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IC Socket Footprint – Why is it important?

By Ila Pal, Ironwood Electronics | Wednesday, July 6, 2011

An IC socket can be defined as an electromechanical device, which provides a removable interface between the IC package and the system circuit board with minimal effect on signal integrity. A removable interface is the major reason for using a socket, and it is required for a variety of reasons, including ease of assembly, reworking, upgrading and cost savings. The cost advantage is saving the IC by not attaching it permanently to the PCB (printed circuit board). The socket is permanently (soldered) or semi-permanently (solder less) attached to the PCB, while the IC device can be inserted into or removed from the socket without disturbing the connections to the PCB. This allows the IC to function as it is soldered into the PCB, but it can be replaced by another IC or multiple ICs. The socket helps to test, evaluate and inspect the complete system. The socket also allows in the field for maintenance, testing, replacement or upgrades. This becomes a critical factor because of technology evolution.

Sockets are a necessary component in designing today's electronic products. In the design process, sockets offer advantages in terms of flexibility of design, prototype evaluation, and product iteration; all geared toward speeding up time to market. During the design verification process and production startup, sockets provide the ability to verify the consistency of the design in both the pre-production as well as in the ongoing production quality control process. Finally, in the end-use application, high-performance sockets may offer an attractive alternate to direct solder attach, especially in those applications where product upgradeability and field repair are important. Regardless of the application, both high performance and small footprint are desirable characteristics for the consideration of any socket.

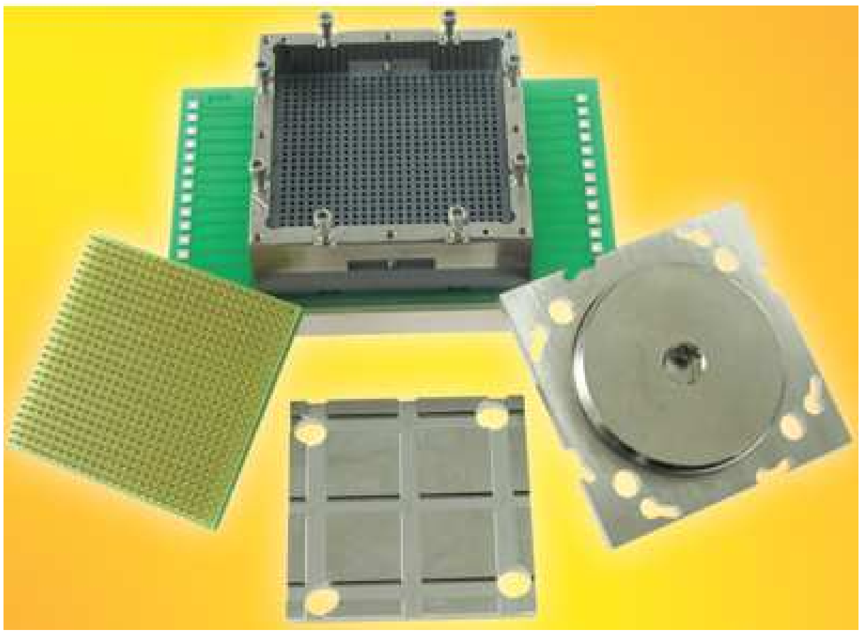
A socket's use can be classified into two major categories:
• Microprocessor, chipset, ASIC – IC development
• Mother board, various application boards – system development

A small footprint is important whenever a socket is considered for:
• Design and development – small keep-out areas allow capacitors and resistors to be placed close to an IC; and similarity to end-use conditions
• Design verification – similarity to initial design and end-use conditions, signal integrity, etc.
• Burn-in application – Cost savings; cost per square inch of PCB utilization; speed-to-market
• Production – minimize board real estate and space for other components
• Failure analysis – similar to production board to weed out signal integrity and logic issues.

The following paragraphs describe various socket mounting configurations and corresponding footprint details.

Solder-mount sockets require no tooling holes to mount on an existing target PCB. The socket solders directly to the target board lands and requires a clearance of 3.75 mm from the perimeter of the BGA package. Standard surface mount methods can be used to attach the surface mount base of the socket, employing low temperature eutectic solder balls, to the target PCB. The IC is then dropped into the socket base, and the lid containing a screw mechanism is added and tightened.

Direct-mount sockets (shown in Figure 1) possess further minimal real estate characteristics (smallest clearance of 2.5 mm from the perimeter of the BGA package) than the solder mount version. The flux and reflow requirement (a semi-permanent attachment process) is eliminated by adding tooling holes to the target PCB and mechanically fastening the socket and back-plate to the PC board. The Z-axis conductive medium is the only component between the IC's solder balls and the target board pads. This Solder-less Direct Connect socket allows the highest speed operation – up to 40 GHz.



