

### Handling and mounting ICs in plastic power packages

#### Introduction

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 STMicroelectronics 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.

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Top clip mounting
Across clip mounting
Double screw bar mounting
Single screw mounting
Double screw mounting



#### 1 Handling and mounting

#### 1.1 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 2* a).
- Never bend the leads more than 90° and never bend more than once (*Figure 2* b).
- Never bend the leads laterally (*Figure 2* c).
- Make sure that he bending/cutting tool does not
- damage the leads.





# Figure 2. Bend the leads at least 3mm, never bend leads more than 90° and never splay the leads out



#### 1.2 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 nonstandard 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.

#### 1.3 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. Figures 3 and 4 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 (CHCI :  $CCI_2$ ) - base solvents should be avoided because the residue could corrode the encapsulant resin.

# Figure 3. The excess junction temperature of a Pentawatt package in the suggested soldering conditions. (350°C for three seconds)







# Figure 5. The thermal resistance of a Multiwatt package is improved by silicon grease. Here the contact thermal resistance is plotted against insulation layer thickness.



STMicroelectronics plastic power packages - MULTIWATT, HEPTAWATT, PENTAWATT, CLIPWATT 19 H 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 7*. 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 *Table 1*.

# Table 1.Resistance junction to heatsink depends on tightening torque in<br/>Multiwatt package

Torque (Nxcm)	Rth (j-heatsink) with grease (°C/W)	Rth (j-heatsink) without grease (°C/W)
30	1.0	1.7
40	0.94	1.63
50	0.89	1.59
70	0.84	1.55
100	0.83	1.52
120	0.82	1.51
150	0.82	1.51

Note: Test device: P638 (160 x 160 sq. mils)  $R_{th (j-c)} = 0.6^{\circ}C/W$ 

Suggested maximum torques for M3 screws are 80Nxcm for TO220, PENTAWATT, HEPTAWATT, MULTIWATT and CLIPWATT 19 H 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  $150N/mm^2$ .

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 6. Multiwatt, Heptawatt, Pentawatt, TO220 and Flexiwatt packages are attached to the heatsink with one or two screws



## Figure 7. Multiwatt, Heptawatt, Pentawatt, TO220 and Flexiwatt packages are attached to the heatsink with a spring clip



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 flatness of the contact surface between device and heatsink must be better than 50 micron for TO220, PENTAWATT, HEPTAWATT and MULTIWATT packages.

Similar problems may arise if the screwhead is too narrow compared to the hole in the heatsink (*Figure 8*).



The solution here is to use a washer to distribute the force over a wider area. An alternative is to use screws of the type shown in *Figure 9* 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.

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 8. The heatsink tab may be deformed it a washer or a wide-headed screw is not used.



Figure 9. The recommended screw type looks like this



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#### 1.4 Flexiwatt#2 - Heatsink mounting





Figure 11. Across clip mounting







Figure 12. Double screw bar mounting











### 2 Revision history

#### Table 2. Document revision history

	Date	Revision	Changes
-	10-May-1997	2	Initial release.
-	13-Mar-2006	3	Added the CLIPWATT 19H power package in the page 7.



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