AN1673

Solder Reflow Mounting Method for the MRF286 and Similar Packages

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MOUNTING METHOD DESIGN

The following document describes a solder mounting method for the MRF286, 60 Watt power device. This mounting methodology is recommended for any ceramic/metal flange device with similar materials and construction (copper tungsten flange with Alloy 42 leads) and a power range from 20–60 watts. This method was developed after comprehensive simulation which included thermal management and mechanical stress modeling. Assemblies of the new design were then built in an automated solder mount assembly line with device leads solder attached to a PC board and the flange soldered directly to a 0.055 inch thick copper plate. The assemblies were then tested for long term reliability and thermal performance. Reliability tests involved temperature cycling the assembled boards from –65°C to +150°C at a ten minute dwell with less than a half minute between cycles. Devices were not under power during the temperature cycling. They were then tested electrically after 500 and 1000 cycles. Additional boards were subjected to power life testing at a specific duty cycle and heatsink temperature.

In order to perform power life tests, the printed circuit boards (PCBs) were assembled to the copper plates. The plates were bolted to fan–cooled, finned aluminum heatsinks with thermal compound on the interface. The assemblies were powered up at an 80% duty cycle for 12,000 cycles representing 1,000 hours of operation. Assembly construction with this device is shown in Figure 1.

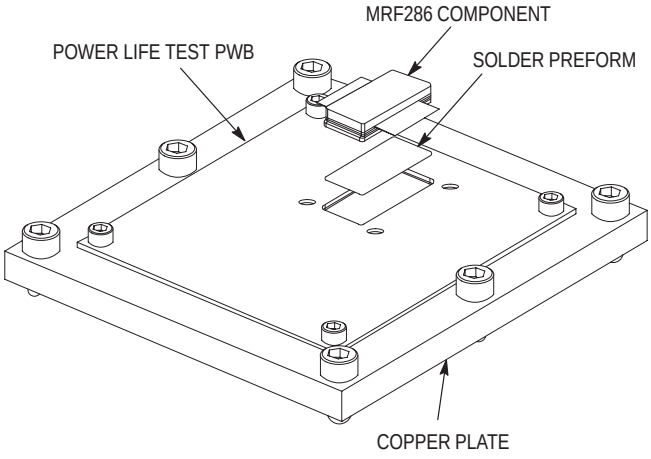


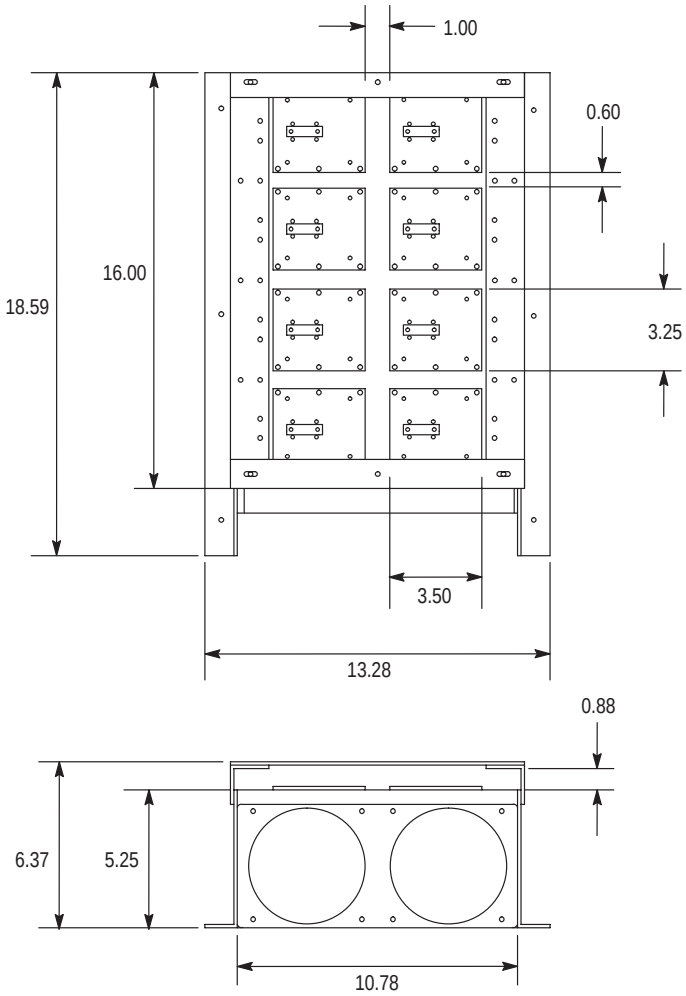
Figure 1. MRF286 60 Watt Power Device

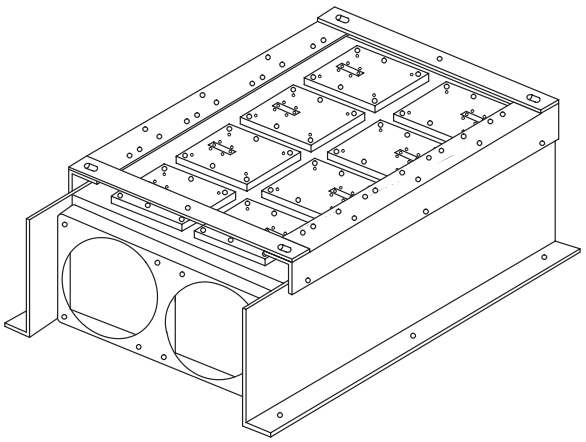
MOUNTING METHOD

The completed power life test assembly is shown in Figure 2. As described in the Mounting Method Design section, the assembly consists of the device solder mounted to a printed circuit board, with the base of the part solder mounted to a copper plate. The copper plate is bolted to an aluminum chassis which is then fan–cooled in order to maintain the die junction temperature at approximately 175°C.

A challenging aspect of high volume manufacturing of any component in a board assembly involves the stack up of tolerances of the completed system. Achievable device tolerances for seating plane height of the component are ±0.005 inches. Achievable tolerances of the printed circuit board are approximately ±0.007 inches. The tolerances of the copper plate can be kept to ±0.003 inches in the recessed area where the component will sit. In the assemblies built for power life test, the recess in the copper plate was machined so that the device leads would be assembled with maximum lead tip deflection of 0.015 inch where the leads attach to the PCB. This was accomplished by utilizing a solder reflow fixture which held the component in place during reflow. The fixture used for this assembly is depicted in Figures 3 and 4. To solder multiple components at one time, a simple fixture can be designed to secure all of the components during the reflow operation. This can be done with several techniques, an array of pins being one example. In the power life test assembly, the varying space tolerance between the backside of the component and the copper plate was filled with solder.

During assembly of the device, the flange is soldered to the copper plate through a slot in the PCB. In the same reflow operation, the leads of the device are soldered to the PCB. All soldering is accomplished in one pass using 62/36/2 Sn/Pb/Ag solder.





