

Circularly-Polarized and High-Efficiency Microstrip Antenna with C-Shaped Stub for WLAN and WiMAX Applications

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Abstract—In this article a novel planar triple-band microstrip monopole antenna with circular polarization and high efficiency is presented for wireless communications applications. This antenna with passbands at 2.4, 3.5, and 5.5 GHz is able to cover WLAN and WiMAX applications according to the IEEE 802.11b/g and IEEE 802.16 standards. The proposed antenna consists of a C-shaped stub to control the circular polarization and an inverted triangular patch which has two slots to achieve mentioned frequency bands. The proposed monopole antenna with dimensions $40 \times 47 \times 1.6$ mm is implemented on the FR4 substrate and fed by a 50Ω microstrip line. Parametric study for antenna dimensions and measurement results are presented in the article. The S-parameters of less than -10 dB, efficiency above 90% and omnidirectional radiation patterns are obtained in the proposed antenna. A brief comparison is made on the characteristics of the proposed antenna and other antennas presented in the articles and the results are presented.

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1. INTRODUCTION

The microstrip antennas are widely preferred candidate for multiple applications systems that can simultaneously support devices operating at different frequency bands such as, Wireless Local Area Network (WLAN) and Worldwide Interoperability for Microwave Access (WiMAX) due to its characteristics of lightweight, low profile and ease of fabrication [1].

According to recent demands for wireless communications components, various multi-band microstrip patch antennas are reported. A compact triple-band coaxial probe-fed sector-shaped patch antenna that covers the UMTS, WiMAX and ISM is studied in [1]. This antenna has circular polarization (CP) at frequency 1.9–2.1 GHz and high gain at 5.2 GHz. However, its radiation patterns are not stable.

Other microstrip antennas without CP characteristics are provided in [2–7]. Quad-band small microstrip antennas with L-shaped and U-shaped slots [3] and rectangular folded strip lines with 2 PIN diodes [4] are proposed. Although, they have a complicated structure and design procedure. A miniaturized dual-band fractal antenna for WLAN and WiMAX applications is presented in [4]. Despite omnidirectional radiation patterns of this antenna, it suffers from low efficiency and unable to cover frequency band of WiMAX (5.5 GHz).

The proposed multi-band patch antenna in [5] has appropriate efficiency and gain but its resonance frequencies are not suitable for practical applications such as the specified IEEE standards. A compact planar dual-band antenna with a superstrate for WLAN application is proposed in [6]. However, it has some disadvantages such as low gain and irregular radiation pattern, especially at 5.5 GHz. Moreover, antennas with ACS-fed and CPW-fed are designed for wireless communications in [7, 8], respectively.

In this paper, a triple-band antenna is targeted for WLAN and WiMAX applications in which the circular polarization at a frequency 5.5 GHz is achieved. The configuration of the planar microstrip antenna consists of a patch layer with an inverted triangular shape and embedded slots on it, a C-shaped stub, a microstrip feed line and a ground plane that is implemented on the FR4 substrate. This antenna is capable of controlling the third frequency band using the triangular patch layer slots.

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