

HANDLING AND MOUNTING ICs IN PLASTIC POWER PACKAGES

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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 integrated circuits, for example, are mounted in some innovative packages, like MULTIWATT, FLEXIWATT and CLIPWATT, 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 strai-

ning 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 the bending/cutting tool does not damage the leads.

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

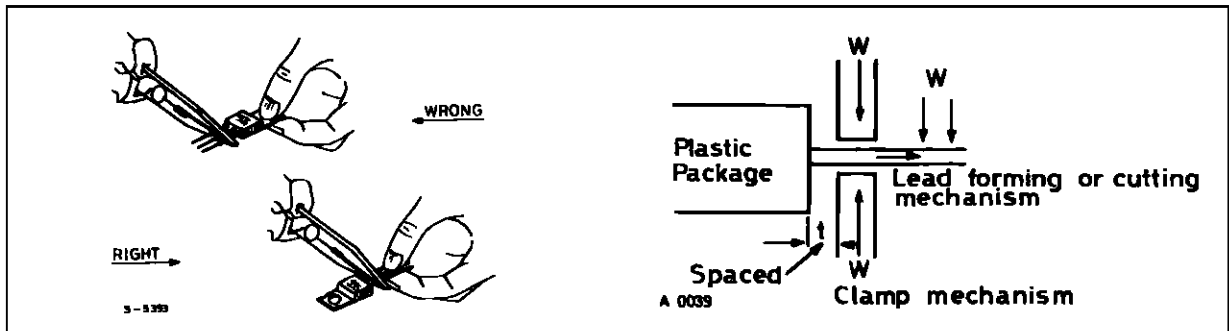
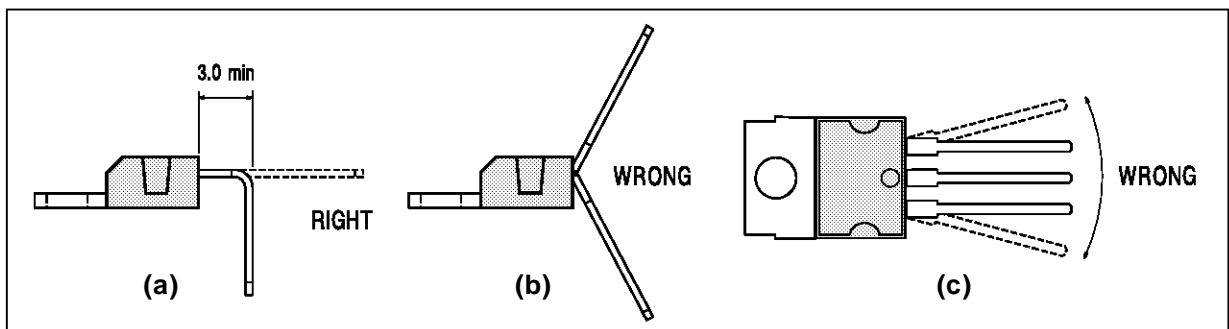


Figure 2 : Bend the Leads at Least 3mm, never Bend Leads more than 90° and never Splay the Leads Out.



APPLICATION NOTE

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 ($\text{CHCl}_2 : \text{CCl}_2$) - base solvents should be avoided because the residue could corrode the encapsulant resin.

HEATSINK MOUNTING

To exploit the full capability of a power device a suitable heatsink must be used. The most important

Figure 3a: The Excess Junction Temperature of a PENTAWATT Package in the suggested Soldering Conditions. (350°C for three seconds)

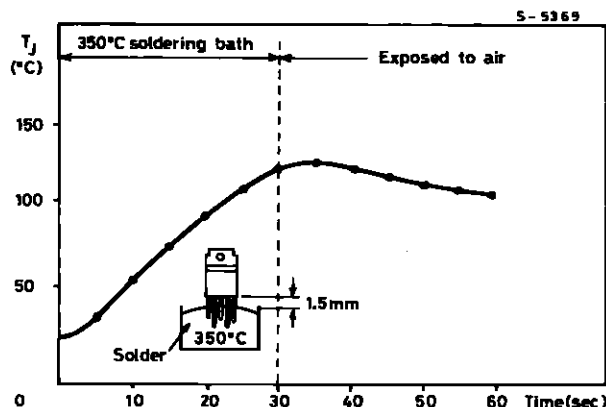
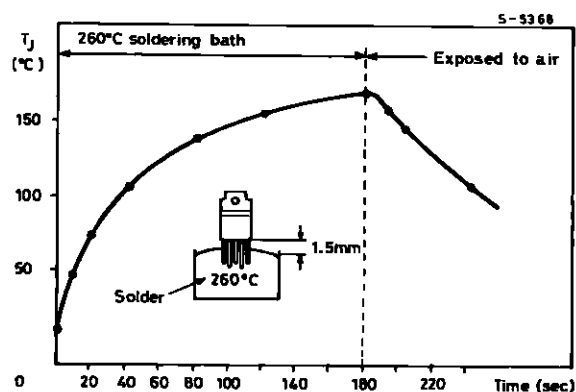


