Benefits of Three Dimensional Packages

The high growth and development of multiple 3D packaging technologies are due to the system level benefits provided, including:

• Size and weight reduction through more semiconductor functions per cm² of PWB space and cm³ of application space
• Enables more design freedom to create innovative new form factors and styling through volumetric packaging approach
• Enables higher electrical performance through shorter interconnect architectures with stacking
• Reduced system level costs

Die Stacking

Amkor’s die stacking technologies are widely deployed in high volume manufacturing across multiple factories and product lines. The key features: reliability, process and materials data are listed in the Stacked CSP data sheet. Customers rely on Amkor’s turnkey and leading edge capabilities in design, assembly and test to solve their most complex 3D packaging or time to market challenges.

Next generation die stacking technology includes the ability to handle wafers and die thinned down to below 35 µm. It can then be reliably stacked and interconnected with up to 16 active devices high, employing leading edge die attach, wire bond and flip chip assembly capabilities.

Die stacking technologies have been demonstrated up to 24 high stacks, however, most stack ups greater than 9 devices high use a combination of die and package stacking technologies to address complex test, yield and logistic limitations.

Die stacking is also widely deployed in conventional leadframe-based packages including QFP, MLF® and SOP formats. Leveraging Amkor’s industry leading infrastructure for high volume, low cost leadframe production, system designers can achieve significant savings in PCB real estate and overall cost.
**Package Stacking (PoP – Package on Package)**

Stacking of fully assembled and tested packages is an area where Amkor has provided significant innovation to overcome the technical, business and logistics limitations associated with complex die stacks. Amkor launched the popular Package Stackable Very Thin Fine Pitch BGA (PSvBGA) platform in 2004. PSvBGA supports single die, stacked die using wirebond or hybrid (FC plus wirebond) stacks and has been applied to Flip Chip (FC) applications to improve warpage control and package integrity through test and SMT handling.

As handheld microprocessors have transitioned to advanced CMOS nodes with higher speed cores with higher I/O, there has been a transition from wirebond to flip chip die designs. Flip chip enables the use of an exposed die bottom package that integrates the packaging design features of PSvBGA in a fcCSP assembly flow, which Amkor calls Package Stackable Flip Chip Scale Package (PSfcCSP). PSfcCSP has a thin exposed FC die enabling fine pitch stacked interfaces at 0.5 mm pitch which is a challenge in a center molded PSvBGA structure.

Continued development resulted in Amkor entering the second generation of PoP applications where new memory architectures, required in mobile multimedia applications, demand higher density stacked interfaces in combination with PoP mounted area and height reductions. The previous PSvBGA and PSfcCSP structures limited the ability of the memory interface to scale in density and pitch, resulting in the need for a new bottom PoP structure.

Amkor developed new technologies to create the next generation PoP solution with interconnect vias through the mold cap, naming this technology Through Mold Via (TMV®). TMV technology provides a stable bottom package that enables use of thinner substrates with a larger die to package ratio. TMV enabled PoP can support single, stacked die or FC designs. TMV is an ideal solution for the emerging 0.4 mm pitch low power DDR2, DDR3 and follow on memory interface requirements and enables the stacked interface to scale with solder ball pitch densities to 0.3 mm pitch or below.

The next few years promise to provide many new challenges and applications for PoP, as handheld multimedia applications continue to demand higher signal processing power and data storage capabilities. Amkor is committed to maintaining strong development and production capabilities to ensure we are at the forefront in meeting next generation PoP requirements.