SGS-THOMSON MICROELECTRONICS

APPLICATION NOTE

HANDLING AND MOUNTING ICs IN PLASTIC POWER PACKAGES

Integrated circuits mounted in plastic power packages can be damaged, or reliability compromised, by inappropriate handling and mounting techniques. Avoiding these problems is simple if you follow the suggestions in this section.

Advances in power package design have made it possible to replace metal packages with more economical plastic packages in many high power applications. Most of SGS-THOMSON Microelectronics power driver circuits, for example, are mounted in the innovative MULTIWATT® package, developed originally for high power audio amplifiers. Though the intrinsic reliability of these packages is now excellent the use of inappropriate techniques or unsuitable tools during mechanical handling can affect the long term reliability of the device, or even damage it. With a few simple precautions, careful designers and production engineers can eliminate these risks, saving both time and money.

BENDING AND CUTTING LEADS

The first danger area is bending and cutting the leads. In these processes it is important to avoid straining the package and particularly the area where the leads enter the encapsulating resin. If the package/lead interface is strained the resistance to humidity and thermal stress are compromised, affecting reliability.

There are five basic rules to bear in mind :

- Clamp the leads firmly between the package and the bend/cut point (figure 1).
- Bend the leads at least 3mm from the package (figure 2a).
- Never bend the leads more than 90° and never bend more than once (figure 2b).
- Never bend the leads laterally (figure 2c).
- Make sure that he bending/cutting tool does not damage the leads.

Figure 1 : Clamp the Leads between the Package and Bend/cut Point.

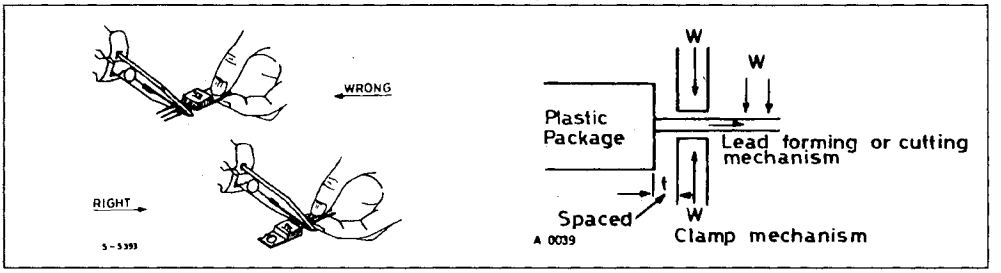
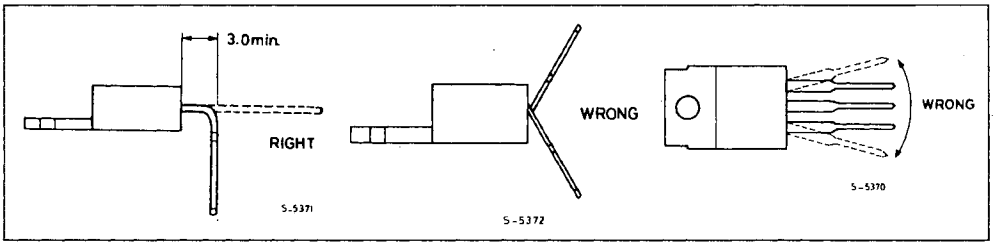


Figure 2 : Bend the Leads at Least 3mm. from the Package, never Bend Leads more than 90° and never Attempt to Splay the Leads Out.



INSERTION

When mounting the IC on a printed circuit board the golden rule is, again, to avoid stress. In particular :

- Adhere to the specified pin spacing of the device ; don't try to bend the leads to fit non-standard hole spacing.
- Leave a suitable space between the IC and the board. If necessary use a spacer.
- Take care to avoid straining the device after soldering. If a heatsink is used and it is mounted on the PC board it should be attached to the IC before soldering.