Figure 3b: The Junction Temperature of a PENTAWATT package in the suggested Soldering Conditions. (260°C for ten seconds)

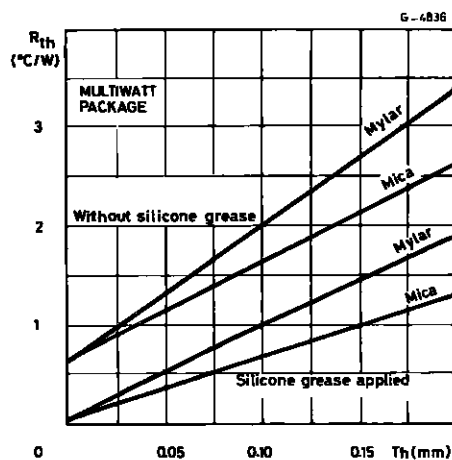


aspect from the point of view of reliability is that the heatsink is dimensioned to keep the junction temperature as low as possible. From a mechanical point of view, however, the heatsink must be designed so that it does not damage the IC. Care should also be taken in attaching the IC to the heatsink.

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 the contact thermal resistance is plotted against insulation layer thickness.



SGS-THOMSON plastic power packages - MULTI-WATT, HEPTAWATT, PENTAWATT and TO220 - are attached to the heatsink with a single screw, FLEXIWATT is attached with two screws. A spring clip may also be used as shown in figure 5b. 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 or in the case of FLEXIWATT packages an high tightening torque may cause cracks in the molded case.

The appropriate tightening torque can be found by plotting thermal resistance against torque as shown in table1.

Suggested maximum torques for 3MA screws are 8Kg/cm for TO220, PENTAWATT, HEPTAWATT, MULTIWATT and FLEXIWATT packages. Particularly for FLEXIWATT package, clipping system is strongly recommended. If different screws, or spring clips, are used, the force exerted by the tab must be equivalent to the force produced with these recommended torques.

If clips are used, it should be taken care of the contact area between the plastic case and the clip: the maximum pressure allowed on plastic is 15kg/mm². Over this value, cracks in the molded body may appear. Therefore clips have to be round or smooth in the contact area to avoid concentrate loads on plastic body of the package.

Figure 5a: MULTIWATT, HEPTAWATT, PENTAWATT, TO220 and FLEXIWATT packages are attached to the heatsink with one or two screws.

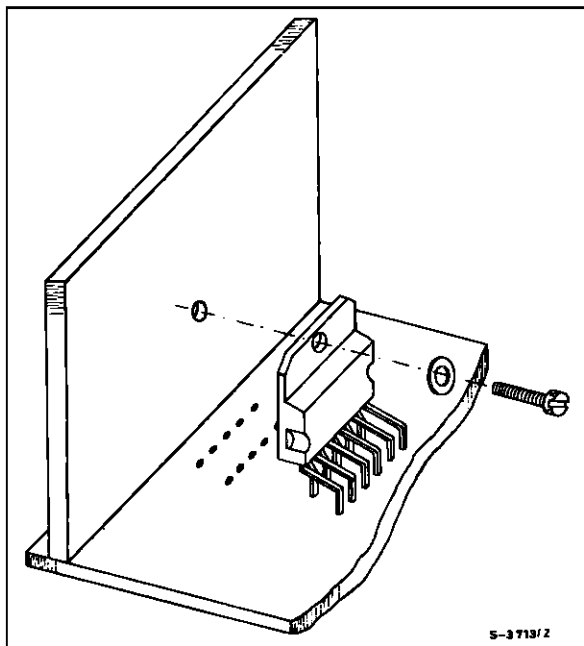


Table 1 : Table resistance junction to heatsink depends on Tightening Torque in MULTI-WATT package