MRF286 HEATSINK ASSEMBLY

Figure 2. Power Life Test Assembly

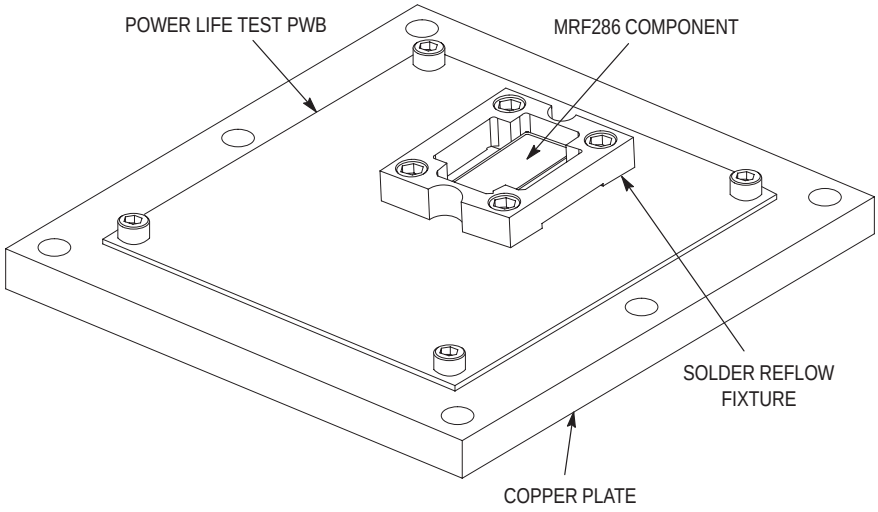


Figure 3. MRF286 Component Assembled with Solder Reflow Fixture

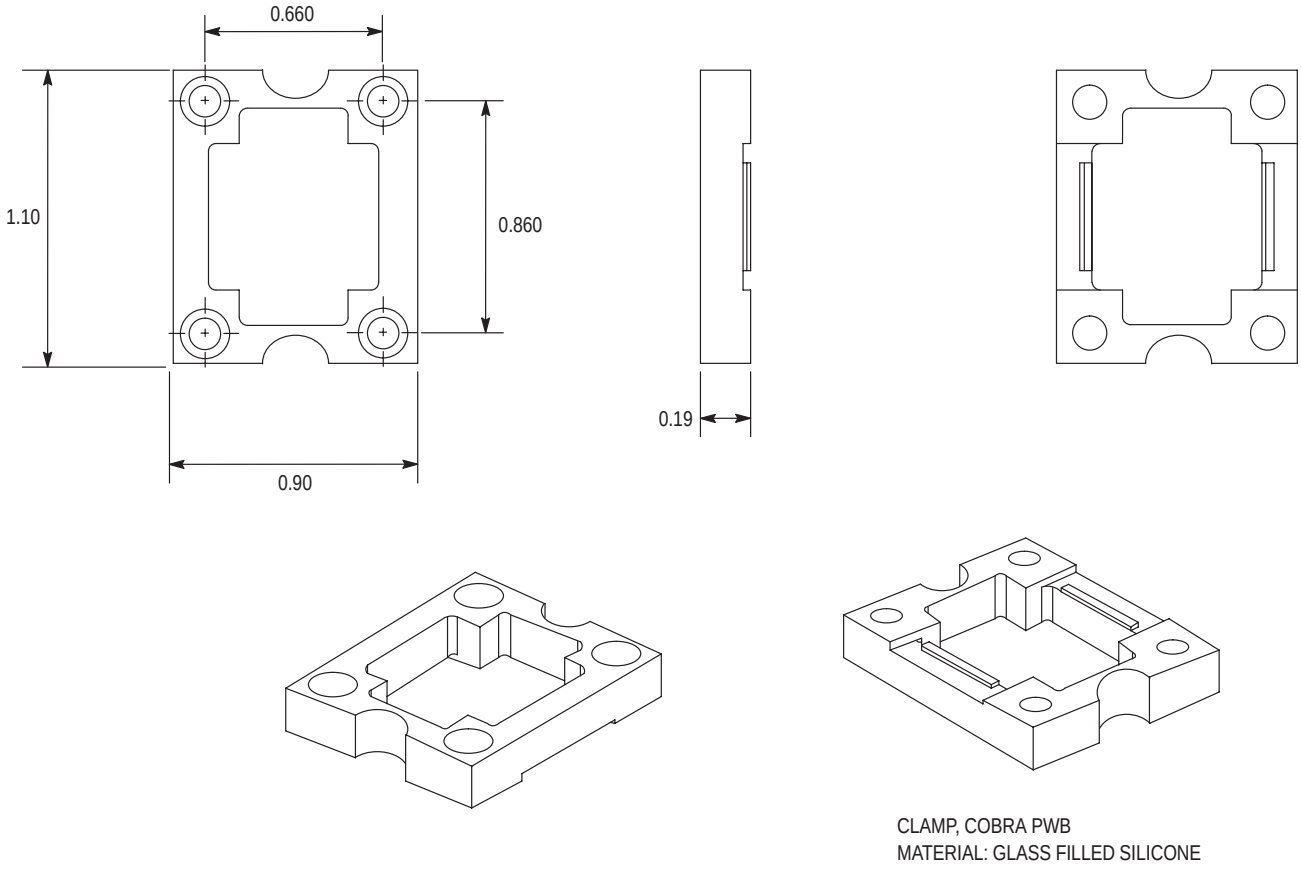


Figure 4. Component Fixture used for Reflow

Prior to proceeding with assembly of the PCB, it is necessary to insure that the level of gold within the solder joint does not exceed 4% by volume. This can be accomplished in a number of ways. Once this was accomplished for our power life test assemblies, the PCB was then screen printed with Sn/Pb/Ag solder paste using a stainless steel stencil, 0.006 inches thick. It was then secured to a copper plate using four #4–40 socket head cap screws. The copper plates were plated with approximately 1,000 to 1,500 microinches of electroless nickel. The plates contain a recessed cavity in which the components were then placed. Prior to placing the component, two .002 inch thick solder preforms were set into the recess. Two drops of no clean flux were placed on the preforms prior to placement of the device. The solder reflow fixture shown in Figure 3 was then fixed in place over the part using four #4–40 screws. Finally, the entire assembly was placed in a BTU convection reflow furnace. In the reflow step, the board is preheated to 150°C and held constant for a minimum of one minute to stabilize the board temperature. Best reflow characteristics are achieved by a “spike” above the 183°C liquidus. Peak temperature of the furnace is at 215°C ±10°C. Maximum time above the liquidus temperature is 90 seconds with 30–60 seconds typical. Maximum time above 150°C is 5.5 minutes. After reflow, the solder reflow fixture was removed by removal of the four screws. The fixture could then be reused. The completed, reflowed board/plate assemblies were screw mounted to the aluminum heatsink after evenly spreading the backside of the copper plate with 0.0005–0.001 inches of thermal compound.

