Broadband and Multiband CPW-Fed Planar Inverted-F Antennas

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Planar Inverted-F Antennas (PIFA) are popular in wireless devices due to their compact and low profile sizes. Conventional designs of a PIFA can be viewed as a post loaded rectangular microstrip patch fed by a probe. PIFAs fed by coplanar waveguides also were investigated in the literature. In this paper, two new CPW-fed PIFA configurations are investigated: one is aimed at increasing the impedance bandwidth and the other is aimed at realizing mutiband operation. In the first configuration, parasitic printed dipole elements are used to significantly enhance the bandwidth. In the second configuration, quarter-wavelength stubs are integrated with the PIFA in order to realize multiband operation. In addition, the effect of enclosing both PIFAs with a wide aperture to convert end-fire radiation to broadside radiation is also investigated.

Theoretical investigations are carried out using Ansoft HFSS (a finite-element solver) and Ansoft Designer which includes a method of moments solver. Various antenna parameters are optimized to obtain desired performance using a dielectric substrate with a 10.2 dielectric constant of 10.2 and 1.27 mm thickness. For the PIFA with parasitic elements, the effect of element dimensions, location, and number of elements on impedance bandwidth as well as radiation patterns are investigated. It is shown that adding one or two parasitic dipole elements in proximity to the driven PIFA element can enhances the bandwidth significantly. Furthermore, stability of the radiation patterns throughout the frequency band is also investigated. For the antenna with stubs, it is shown that adding a single stub to the PIFA element results in dual band operation with good bandwidth for each frequency band of operation. The effect of adding more stubs to produce more frequency bands is also investigated.

In order to obtain broadside radiation, both proposed antennas were surrounded by the CPW ground planes resulting in PIFAs placed in a wide aperture. Aperture dimensions in addition to the PIFA dimensions were optimized to produce broadband operation for the PIFA with parasitic elements or multiband operation for the PIFA with stubs. In addition to obtaining broadside radiation, it is shown that the aperture also improved the stability of the radiation patterns for the broadband antenna throughout the frequency band. All the results are validated experimentally. Design details as well as theoretical and experimental results will be presented.