Torque	R _{th} (j-heatsink) with grease	R _{th} (j-heatsink) without grease
Kg · cm	°C/W	°C/W
3	1.0	1.7
4	0.94	1.63
5	0.89	1.59
7	0.84	1.55
10	0.83	1.52
12	0.82	1.51
15	0.82	1.51

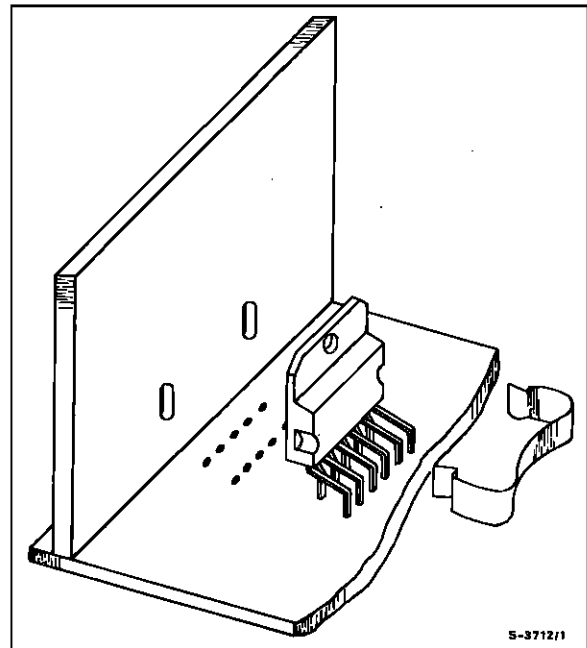
Test device: P638 (160 x 160 sq. mils)
R_{th} (j-c) = 0.6°C/W

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 TO220, PENTAWATT, HEPTAWATT, MULTIWATT and FLEXIWATT packages.

Similar problems may arise if the screwhead is too narrow compared to the hole in the heatsink (figure 6).

The solution here is to use a washer to distribute the pressure over a wider area. An alternative is to use

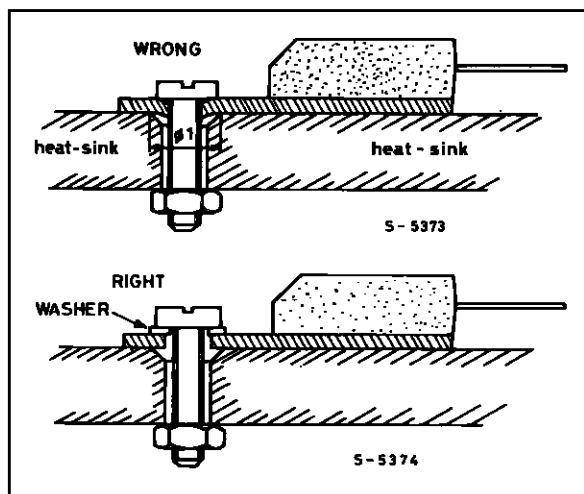
Figure 5b: MULTIWATT, HEPTAWATT, PENTAWATT, TO220 and FLEXIWATT packages are attached to the heatsink with a spring clip.



APPLICATION NOTE

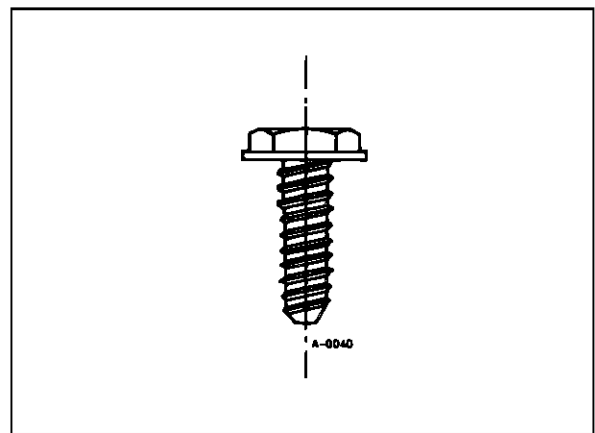
screws of the type shown in figure 7 which have a wide flat head. When self-tapping screws are used it is also important to provide an outlet for the material deformed as the thread is formed. Poor contact and broken die will result if this is not done. Another possible hazard arises when the hole in 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 6 : The Heatsink Tab may be deformed if a Washer or a Wide-headed Screw is not used.



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.

Figure 7 : The recommended Screw Type Looks Like this.



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