Crosstalk Analysis of Micromachined Rectangular Coaxial Lines

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Increased interests in mm-wave applications and related systems have contributed to the development of various micro-fabrication technologies capable of producing high performance lines and components. Traditional approaches revolve around the planar structures i.e., microstrip lines and/or coplanar waveguides and the application thereof. Although the cost is low, they inherently have problems such as significant cross-talk and substrate losses. Recent advances of microelectromechanical systems (MEMS) fabrication techniques including the surface micromachining have contributed to several successful demonstrations of low-loss, small, rectangular coaxial lines (RCLs), also known as recta-coax. A common theme for surface micromachining RCL processes is the necessity for using the release holes. For higher package densities it is desired that the neighboring lines are separated by a single wall. To facilitate easier fabrication, the release holes need to be integrated in the common wall. From the fabrication perspective, these holes should be as large as possible. However, this results in larger coupling through the holes.

In this paper, coupling through holes etched in a common wall between the neighboring surface micromachined RCLs is studied. Analytical models for single and multiple-hole structures are developed using Bethe's small aperture theory, and excellent agreement with finite element and finite integration simulations is obtained. An isolation test structure composed of 200μm center-to-center separated, 300μm tall, 50Ω rectangular coaxial lines is designed, built, and measured. Coupling levels below -55dB over 1cm long coupling lengths are measured throughout the Ka band. It is found that the probe radiation is more than 10dB higher than the coupling through the common wall holes. An extensive cross-talk analysis of multi-layered RCLs is conducted and over 60dB of isolation in multiple dimensions is computed. These results have shown that ultra dense fully integrated three-dimensional systems are capable for simultaneous Rx/Tx mm-wave operation with very little cross-talk between interconnects, components, and sub-systems.