Application Note AN-1031

Lead Bending Considerations for International Rectifier's Power Semiconductor Packages

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Introduction

This application note is intended to address the frequently asked package-related question of how the legs of through-hole packaged devices may be safely bent without endangering part reliability.

Lead bending

Through-hole packaged parts are mostly supplied to customers with the leads projecting straight out of the plastic body. Many practical power circuits however use bulky heat sinks in contact with the device tabs to enhance thermal performance; but this may preclude the straight-leaded orientation arrangement of the standard part. Consequently it is quite usual to change the lead direction to make a more convenient electrical connection on an adjacent printed circuit board. Where the customer carries out this function, there are certain important guidelines that should be observed. (Please note that IR can offer a lead bending option for many of the more common variations- for further details please contact your local Sales office- details available via "contact us" on the IR Web site www.irf.com)

Clamping

In order to limit any stress that the bending action imposes on the leads, it is essential to firmly clamp **leads** at the body-refer to Figure 1. The minimum distance that a bend should start away from the plastic body will vary from part to part - Table 1 provides these values for the most common power packages. In general, the larger the clamp area the more reliable the quality of the lead forms.

Under **no** circumstances must the plastic body be held or restricted while lead forming as this has the potential to mechanically damage the package-particularly at the metal-to plastic interface.

Bend radius

IR recommends that the bend radius should never be less than the thickness of the lead material. The general rule of thumb is to create a radius that is one to two times the material thickness- "T" in figure 1. However, in certain design constrained situations, where lead length is critical, the radii may be made equal to the lead material thickness.

With the majority of lead forms, there will be an element of micro cracking on the solder plating on the outer radii which will expose the copper. This is not at all uncommon and will not affect the strength of the leads. However, if the lead form radii are too small compared with the lead thickness, then deep cracks will appear,

leading to reliability issues at some later stage of the part's operating life. Refer to Table 1 for recommended dimensions.

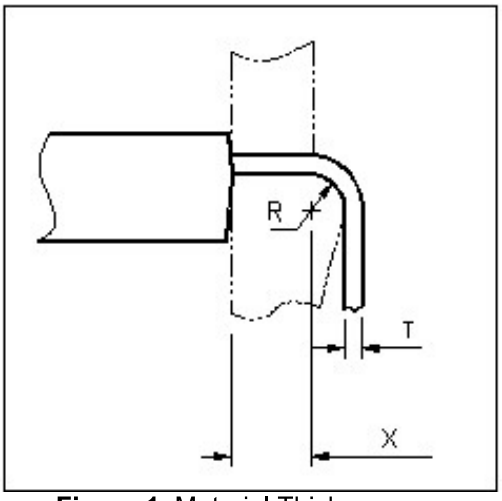


Figure 1. Material Thickness

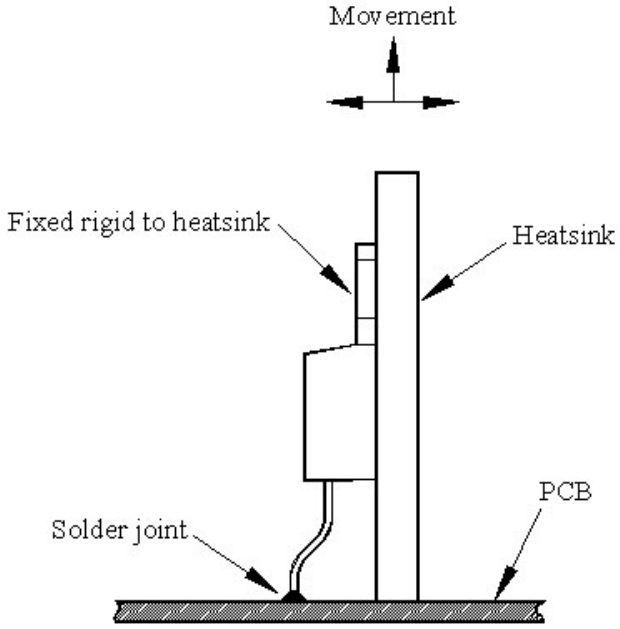
Table 1. Recommended Leadform Dimensions

Package Outline	*X min. (Clamping Dim)*	*"T" nominal*
Super-247	*2.75mm*	*0.6mm (dam bar area only)*
Super-220	*1.75mm*	*0.8mm*
TO-247	*2.75mm*	*0.6mm*
TO-220	*1.75mm*	*0.46mm*
TO-220 Full-pak	*1.75mm*	*0.46mm*

Hand bending
Where lead bending is required on relatively low quantities of parts, i.e. for development, pre-production and even limited pilot production, bending may carried out by hand. It is still very important to abide by the rules laid down above. Clamp the leads with pliers **ensuring that static precautions are fully observed**.
For accuracy of bend it is better to use un-tapered snipe-nose pliers.

Other considerations
There may be other compelling reasons for having a lead bend apart from the requirement to re-direct the leads purely for connection purposes.

Stress relief
For some mechanical arrangements the heat sink and the lead termination point may be subjected to relative movement (Figure 2). In these cases where these forces are unavoidable, it is desirable to introduce a stress-relieving lead bend in order to re-position this stress. With a simple bend of this sort, the stresses which would normally have degraded either the lead-to-body joint or the lead-to-pcb joint, will be absorbed along the lead length.



Board clearance
Where leads are terminated in a PCB or similar substrate, the original in-line alignment of the leads (Gate, Drain, Source for a power MOSFET) may not provide an adequate electrical clearance/ creepage distance between track pads. By offsetting the centre leg as shown in Figure 3 this problem may be avoided.

Figure 2. Heat sink and Lead Termination

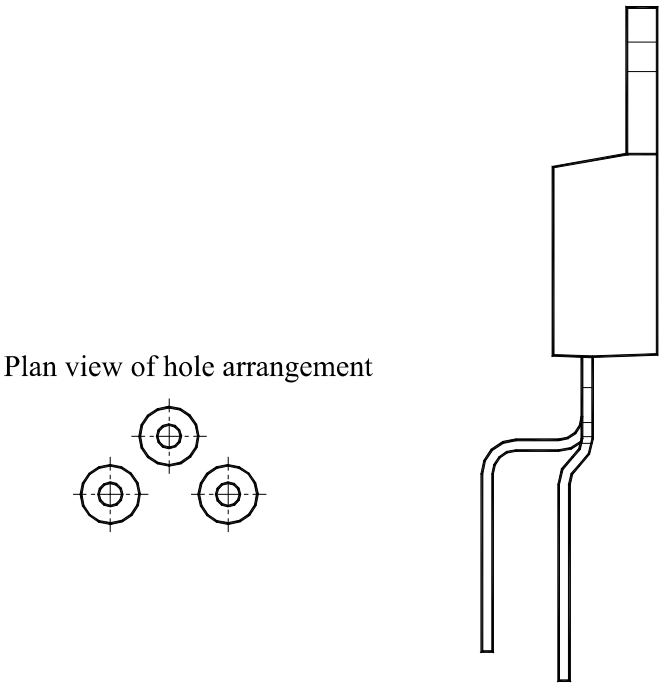


Figure 3. Center Leg Offset