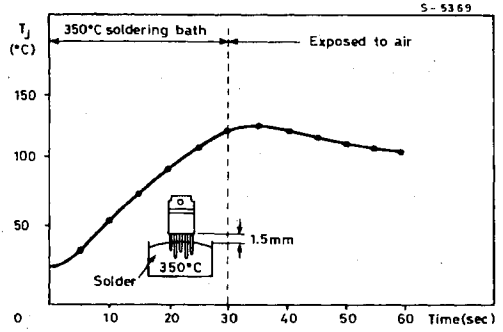
SOLDERING

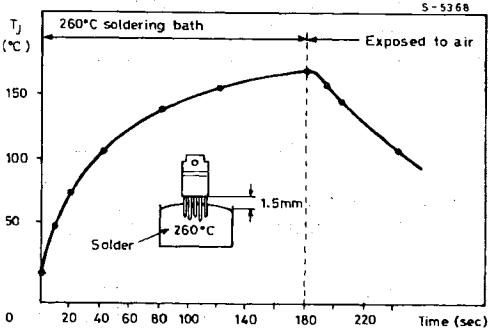
The greater danger during soldering is overheating. If an IC is exposed to high temperature for an excessive period it may be damaged or reliability reduced.

Recommended soldering conditions are 260°C for ten seconds or 350°C for three seconds. Figure 3 shows the excess junction temperature of a PENTAWATT package for both methods.

It is also important to use suitable fluxes for the soldering baths to avoid deterioration of the leads or package resin. Residual flux between the leads or in contact with the resin must be removed to guarantee long term reliability. The solvent used to remove excess flux should be chosen with care. In particular, trichloroethylene ($CHCl : CCl_2$) - base solvents should be avoided because the residue can corrode the encapsulant resin.

Figure 3 : The Excess Junction Temperature of a PENTAWATT Package in the suggested Soldering Conditions.





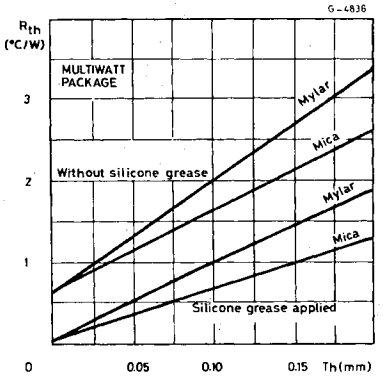
HEATSINK MOUNTING

To exploit the full capability of a power device a suitable heatsink must be used. The most important aspect from the point of view of reliability is that the heatsink is dimensioned to keep the junction temperature as low as possible. From a mechanical point of view, however, the heatsink must be designed so that it does not damage the IC. Care should also be taken in attaching the IC to the heatsink.

The contact thermal resistance between the device and the heatsink can be improved by adding a thin layer of silicon grease with sufficient fluidity to ensure uniform distribution. Figure 4 shows how the thermal resistance of a MULTIWATT package is improved by silicone grease.

An excessively thick layer or an excessively viscous silicon grease may have the opposite effect and could cause deformation of the tab.

Figure 4 : The Thermal Resistance of a MULTIWATT Package is improved by Silicon Grease. Here Thermal Resistance is plotted against Grease Thickness.



SGS-THOMSON plastic power packages - MULTIWATT, PENTAWATT and VERSAWATT - are attached to the heatsink with a single screw. A spring clip may also be used as shown in figure 5. The screw should be properly tightened to ensure that the package makes good contact with the heatsink. It should not be too tight or the tab may be deformed, breaking the die or separating the resin from the tab.

The appropriate tightening torque can be found by plotting thermal resistance against torque as shown in figure 6.

Suggested tightening torques for 3MA screws are 8Kg/cm for VERSAWATT, PENTAWATT and MULTIWATT packages. If different screws, or sping clips, are used the froce exerted by the tab must be equivalent to the force produced with these recommended torques.

Even if the screw is not overtightened the tab can be deformed, with disastrous results. If the surface of the heatsink is not sufficiently flat. The planarity of the contact surface between device and heatsink must be better than 50µm for PENTAWATT and VERSAWATT packages and less than 40µm for MULTIWATT packages.

