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Design and Modeling of Periodically Loaded Transmission Line Metamaterial Structures SUSHIL BHARATAN, MICHAEL PETRAS, CHANDRA RAMIAH, Freescale Semiconductor, Inc., R. RAMPRASAD, University of Connecticut — Transmission lines periodically loaded with suitable elements form a class of photonic band gap (PBG) materials that display unusual properties at frequencies where the electromagnetic (EM) wavelength is much smaller than the spacing between periodic loading. So, effective medium theories which use circuit elements as building blocks can be used to describe these systems. A design framework to determine the properties of such meta-material structures has been developed based on circuit models of the unit cells. The models were parameterized using full wave EM field solvers, and the parameterization has been used in subsequent designs of a large class of structures. The predictions of our effective medium model and that of the EM simulations have been validated by measurements. The effective medium model is orders of magnitude faster than full wave EM simulations, reflecting the efficiency of this approach in rapid design. This technique is applied here to 1-D transmission line structures loaded periodically with metal posts. However, it can easily be extended to other types of periodic loading and to 2-D structures as well.

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