WHITE PAPER

Customizing Processes for Hermetic Assembly Of Devices Designed for Plastic Packages (2 of 3)

Charlie C. Megia
Golden Altos Corporation
402 South Hillview Drive, Milpitas, CA 95035
cmegia@goldenaltos.com
Tel: 1-408-956-1010 Fax: 1-408-956-1212

Abstract

Today's leading-edge semiconductor devices are designed and manufactured for high volume, low cost industrial and consumer based products. The design and layout of these new integrated circuits (ICs) favor plastic molded assembly with an eye toward reduced cost, not dependability. This leaves the high reliability, low volume military and aerospace applications with fewer hermetic package choices directly from the Original Component Manufacturer (OCM). The challenge exists to bridge the reliability requirements of military and aerospace communities with leading edge ICs designed for the mass market.

Wire bond issues

Plastic packages typically will use gold ball bond process to connect the die to the package. The latest trend of using copper wire offers a significant cost saving while still following similar bonding construction as using gold wire.

Ball bond dimensions are smaller than the aluminum wedge bonds used in military and space hermetic assembly since the point of contact on the die is just the size of the ball, not the wedge.

Bond angles greater than 30° do not affect the adjacent bond even with tight bond pad spacing of 0.25 mils. With ball bonding, the wires exiting the ball from the top and will not touch the adjacent wire, a bond pad or bond.

This is not the case with wedge bonds as the bonds are typically longer due the structure of the bond. See Figure 2.1 below from MIL-STD-883 TM2010.

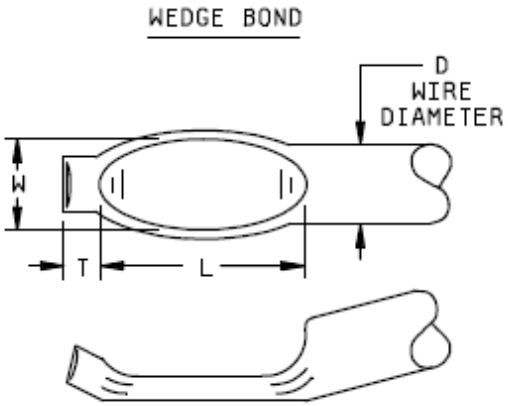

Fig. 2.1 from MIL-STD-883 TM2010

Due to the physical structure of the wedge bond, the bond angles play a critical role in connecting the die to the package. If the pad spacing is limited as it is with high pin count devices used in plastic packages, the heel or the bond tail can overlap the adjacent bond pad.

These structures are shown in Figures 2.2a and 2.2b on a high pin count LGA plastic package device being adapted for hermetic assembly. The gold ball bond process used for plastic assembly is not affected by bond angles or limited pad spacing.

Figure 2.2a. Ball bond

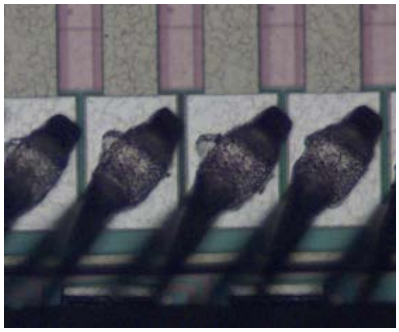

Figure 2.2b. Wedge bond

Wire Bond Process Change

Several ways exist to mitigate this problem and a combination of process changes may be required to achieve optimal assembly yield results.

The probability of device being redesigned at the die level for hermetic assembly only is very low due to the cost for low-volume production runs. This alternative is usually not an option.

Hermetic package layout redesign is an option to reduce the wire egress angle out to the package post. While this choice could be a costly proposition, it's considerably less expensive when compared to a die layout redesign and fabrication.

Other options include using smaller footprint wedges and changing the bond sequence from forward bond to reverse bond on connections with severe bond angles. This will eliminate the length of the bond tail thus reducing the overall bond length.

Wire crossover must be avoided on bonds located on the same tier since both the power and ground plane might be located on the same tier as the device input and/or output signal connections.

Other electrical considerations must be taken into account. Signal pairs where the impedance must be matched forces the length of these wire to be of similar dimension. The use of multiple tiers can also improve bond angle. The downside can be an increase in the package dimensions. Figure 2.3 is an excellent example using multiple tiers to maintain matching pair impedance while improving bond egress angles to as close to 90° and.

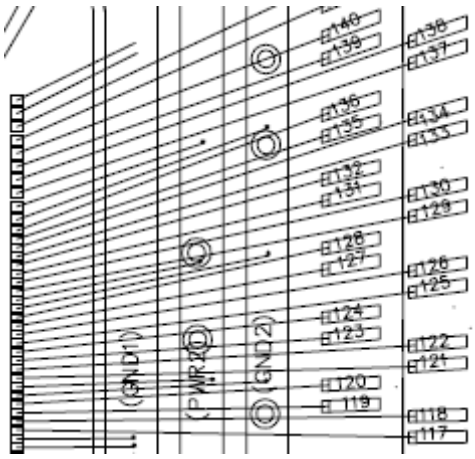

Figure 2.3 Multi-tier with match pairs

The methods discussed for wire bond make it possible to assemble a die (originally designed for a plastic package) in a hermetic package. A combination of these techniques often yields positive results, but there's no guarantee all devices will make this transition.