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DESIGN AND OPTIMIZATION OF NOVEL RF PACKAGING STRUCTURES USING MULTIRESOLUTION AND STATISTICAL SCHEMES

Manos M. Tentzeris*, Daniela Staciulescu, Nicholas G. Cafaro, Joy Laskar
School of ECE, Georgia Institute of Technology, Atlanta, GA 30250-0250
(FAX : (404) 894-4641)
(*e-mail:etentze@ece.gatech.edu)

The explosive growth in wireless communications has spawned a great deal of research in electronic interconnects and packaging for high performance devices. In many respects, packaging and interconnects are the limiting factors in high data rates/high-bandwidth circuits and, therefore, require careful consideration in system design. Most interconnections are commonly formed in one of three technologies: wirebond, flip-chip or tape automated bonding. Wirebond is by far the most pervasive of the three due to its ability to provide simple, reliable, and above all, low-cost connections.

Wirebonds have been widely used at lower frequencies in digital applications, where parasitics are not as critical. However, when used in high frequency analog applications such as receiver front ends, wirebonds can exhibit appreciable parasitics. In the microwave regime, the wirebond can be on the order of a wavelength and the discontinuity the wirebond introduces may result in significant loss. One way to mitigate this adverse effect is through the use of multi-wire interconects. In this way, the parasitic effect at higher frequencies gets reduced depending on the distance and the positioning of the wirebonds.

Flip-chip packaging is an alternative RF packaging configuration that offers low cost, high density and short transition interconnect as well as higher mechanical reliability. Among the critical design issues, the use of multiple signal and/or ground bumps is sometimes necessary for thermal and electrical shielding purposes. Though preliminary results have shown that multiple signal configurations don't improve the electrical performance, multiple ground bumps have demonstrated promising results.

It has been clear from the preceeding discussion that gaining a general understanding of the number and the geometrical parameters of both wirebond and flip-chip configurations is critical for the optimization of their electrical performance. The MultiResolution Time-Domain (MRTD) technique that is based on the Haar expansion basis provides an accurate and reliable full-wave technique that combines the advantages of the FDTD time-domain technique, while reducing the memory and execution time requirements by orders of magnitude. In addition, the capability of wavelets to offer a time- and space-adaptive resolution enhances the simulation efficiency especially close to the geometry discontinuities. The statistical technique of DOE (Design of Experiment) applied on the simulated results identifies the most significant geometrical parameters and further reduces the time required for the derivation of practical design rules.