AN1674

Mounting Method with Mechanical Fasteners for the MRF286 and Similar Packages

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INTRODUCTION

The following document describes a mounting method for the MRF286 and packages of similar construction using a copper tungsten (CuW) flange and ceramic window frame with Alloy 42 leads. This mounting method involves bolt down of the CuW flange to a heatsink with the leads soldered to a printed circuit board. Critical elements that must be carefully addressed are mechanical stress of the assembly and thermal management. The mounting method described has adequately taken these issues into account through simulation modeling and power life test evaluation.

Figure 1 is a photograph of the MRF286 power amplifier. This is a power device operating at 2 GHz with 60 watts of output power. It is primarily used for communications network base stations and land mobile applications.

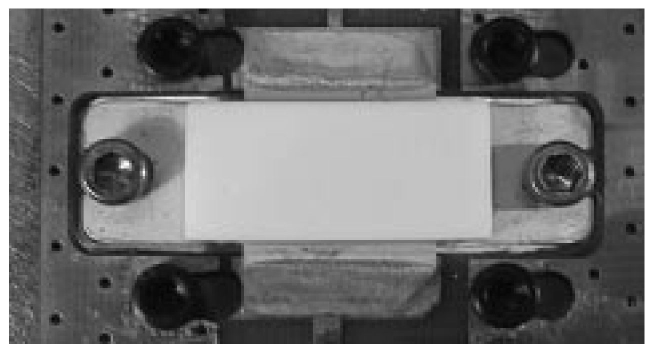

Figure 1. Photograph of the MRF286 Power Amplifier

MOUNTING METHOD DESIGN

Design of the mounting method was done 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 bolted to a plate which was then bolted to a heatsink. 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 heatsink. The plates were bolted to the fan–cooled, finned aluminum chassis 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.

The completed power life testing assembly is shown in Figure 2. As described previously, it consists of the device leads solder mounted to a printed circuit board, with the base of the part screw mounted to a heatsink plate (which was copper in the tests performed). The plate is bolted to an aluminum chassis which is then fan–cooled in order to maintain the die junction temperature at approximately 175°C.

