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A Yttrium Iron Garnet-Lead Zirconate Titanate Phase Shifter
G. SRINIVASAN, A.S. TATARENKO, Oakland University, M.I. BICHURIN, Novgorod State University, Russia — Tunable microwave phase shifters are of interest for miniature oscillators and phased array antenna systems. Traditional ferrite phase shifters use magnetic tuning systems that are slow, demand high power, and are not miniature in size. Here we discuss the design, fabrication and characterization of a novel electric field tunable phase shifter based on a yttrium iron garnet (YIG) – lead zirconate titanate (PZT) bilayer. The electrical control of the phase shift is realized through magnetoelectric (ME) interaction. The phase shifter consisted of a microstrip transmission line with stubs of $\lambda/8$ and $3\lambda/8$ lengths for generating circularly polarized microwave magnetic field in the YIG-PZT resonator. The ME resonator was made from 124 micron thick (100) YIG film on GGG and 0.5 mm thickness PZT with electrodes. The operating frequency of the phase shifter was set by applying appropriate bias magnetic field. The phase shift vs. electric field E characteristics was linear or quadratic in E, depending on the operating frequency. The maximum phase shift was 180 deg. and showed an insertion loss of 1.5-2.0 dB at 5 GHz and 3-4 dB at the frequency 10 GHz. The ME phase shifter is capable of rapid tuning, miniature in size and dissipates practically zero power. – The work was supported by grants from ONR, ARO and NSF.

G. Srinivasan

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