higher temperatures to ensure strong solder joints. A longer preflow time of 60-120 seconds with a higher max soak temperature of about 210°C may be required. The maximum liquidus temperature must be adjusted as well. Lead-free finishes could require temperatures up to 260°C. The time above 200°C should be limited to 180 seconds and the time above 225°C should be limited to 30 seconds.

Summary

Following these guidelines will help you create strong solder connections and limit the risk of damaging components. The reflow guidelines refer to all Cree, Inc. Power devices in SMT packages. Cree does not recommend using an IR reflow process to solder any of our larger packages because of the potential to overheat parts from IR absorption in the black packaging. Vapor-phase reflow has very consistent heating patterns and works very well even on large through-hole devices.

It should be remembered that soldering is not an exact science. The information and profiles presented here should be viewed as guidance and not absolutes. Depending on the complexity and component sizes within your product, the times and temperatures may have to be modified to achieve superior results. Please contact Cree if your heating and cooling profiles vary greatly from those presented here.

Refer to Appendix A for recommended soldering techniques listed by package and to Appendix B for recommended solder pad layout.

Appendix A

	SMB	TO-252-2	TO-263-2	TO-220-2	TO-220-3	TO-247
HAND SOLDER	NR	X	X	X	X	X
WAVE SOLDER	X(a)	X(a)	X	X	X	X
Convection Reflow	X	X	X	X	X	X
Infrared Reflow	X	X	NR	NR	NR	NR
Vapor Phase Reflow	X	X	X	X	X	X

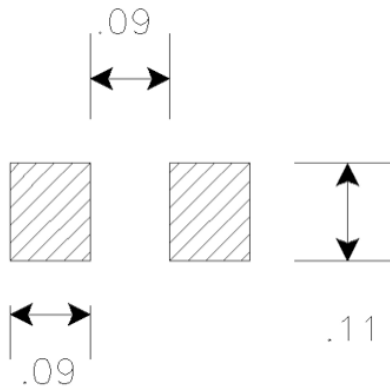
X: Acceptable

NR: Not Recommended

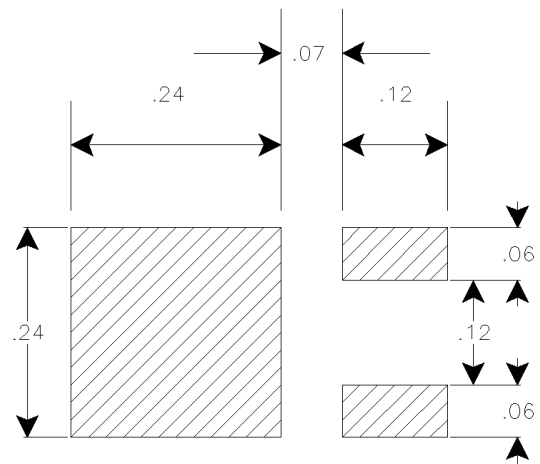
(a) Dual Wave

Appendix B

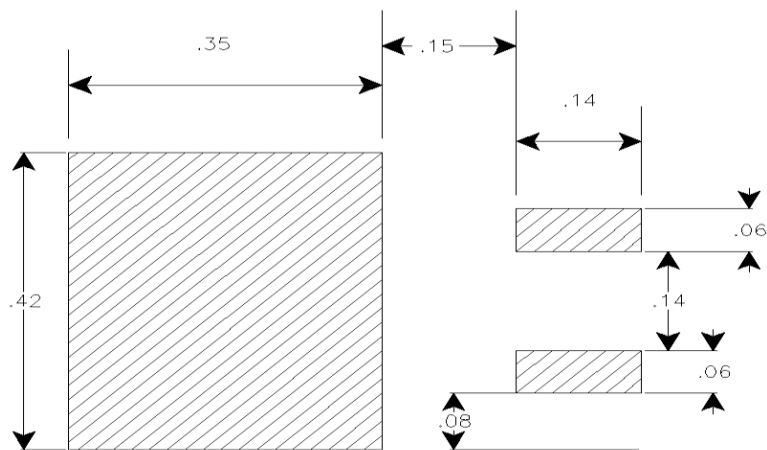
Recommended solder pad layout.



SMB



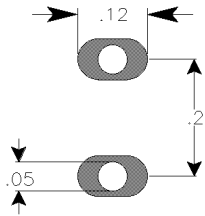
TO-252-2



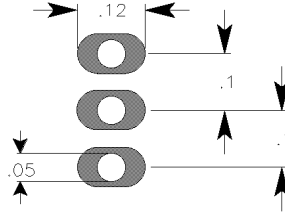
TO-263-2

Appendix B

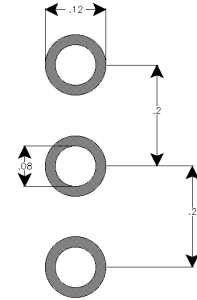
Recommended solder pad layout (continued)



TO-220-2



TO-220-3



TO-247