# Efficient Characterization of Interference Propagation in Multilayered Substrates with Multiple-Stage Open Discontinuities

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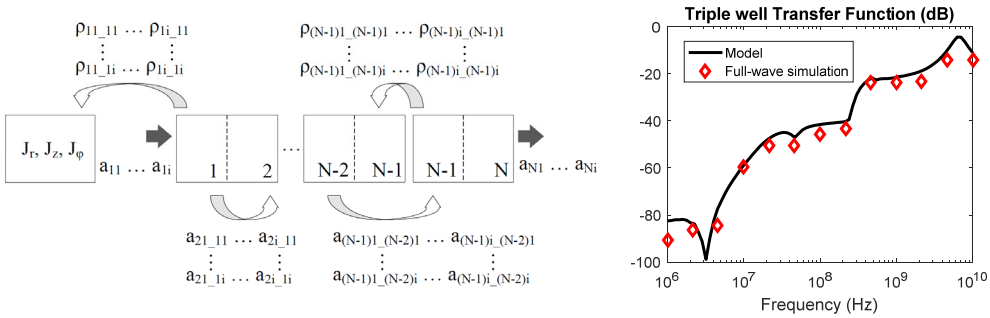
## Extended Abstract

Integration levels in electronic systems have been continuously increasing to enable the development of high-performance products and applications. This implies that different electronic functional blocks (e.g. ADC's, radios) are implemented in the same substrate and, therefore, share a common path for potential unwanted coupling between them. In this context, characterizing electromagnetic interference propagation mechanisms in multilayered substrates with embedded isolation structures is a key point to enable a disturbance-aware design environment. In addition, the continuous increase of operation frequencies pushes the validity of quasi-static approximations, as well as single-mode representations that lead to traditional behavioral RC networks. Consequently, there is a need of models able to account for electromagnetic effects, such as multimodal propagation [1], in an effective way.

In this work, a modeling methodology is proposed for the characterization of interference propagation in multilayered substrates (e.g. SOI or bulk substrates) in the presence of multiple-stage discontinuities (see Fig. 1-a), for efficient modeling of complex passive isolation structures of multiple kinds, such as triple wells or filled trenches. It is based on a modal expansion of fields and a subsequent smart selection of those modes that effectively contribute to substrate coupling. With it, we are able to obtain a reasonably accurate characterization (see Fig. 1-b) approximately 300 times faster than with FEM full-wave simulations.




(a) (b)

**Figure 1.** (a) Solution flow of the complete multiple-stage structure. (b) Example of a triple-well structure transfer function obtained with the proposed model and with full-wave simulations.

## References

1. M. Grau Novellas, R. Serra, M. Rose, "Methodology for Coupling and Interference Prediction in Integrated Circuit Substrates," *IEEE Trans. on EMC*,**58**, 4, 2016, pp. 1118-1127