The actual board assembled for power life test is shown in Figure 5.

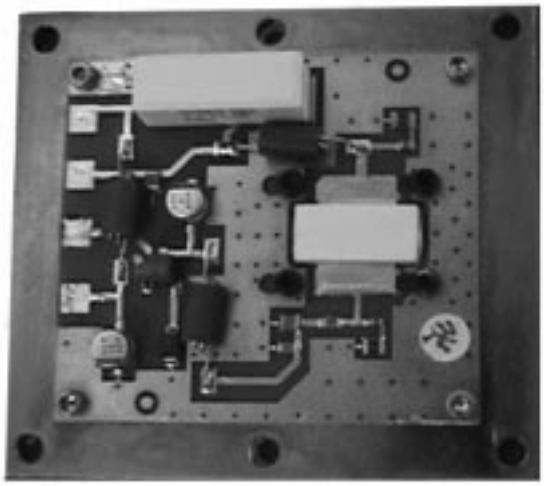


Figure 5. Power Life Test Board

PCB assembly steps are outlined in the following flow assembly.

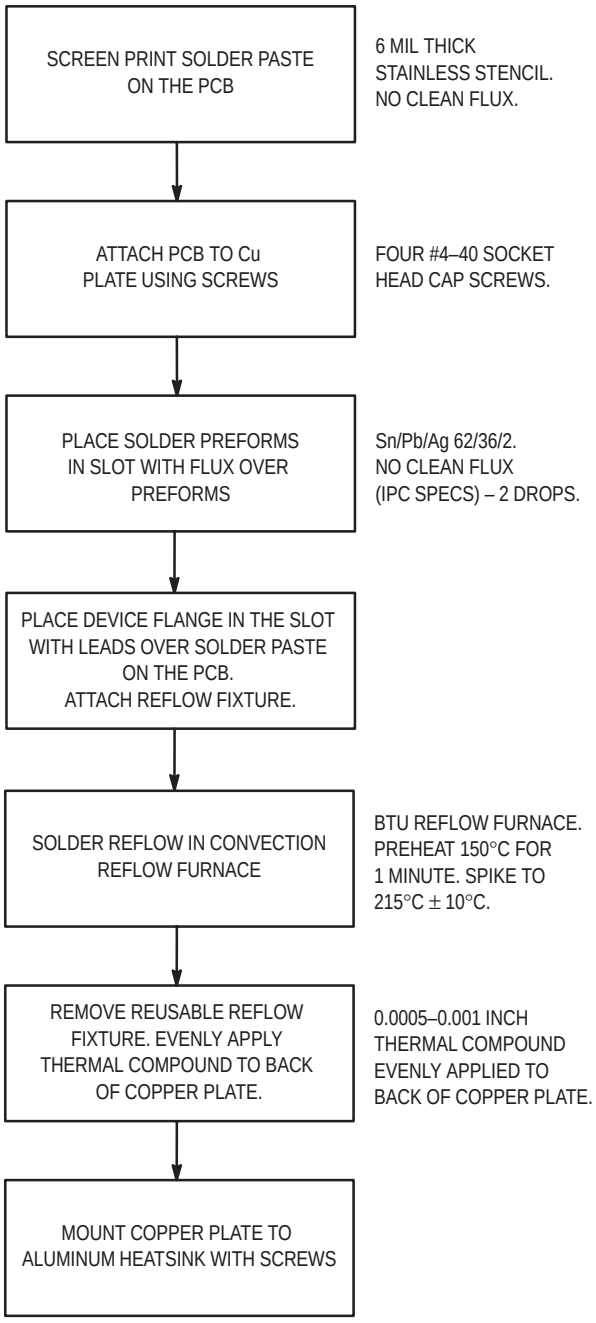


Figure 6. Process Flow for Board Assembly

SUMMARY

Information relating to mechanical analysis, power life testing, and thermal management can be found in the MRF286 Engineering Bulletin, “Thermal Management and Solder Mounting Method for the MRF286, 60 Watt Power Device in a CuW (Copper Tungsten) Base Package.” Order this document by EB211/D.

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