Abstracts

A study on substrate effects of silicon-based RF passive components

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The substrate effects on the performance of metal-insulator-metal (MIM) capacitors and spiral inductors are critical to silicon RF IC's. Based on measured results and physical modeling, this paper presents an extensive study on the substrate parasitics. Contrary to common belief, it is shown that (1) the energy loss in lightly doped substrates is higher than that in epi substrates with heavily doped bulks, (2) the eddy current induced by inductors is negligible even in heavily doped epi substrates up to several giga-hertz, and (3) the high-frequency degradation of Q for inductors on epi substrates is due to a larger substrate parasitic capacitance which results in a lower self-resonant frequency compared to lightly doped cases. Furthermore, we report for the first time the improvement in Q for inductors on epi substrates with a patterned ground shield. A fourfold improvement in the Q of a LC resonator is achieved using polysilicon, or source/drain diffusion, PGS's.

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