SUBSTRATE NOISE

Analysis and Optimization for IC Design

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Foreword

The understanding, prediction, and control of unforeseen interactions within integrated circuits has been a major impediment to the timely development of analog, mixed-signal, and high-performance digital integrated devices since the dawn of the industry in the 1960s. The most important of these have resulted from the effect of package lead impedance, thermal effects, and electrical interactions through the substrate. Since the physical origin of these was often not well understood, much less characterized and modeled, the interactions were often not evident until actual silicon devices were fabricated, requiring cycles of design changes to produce a manufacturable device.

This problem has become more severe as the complexity of mixed analog-digital integrated circuits has become ever greater, and the operating frequencies and bandwidths processed on chip have increased steadily. The semiconductor industry is moving towards an era in which analog and digital subsystems will reside together on large complex chips, resulting in far higher levels of integration than now. This can only occur if these unforeseen interactions can be more effectively predicted during the design process than is the case now, resulting in reasonable design cycles to achieve a manufacturable product.

This book addresses the critical problem of the modeling and characterization of interactions through the substrate, perhaps the most difficult of the classes of interactions to characterize and model. Solution of the problem involves finding modeling approaches that maintain the right compromise between computational complexity and degree of accuracy. Computational approaches that are well suited to the particulars of the problem, and finally developing design approaches that result in designs that are relatively insensitive to substrate interactions. The book provides an excellent summary of the state of the art in these areas.

Paul R. Gray