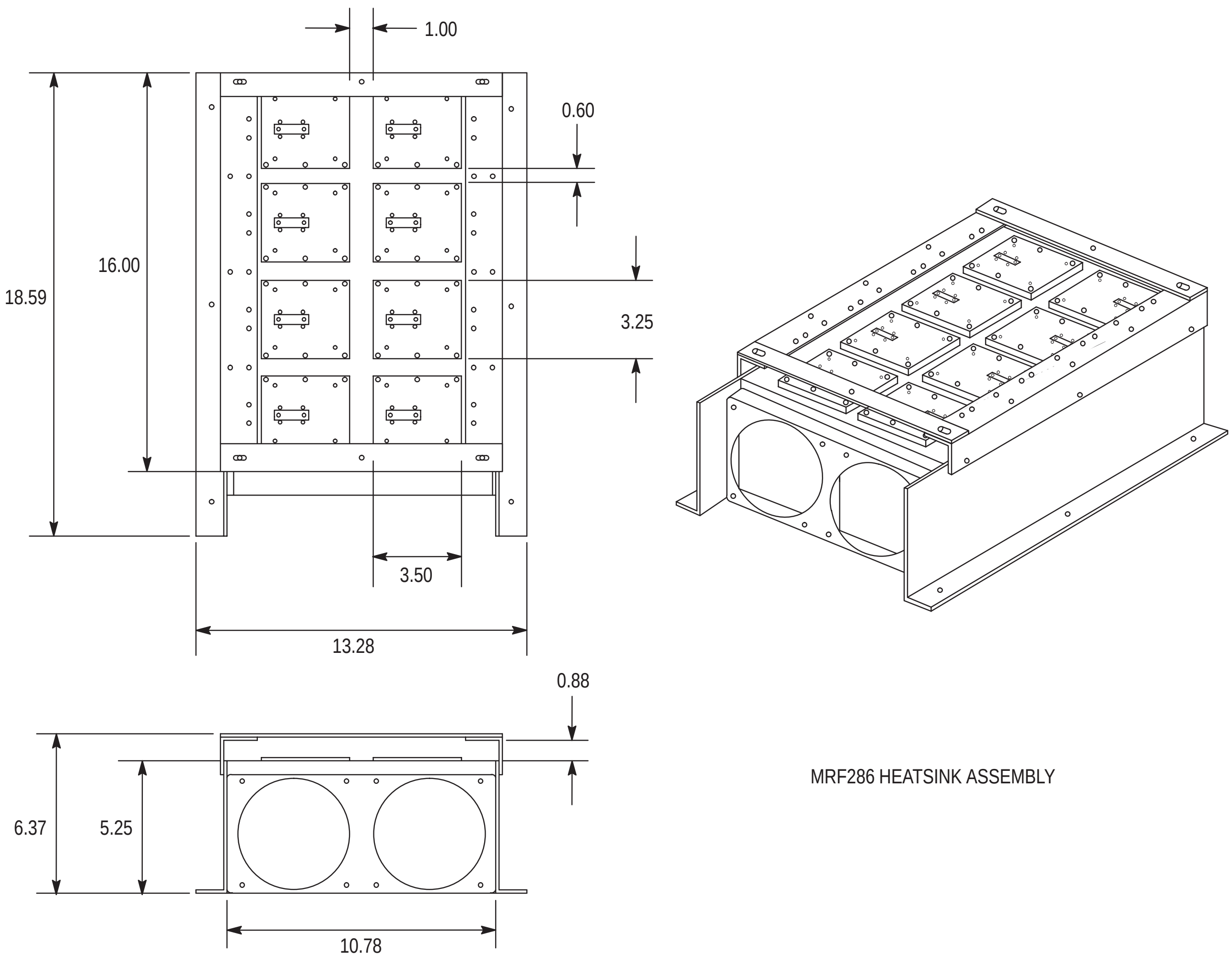

Figure 2. Power Life Test Assembly

TOLERANCING

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 testing, 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. Although the solder fixture used in the reflow of the power cycling boards was screw mounted, this type of fixture or an array of pins can easily be designed to be clamped to the PCB or to a graphite boat during reflow.

