Abstracts

Coplanar Transmission Lines on Thin Substrates for High-Speed Low-Loss Propagation

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We investigate the attenuation and phase velocity characteristics of coplanar strip (CPS) transmission lines designed for high-speed, low-loss propagation at sub-THz frequencies. Photoconductor switches driven by femtosecond optical pulses were used to generate propagating picosecond electrical transients. External electrooptic sampling was used to measure the time-domain impulse-response characteristics with subpicosecond time resolution. The finite-difference transmission-line-matrix (FD-TLM) numerical method was used to model picosecond pulse propagation on identical transmission lines. The experiment and the numeric simulations have clarified nonquasistatic high-frequency effects and were shown to agree over a 500-GHz frequency range. Additionally, analytic quasi-static velocity and characteristic impedance formulas have been verified and their frequency range of validity established for the investigated CPS geometries. Radiation into the substrate is the dominant loss mechanism at frequencies above ~100 GHz for the CPS lines on thick substrates. CPS transmission line fabrication on thin substrates has been proposed as a method for reducing high-frequency loss and increasing the microwave propagation velocity. CPS transmission lines fabricated on 8-µm-thick Si membranes have been studied and demonstrated to possess the desired high-speed, low-loss properties.

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