Application of SIP Hall Sensors

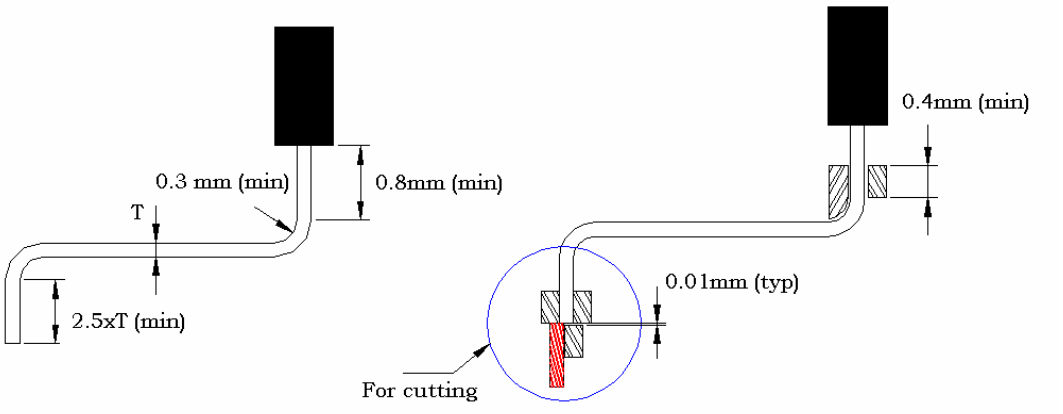
Lead trimming and forming recommendations

Lead trim & form operations are often applied on SIP packaged Hall sensor ICs during system assembly, in order to position the sensor exactly at operating position and shape the leads to secure electrical contacts by soldering on PCB or welding.
Significant forces are applied during trim and form operations. Without appropriate precautions applied force may act as a stress factor to the plastic body of the sensor or to the leads relative to the plastic body. Such stress may cause a device malfunction, kay parameter drift or introduce a reliability risk (latent defect), like below:

- Stress applied on the branded side of the package may cause Hall element parameter drift or silicone structure damage.
- Stress applied on the leads relative to plastic body may cause wire bond damage, package crack or delamination from a leadframe. Cracks and delamination, if not leading to an immediate malfunction, will further weaken wire bonds, allow moisture penetration and bond corrosion – all reliability risks.

Lead clamping

- Package stress relief shall be secured through steady clamping of leads from both sides during trim or form operation (in the same direction as the trim or form action).
- The stress relief clamp has to have a minimum pressing surface width of 0.4mm (1mm is preferable) on both sides of the component pins, clamp lin shall be between the bending(cutting) line and the plastic body.
- Care has to be taken that the clamping force is strong enough to hold the component pins i



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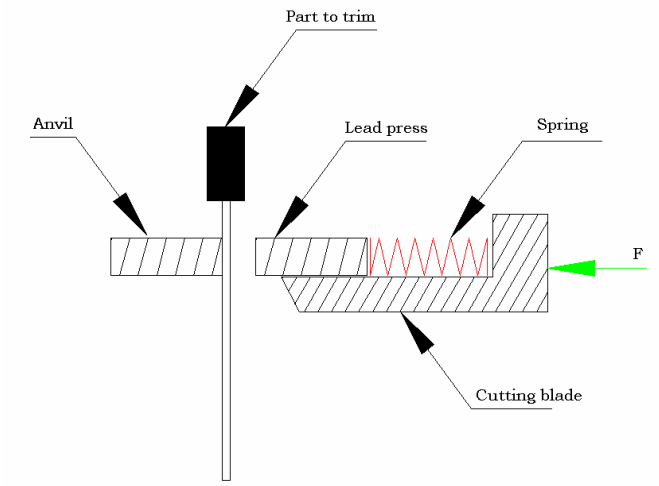
ithout damaging the leads on the clamping position (locally flattening the pins). When pneumatic cylinders are used to operate clamping and cutting/bending, the force of clamping cylinder shall be minimum 3 times the force of the cutting/bending one.

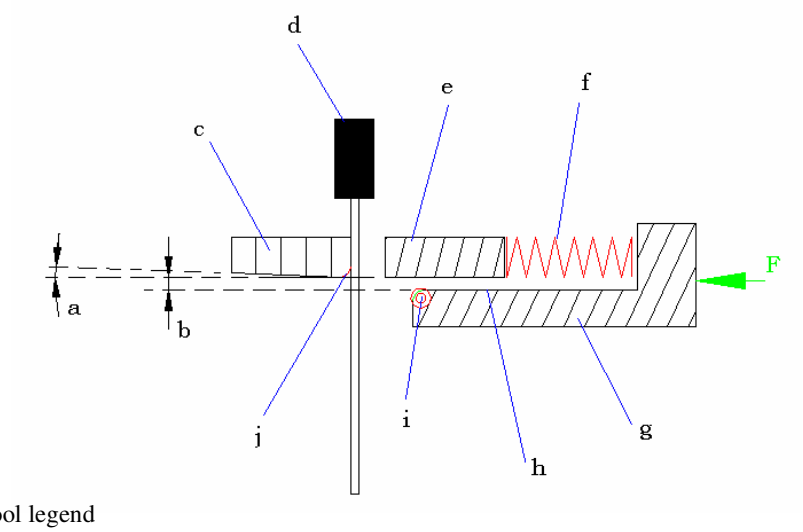
Trimming (Lead cutting)

