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Research Article

A Double Inverted F-Shape Patch Antenna for Dual-Band Operation

M. M. Islam,[1] M. R. I. Faruque,[1] W. Hueyshin,[1] J. S. Mandeep,[2] and T. Islam[2]

[1] *Centre for Space Science (ANGKASA), Universiti Kebangsaan Malaysia, 43600 Bangi, Selangor, Malaysia*
[2] *Department of Electrical, Electronic and Systems Engineering, Universiti Kebangsaan Malaysia, 43600 Bangi, Selangor, Malaysia*

Correspondence should be addressed to M. M. Islam; mmoiislam@yahoo.com

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A double inverted F-shape patch antenna is presented for dual-band operation. The proposed antenna is comprised of circular and rectangular slots on a printed circuit board of 40 mm × 40 mm × 1.6 mm with a 50 Ω microstrip transmission line. Commercially available high frequency structural simulator (HFSS) based on the finite element method (FEM) has been adopted in this investigation. It has a measured impedance bandwidths (2 : 1 VSWR) of 18.53% on the lower band and 7.8% on the upper band, respectively. It has achieved stable radiation efficiencies of 79.76% and 80.36% with average gains of 7.82 dBi and 5.66 dBi in the operating frequency bands. Moreover, numerical simulations have been indicated as an important uniformity with measured results.

1. Introduction

The raising demands of wireless communication systems enforce the improvement of dual-band antennas that have abilities to operate under different standards in different frequency bands. Advances in wireless communications have introduced tremendous demands in the antenna technology. It also paved the way for wide usage of mobile phones in modern society resulting in mounting concerns surrounding its harmful radiation [1, 2]. Microstrip patch antenna plays an important role as a harbinger in wireless communication systems and is gradually carrying out to face the changing demands of update antenna technology. Microstrip patch antennas are presently under concern for using in broadband communication systems due to their attractive characteristics, such as low profile, low cost, lightweight, wide frequency bandwidth, ease of fabrication, and easy integration with monolithic microwave integrated circuits [3, 4]. However, the limitations of the microstrip patch antennas are having narrow bandwidth, and for that reason the demand of the bandwidth enhancement is gradually rising in the practical applications [5]. In order to enhance its bandwidth, many approaches have been applied conventionally, such as using thick substrates with low dielectrics constant, impedance matching network, parasitic patches stacked on the top of the main patch [6], slots loaded on the patch, high dielectric constant substrate, and adopting short-circuit pin [7].

In [8], a rectangular slot antenna has been stated for dual frequency operation. Reference [9] has narrated a printed dipole antenna to cover dual band with U-slot arms. Reference [10] has been reported a low cost microstrip dipole antenna for wireless communications. In [11], a PIFA antenna has been presented for dual band operation with U-slot. Reference [12] has been mentioned a dual loop antenna for 2.4/5 GHz wireless LAN. A monopole antenna with double-T has been stated in [13] for 2.4/5.2 GHz WLAN operations. A dual polarized antenna has been mentioned in [14] for Ku-band application. Microstrip antennas on FR4 substrate material were discussed for UWB applications in [15, 16].

In this research, a double inverted F-shape 40 × 40 mm^2 patch antenna for dual-band operation has been proposed and investigated to increase the bandwidth and reduce the size at the same time. The effect on antenna resonances and other antenna parameters is concentrated due to slots on the patch and ground plane to design the proposed dual-band double inverted F-shape antenna with enhanced bandwidth and efficiency. Some techniques are employed such as increasing substrate thickness, changing patch by cutting rectangular slots, and cutting ground plane to achieve the resultant parameters such as impedance matching, gain,