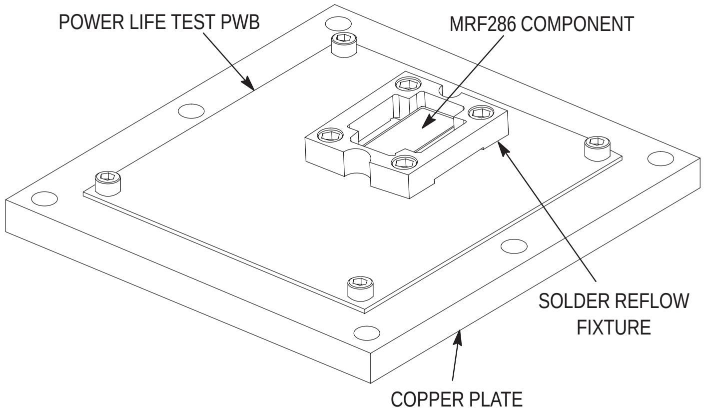

Figure 3. MRF286 Component Assembled with Solder Reflow Fixture

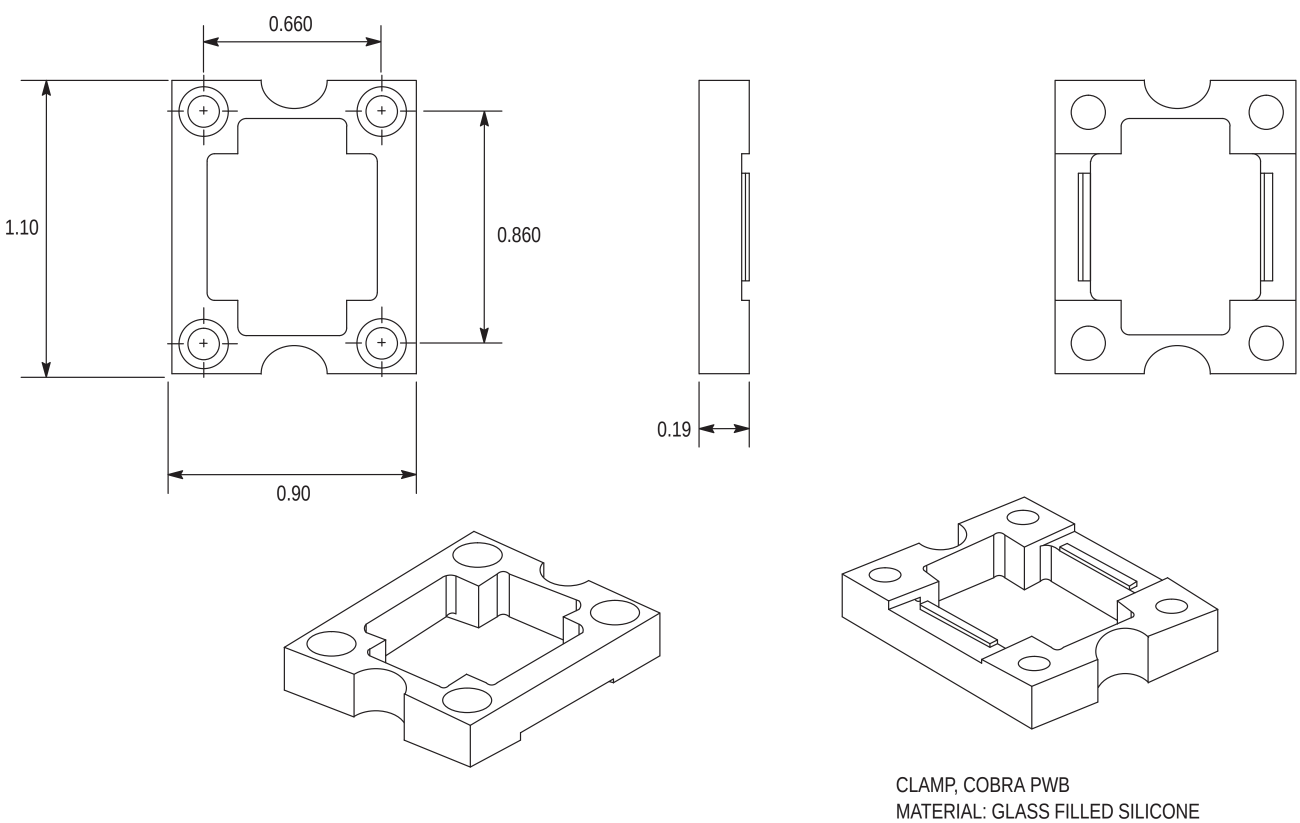

Figure 4. Component Fixture Used for Reflow

ASSEMBLY OF THE POWER LIFE TEST BOARDS

To eliminate any potential effects due to gold embrittlement, it is necessary to ensure that the level of gold within the solder joint does not exceed 4% by volume. This can be accomplished by solder dipping the leads into a solder pot of Sn/Pb solder. After the solder dip, the PCB is then screen printed with Sn/Pb/Ag (62/36/2) solder paste using a stainless steel stencil, 0.006 inches thick. The PCB is placed on a reflow boat. The solder reflow fixture shown in Figure 2 is then fixed in place over the part using four #4–40 screws. Finally, the entire assembly is 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 is removed by unscrewing the four screws. The fixture can then be reused. Thermal compound is then evenly spread on the backside of the component. The PCB with the component is secured to a copper plate using four #4–40 socket head cap screws. These copper plates are plated with approximately 1,000 to 1,500 microinches of electroless nickel and have a recessed cavity in which the power component sits. The flanges are then screw mounted (#4–40 screws) to the copper plate. The completed, reflowed board/plate assemblies are screw mounted to the aluminum heatsink after evenly spreading the backside of the copper plate with 0.0005–0.001 inches of thermal compound. Process flow of the assembly is shown in Figure 5.

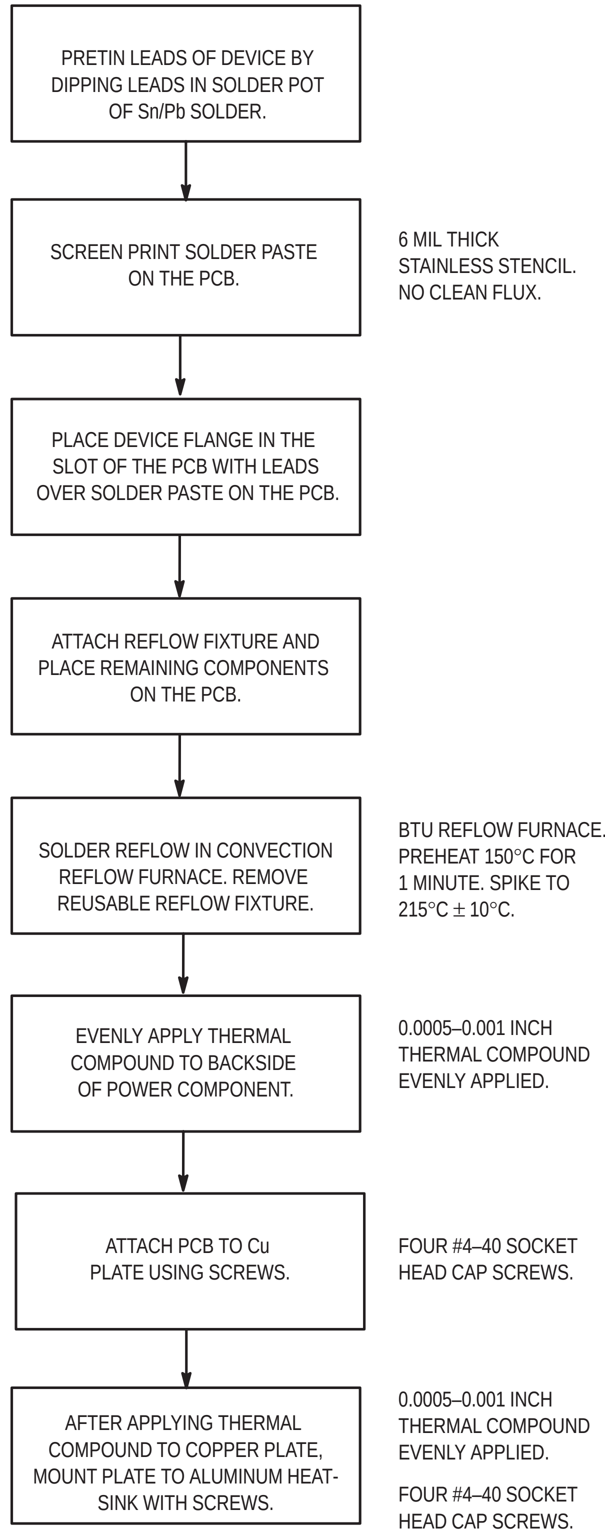

Figure 5. Process Flow of the Bolt Down Power Life Test Assembly

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