A Broadband Planar Folded Dipole over an EBG Ground Plane

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When a straight-wire dipole element is located parallel to a metal or perfect electric conductor (PEC) ground plane, the image current within the ground plane has equal amplitude and is 180º out-of-phase with the source current along the dipole. At a spacing s, of 0.25λ above the metal ground plane, one-half of the dipole's radiation is redirected normal to the ground plane, increasing the directivity by approximately 5 dB. At very close spacings where $s \rightarrow 0$, the increase in directivity is approximately 7 dB. As $s \rightarrow 0$, the radiation resistance of the dipole also approaches 0 and there is a significant decrease in realizable bandwidth. While the radiation resistance of the dipole can be matched to 50Ω [S. R. Best, *IEEE AWPL*, Vol. 3, pp. 359, 2004] to realize a high radiation efficiency, the realizable bandwidth remains narrow. EBG ground planes [D. Sievenpiper et al, *IEEE Trans. Microwave Theory Tech.*, Vol. 47, No. 11, pp. 2059, 1999] allow a dipole element to be closely spaced to the ground plane and maintain a reasonable bandwidth. Here, we consider the performance properties of a planar folded dipole element in close proximity to an EBG ground plane with emphasis in examining the bandwidth and pattern characteristics. We show that a planar folded dipole element can be designed to exhibit a 2.0:1 *VSWR* bandwidth in excess of 30% [S. R. Best and D. Hanna, *Antenna Applications Symposium*, 2005]. We show that an impedance match can be achieved independent of the EBG ground planes reflection phase. We show that usable bandwidth is limited by pattern degradation at both the upper and lower ends of the matched bandwidth. We compare the performance of the folded planar dipole element over both the EBG and PEC ground planes and describe limitations of element design that affect achievable bandwidth.

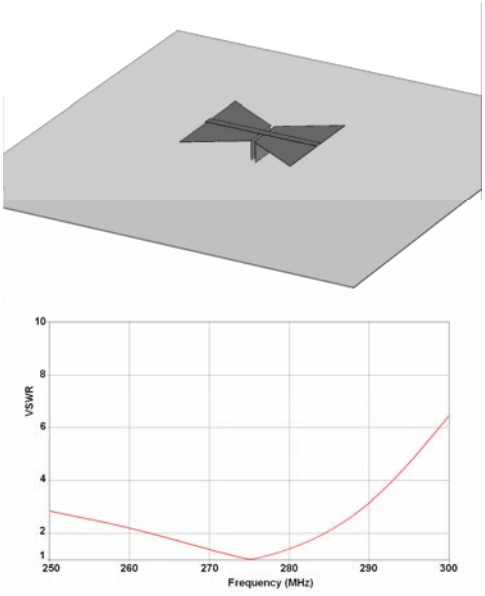

Fig. 1. Planar folded dipole over a PEC ground plane.

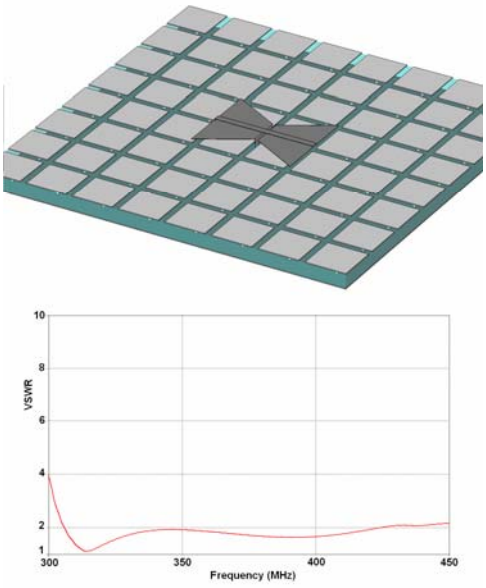

Fig. 2. Planar folded dipole over an EBG ground plane.