- Assure that the cutting blade clearance is not too much, otherwise bending may occur while trimming. As a rule of thumb, one can apply a clearance of <=10% of the material thickness for soft materials like copper. [The cutting speed-index for a stroke <= 10mm is in between 30…50 devices /min.]
- Soft cutting shall be applied only, e.g. parts shall not fly away from the cutter. Best method is to release clamping after cutting action.
- A simple cutter with a pre-acting clamping is shown below. Dimension the spring force accordingly.



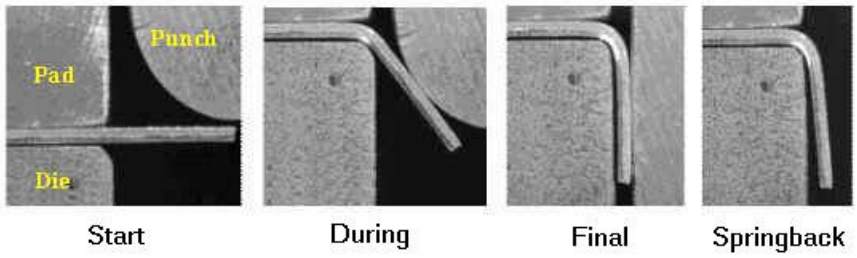
Forming (Lead bending)

- Lead forming (bend line) must be done below the dambar cutting portion. Lead forming falling into the zone of the tie bar, should be avoided because a smooth radius is difficult to achieve in this area (the stiffness of the material is bigger).
- When bending the leads, be assure that there is a clearance of minimum 0,8 mm from the package bottom edge to the line of bending.
- Do not apply a bending radius smaller than 0.3mm. Use a smooth supporting and bending anvil or a roller bending.
- Elimination of lead spring-back must be done by over-bending the leads, or bottoming (=squeezing the part at the end of stroke) and not by mechanical deformation.
- Because of the unavoidable friction that occurs during bending, the tooling marks may be present on the leads surfaces. These marks shall not represent exposed base leadframe material or peeling of plating (swarf). This is achieved by an adequate clearance on the forming tool. The tolerances on the lead frame and plating, together with the quality of the bending tool will determine the forming quality
- Clamping marks shall be inspected after processing, as a process quality and tool weariness indicator.
- Forming relies on a “leg” of material to be pushed or wiped up into position while the base material is held flat. The length of a formed leg should be at least 2.5 times the material thickness beyond a bend radius.

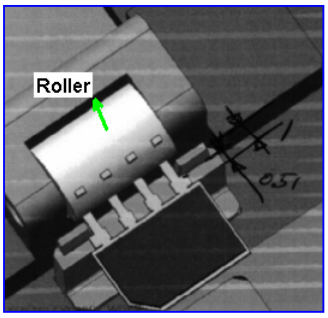


Form tool legend

Index	Function
a	Angle to allow overbending, compensating for springback (typically 2…8% of bending angle)
b	Clearance, taking in account pin thickness and plating with tolerances [friction]
c	Anvil (lead support and lead-backer for lead press)
d	Part to bend
e	Lead press (clamping)
f	Lead press spring
g	Lead bending anvil
h	Possible profiled shape for springback compensation
i	Smooth polished radius surface or roller.
j	Bend radius of component pin



Bending by smooth support and acting anvil



Example of roller bending tool

Copper leadframe properties

[Overview list for copper + Matte tin plating , plating thickness 5→20 microns]

Yield strength [0.2%]	Ult. tensile strength	Young's mod.	Poisson ratio	Shear mod.
330 [Mpa]	356 [Mpa]	107 [GPa]	0.34	39.9 [GPa]

Insertion onto the PCB and Soldering Support

- Automatic SMD style placement of SIP parts with straight leads parallel to the PSB is risk free when within standard SMD insertion process tolerances.
- Throughole insertion, especially automatic requires a precise pin-to-via pattern matching by an optical alignment system.
- Prior to insertion, parts shall be inspected for bent leads, resulting from lead trim/form process. Insertion of parts with bent leads creates an undefined stress to the package and may lead to a delamination – during insertion of during the following soldering process when a thermal impact will be applied on top of mechanical tension.
- It is recommended to have on-line displacement and force control of the insertion head, thus being able to reject parts where those parameters are out of nominal window.
- Care shall be taken, when supporting the SIP sensor in position for soldering with pushers, frames, etc. that not more than 3N force is applied by this support to avoid "spring loaded" leads during soldering. High temperature of soldering may heat the plastic body over epoxy glass transition point (150C). No force external or through spring loaded leads shall be applied to the body under such conditions.