Abstracts

Electromagnetic Coupling of Coplanar Waveguides and Microstrip Lines to Highly Lossy Dielectric Media

M.F. Iskander and T.S. Lind. "Electromagnetic Coupling of Coplanar Waveguides and Microstrip Lines to Highly Lossy Dielectric Media." 1989 Transactions on Microwave Theory and Techniques 37.12 (Dec. 1989 [T-MTT] (1989 Symposium Issue)): 1910-1917.

In medical diagnosis and geophysical well-logging applications of electromagnetic (EM) techniques, it is of critical importance to couple the EM energy to the object under interrogation efficiently and with minimum external leakage. Experimentally, a family of coplanar waveguides and microstrip lines has proven to be ideal EM energy couplers for such applications. To date, no analytical work has been done to investigate the coupling characteristics of these structures to highly lossy dielectric media. In this paper, the spectral-domain technique is utilized to analyze the coupling characteristics of coplanar waveguides and microstrip lines to multilayer lossy dielectric media. Numerical results illustrating the dispersion characteristics of coplanar and microstrip lines, as well as the various electric field components coupled to highly lossy dielectric media, are presented. It is shown that the presence of a superstrate of lossless dielectric between the coplanar waveguide and the lossy medium plays a key role in setting up an axial electric field component that facilitates leaky-wave-type coupling to the lossy medium. The thickness of the superstrate relative to the gap width in the coplanar waveguide is important in controlling the magnitude of this axial electric field component. It is also shown that even a very thin superstrate layer would generate the leaky-wave type axial electric field component in the lossy medium. The coupling characteristics of the microstrip and coplanar lines are compared, and results generally show improved coupling if coplanar waveguides were utilized. Specifically, values of the attenuation constant alpha are higher for coplanar waveguide than for microstrip line, and for both structures, alpha decreases with the frequency decrease. These, as well as other observations, are illustrated graphically.

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