Figure 5 : MULTIWATT, PENTAWATT and VERSAWATT Packages are attached to the Heatsink with a Single Screw or a Spring Clip.

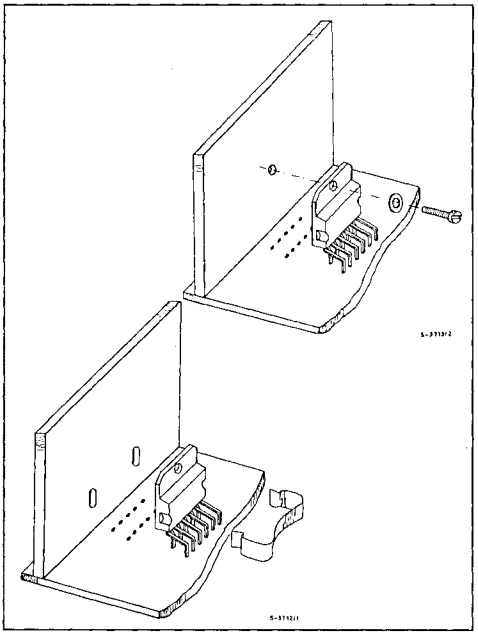


Figure 6 : Contact Thermal Resistance depends on Tightening Torque.

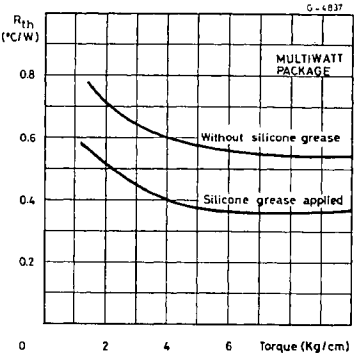
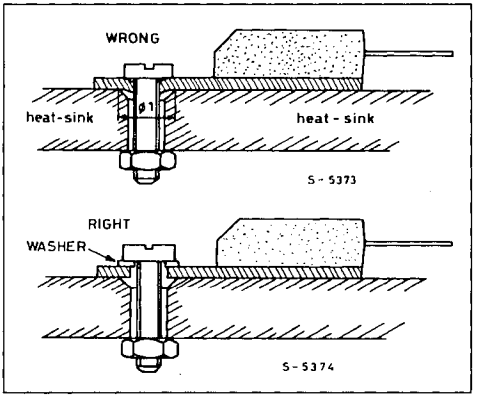


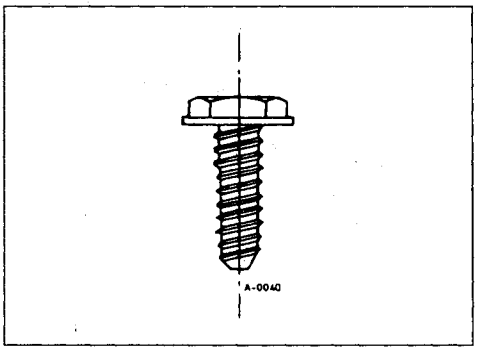
Figure 7 : The Heatsink Tab may be deformed it a Washer or a Wide-headed Screw is not used.



Similar problems may arise if the screwhead is too narrow compared to the hole in the heatsink (figure 7).

The solution here is to use a washer to distribute the pressure over a wider area. An alternative is to use screws of the type shown in figure 8 which have a wide flat head. When self-tapping screws are used it is also important to provide an outlet for the material deformed as the thread is formed. Poor contact will result if this is not done. Another possible hazard arises when the hole in the heatsink is formed with a punch : a circular depression may be formed around the hole, leading to deformation of the tab. This may be cured by using a washer or by modifying the punch.

Figure 8 : The recommended Screw Type Looks Like this.



Serious reliability problems can be encountered if the heatsink and printed circuit board are not rigidly connected. Either the heatsink must be rigidly attached to the printed circuit board or both must be securely attached to the chassis. If this is not done the stresses and strains induced by vibration will be applied to the device and in particular to the lead/resin interface. This problem is more likely to arise when large boards and large heatsinks are used or whenever the equipment is subjected to heavy vibrations.