

Transistor Mounting and Soldering

Rev. 3

Introduction

There are three basic steps recommended to mount and solder RF power transistors into a circuit.

Solder pre-tin the transistor leads
Mount the transistor
Solder the transistor leads to the circuit trace

Solder Pre-Tinning

Pre-tinning is an effective technique to improve solderability. The purpose of pre-tinning is to remove the gold from the lead of the transistor prior to soldering the device onto the circuit board. Thus, pre-tinning reduces defects associated with cold solder joints when gold is mixed with Tin-Lead (Sn-Pb) solder. It has also been observed that excessive gold in a solder joint can cause solder embrittlement. After time, depending on the environmental stress applied to the solder joint, cracks and even an open circuit may result. Worse still there may be a period of time where the joint is intermittently open or closed, thus making troubleshooting extremely difficult. Therefore, pre-tinning and removing the gold from the leads prior to soldering is a prerequisite for reliable solder connections.

There are several methods for performing pre-tinning. One method uses a soldering iron and solder wick. First, apply solder to the transistor lead with the soldering iron, and then remove the solder with the wick. Care must be taken to ensure that most of the gold is removed from the lead. Also, ensure that after wicking the excess solder, the lead remains smooth and flat.

A better process is known as “double dip” tinning. For this process, two solder pots are used. The type of solder used will depend on the properties of the PCB/carrier. Note that the exact same solder is used in both solder pots. The double dip method is performed in the following manner:

Dip the leads into the solder flux being used, and then dip the leads into the molten solder contained in the first solder pot. Remove from the first pot and dip the leads into the molten solder of the second pot.

As indicated earlier, the intent is to re-flow and remove the gold from the leads; therefore the solder in the first pot becomes contaminated with gold. The second solder pot does not have gold in solution, and therefore deposits only pure solder onto the leads. This method can be carried out with a great deal of success for relatively high volumes.

If a “hands off” approach is desired, machines can be utilized to automate the lead tinning process. The machines generally work on the same principle of removing the gold-laden solder and replacing it with gold free solder, but they usually have a single solder pot working as a solder wave to achieve the gold free solder joint. Outside contract tinning facilities are also available.

Mounting the Transistor

Prior to mounting the transistor onto the circuit, a design review of the mounting surface and transistor is very important. Verify that the two mating surfaces are compatible with regards to thermal expansion/contraction cycle that the system will undergo. Mismatches may be overcome by providing some form of stress relief in the transistor lead itself.

Verify that the device is clean and free of burrs. The flange flatness specification is generally .002”. Mounting surface finish roughness (Ra) should be in the order of 0.8um or 0.03 mils, If the flange or mating surface is not adequately flat, it may bend and transmit stress to the package and perhaps cause cracking of the die or other

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elements of the transistor. It is also important to ensure that any machined features, such as holes, are checked for burrs around the edges. Burrs have been known to cause bending stress and subsequent cracking.

The bottom of the device should be coated with heatsink compound prior to mounting. M/A-COM recommends a heatsink compound similar to GC Electronics part number 108109. The layer of heatsink compound applied should be thin since it is only needed to fill the micro-gaps between mating surfaces. If too much compound is applied, it may act as a thermal insulator.

Torque

The device should be placed firmly in the channel. Lead length should be kept as short as possible to minimize stray inductance. In order to provide adequate clearance between the package body and mounting hardware, size 4-40 screws with split-lock and flat washers should be used. Torque is to be applied in 2 steps: First, finger-tighten to 0.5 Kg-cm or 0.4 inch-pounds on each side. Second, apply controlled torque with a controlled torque screwdriver to 6 Kg-cm +/- 1Kg-cm or 5.2 inch-pounds +/- 0.8 inch-pounds on each side. Excessive torque may damage the device. The use of washers is recommended to control the torque. The leads may now be soldered to the PCB.

Soldering The Leads

When performing the final soldering of the leads to the PCB, accepted soldering practices should be followed. It is important to verify the compatibility of the solder types. It is also important to use the appropriate flux for the desired application (i.e. rosin based, no-clean, lead free, etc.).

The temperature of the soldering iron must be controlled so that adequate heat is applied to re-flow the solder. If the temperature is too low, a cold solder joint or other nonconformity may result. After soldering, remove excess flux with a suitable cleaning solution.

The M/A-COM RF Power Hybrid Operations Soldering Procedure

M/A-COM uses the following methods for soldering a transistor onto a PC board:

The PCB is first pre-tinned so that there is solder below the lead. We then manually solder the leads onto the board using solder type SN62 or SN63 with RMA flux 197. (The melting points of SN62 and SN63 solders are 179°C and 183°C respectively). While soldering the leads of the transistor onto the board, we hold them in place with a probe. The temperature of the soldering iron should be maintained at approximately 250°C.

If appropriate, the PCB can be placed on a hot plate set to 200°C prior to soldering the leads with the iron. This improves the flow of the solder, thus improving the reliability of the solder joints.

We use a Metcal soldering system MX-500 with a #137 tip. The tip size should be selected according to the package lead width. Metcal has a wide range of models with temperature sensing capability at the tip. Other companies such as Weller and Edsyn make solder systems that should also work well.

Summary

These suggestions should only be used as general instructions for mounting transistors into the next assembly. Care should be taken if the transistor is immersed in any flux, solvent, or cleaning solution. However, this is generally not a concern for hermetically sealed devices that do not use an epoxy material for lid sealing. An ultrasonic cleaning system should NOT be used as the vibration could damage the transistor. Lastly, good ESD practices should be employed throughout the assembly operation.