CONTROLLING WIREBOND LENGTH

Wire bond length is normally something assembly subcontractors worry about only for mechanical reasons. Their impact on electrical performance is not well-understood by the materials and mechanical engineers who support the assembly lines. An assembly engineer usually wants high enough wirebond loops to avoid stressing the wire above the ball. She or he also wants downbonds long enough to keep far away from the die edge to avoid bonding to epoxy resin bleedout.

It is up to the high frequency customer to explain the critical nature of keeping these wires short and to put enough documentation restrictions in place to insure wire lengths are consistent over time.

Automatic wirebonders use reference points to calculate where the ball bonds and stitch bonds (second bonds) are to be placed. This is used to compensate for small variations in the die and leadframe placements. There are reference locations on the die and on the leadframe which are found by an optical recognition system on the bonder. The usual method is that ball bonds on the die are referenced to the die and stitch bonds on the leadframe are referenced to the leadframe. However, most bonders will allow us to reference the downbond stitch bonds to the die instead. Figure 13.1(c) shows when using this referencing method when a die is mis-positioned, the downbonds will “move” with the die, always maintaining a uniform downbond length. With the standard reference method as shown in Figure 13.1(b), the wires on the bottom get shorter while the wires on the top get longer. The one hazard with referencing stitch bonds to the die is if the die moves too much, the bonder will try to bond off the edge of the paddle. The bottom wires in Figure 13.1(c) demonstrate this risk: if the die moves any farther, the stitch bonds will be off the paddle. A similar problem occurs with the normal referencing as shown by the bottom wires in Figure 13.1(b) where the stitch bond is getting too close to the die edge. In the extreme case, the bonder would try to make the stitch bond on the die instead of on the paddle.
Another caution with using stitch bonds referenced to the die is clearance to the signal wires must be addressed. If the die shifts or rotates from nominal when the die is attached, the spacing between a downbond and a signal wire may be compromised to the point of shorting. Figure 13.2 shows shorting becomes a significant risk as the die rotates.

This issue will seldom result in an actual short since the two wires are normally in different planes except for very near the die. It does create an inspection issue since operators cannot tell if it is shorted by looking directly down on the part. If this alignment issue is understood and accounted for in the programming of the downbond locations, it will not normally be a significant problem.

ADJUSTING WIREBONDS FOR TUNING

In most cases, short wires are desirable. However, since electrical models used in RF design are still not perfect, there are times when a longer wire is desirable for tuning reasons. This is usually found after prototypes have been built and some electrical parameters did not match simulation values. Often changing lengths of particular ground bonds, as shown in Figure 13.3, will trade off one performance parameter for another. By varying downbond lengths on sample parts, a preferred balance in electrical parameters is found. Once this is achieved, the preferred length must be well-documented for repeatable results with the subcontractor. In some cases, the reason behind the performance tradeoff is well-understood and simulations can replicate the tradeoff as downbond inductance is varied.