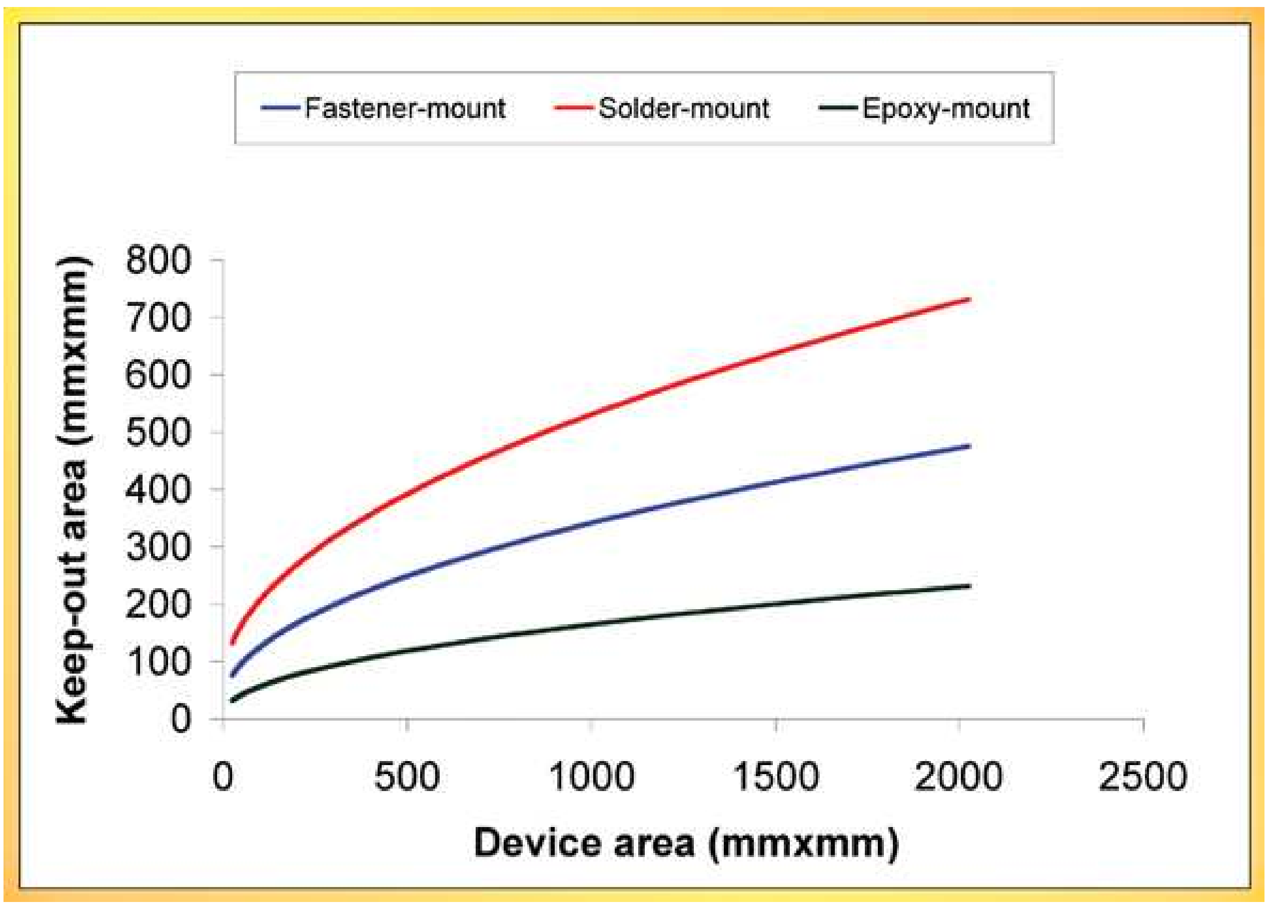
Epoxy-mount sockets (shown in Figure 2) require no tooling holes to mount to a target PCB and possess the smallest footprint (clearance of 1.25 mm from the perimeter of the BGA package) than the other versions. An intricate pattern on the socket wall maximizes surface area to ensure a high-strength bond to the target PCB. The epoxy sockets align to the target land pattern with a special alignment guide. A bead of epoxy is applied around the specially designed base of the socket to attach it to the target PCB. The remaining features are the same as the direct mount socket. This epoxy mount version allows the highest speed operation as well – up to 40 GHz.

A clam-shell lid or swivel lid that allows quick removal and replacement of BGA packages can be integrated to the socket base structure while featuring the same space efficient design as any of the mounting configurations mentioned earlier.

Z-axis Conductive Medium

Two of the most common high frequency contactors for a socket are elastomer and spring pin with bandwidths of 8 GHz to 40 GHz and 2 GHz to 20 GHz, respectively, depending on the device requirements. These contactors define the vertical profile for the socket. Elastomer-based sockets are 8.5 mm from the PCB surface. Spring pin based sockets are 10 mm to 12mm from the PCB surface. The clam-shell lid option adds another 7 mm to 10 mm to the vertical height.

Figure 3 shows the relation between the keep-out footprint area versus the device footprint area for the three different socket mounting configurations. It can be seen from the graph that the epoxy-mount provides the smallest keep-out to device footprint ratio. The graph is very useful in selecting the right socket configuration based on the device and keep-out footprint dictated by application requirements. Selective areas can be removed from the socket wall to make the footprint further small in all three socket configurations. A bending moment analysis has to be performed in those special cases to validate the rigidity of socket structure.



Conclusion

Small footprint is a necessary evil for both IC level and system level development and testing. A common PC board footprint provides advantages and benefits when moving from product design into development testing and verification which include:

- Electrical parameters remain unchanged
- Overall cost and time to market are reduced
- Compatible socket mounting enables cross verification

Direct-mount offers the benefit of easily removability from the system board. Epoxy-mount offers the smallest footprint without the requirement of tooling holes in the target PCB. Small footprint is exceptionally valuable in those tiny handheld device board system testing as the future paves toward miniaturization.

About the Author

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