Abstracts

Modeling of Picosecond Pulse Propagation in Microstrip Interconnections on Integrated Circuits

K.W. Goossen and R.B. Hammond. "Modeling of Picosecond Pulse Propagation in Microstrip Interconnections on Integrated Circuits." 1989 Transactions on Microwave Theory and Techniques 37.3 (Mar. 1989 [T-MTT]): 469-478.

We have made theoretical time-domain analyses of the dispersion and loss of square-wave and exponential pulses on microstrip transmission line interconnections on silicon integrated-circuit substrates, using the quasi-TEM approximation. Geometric dispersion and conductor line width, as well as losses from conductor resistance, conductor skin effect, and substrate conductance, are considered over the frequency range from 100 MHz to 100 GHz. Results show the enormous significance of the substrate losses and demonstrate the need for substrate resistivities >10 Omega · cm for high-performance circuits. The results also show the effects of geometric dispersion for frequencies above 10 GHz (which increase with decreasing line width), the unimportance of conductor skin-effect losses for frequencies up to 100 GHz, and the transition from a high-frequency regime where losses do not affect phase velocity to a low-frequency regime where the ratio of the conductor and substrate loss coefficients determines phase velocity. Qualitatively similar phenomena are seen for Al, W, and WSi/sub 2/ lines, but low-frequency velocity is increased for either increasing conductor resistivity, decreasing conductor line width, or both. Poly-Si, with its significantly greater loss, shows qualitatively different frequency-dependent behavior. High phase velocity and high loss can coexist in poly-Si lines.

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