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U-Slot Rectangular Patch Antenna for Dual Band Application

Abstract

Dual and multi-band rectangular microstrip antennas can be realized by cutting U-slots inside the patch. In this paper, the length and width of U-slots are optimized in order to achieve dual-band and multi-band operation. Computer Simulation Technology (CST) software was used to design, simulate and optimization of antenna. Two resonant frequencies at 1.8 and 2.4 GHz were found with reasonable gain. Additional resonant frequencies could also be achieved from 2.8 to 3.0 GHz using the similar approach.

Chapter 12
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Mohammad Shawkat Habib, I.M. Rafiqul, Khaizuran Abdullah and M. Jamil Jakpar

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Keywords Patch antenna · U-slot · Dual band

12.1 Introduction

Wireless local area network (WLAN) is one of the most important applications of the advancing wireless communication technology. Developed by the Institute of Electrical and Electronics Engineers (IEEE) and the 802.11 standard the wireless local-area network (WLAN) standard is a family of specifications for WLAN technology [1–3]. Most of the wireless devices are integrated with IEEE WLAN functionalities [4–6]. The emerging market of wireless devices like the laptops, tablet pc etc. has set off notable research activities on the design of cost-effective, multi band yet simple antennas. With the benefits of having low manufacturing

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cost and compatible in size, the planar antennas are good choice for the majority of the wireless LAN stations both on subscriber end and base station side. This paper presents a patch antenna with U shaped slot resonant at 2.4 GHz for WLAN application and 1.8 GHz for cognitive radio application.

Dual-band and multi-band rectangular microstrip antennas are realized by cutting U-slots, V-slots, or a pair of rectangular slots inside the patch. The technique for designing dual-band microstrip antenna is to cut slots of different shapes at an appropriate position inside the rectangular patch [7–9]. Since the slots are cut inside the microstrip antenna, they neither increase the patch size nor significantly affect the radiation pattern of the antenna. When the slots are cut very close to the radiating edge of the microstrip antenna, they alter the third-order-mode resonance frequency of the patch and, along with the fundamental mode; result in a dual-band response [10]. By integrating four slots inside the patch, a nine-band antenna, covering various cellular and TV bands, was reported in Ref. [11]. The analysis for studying the effects of a U-slot on the broadband or the dual-band response in a rectangular microstrip antenna was reported in Ref. [12].

In most of the design, depending upon where the slot is cut, the slot length is taken to be equal to either a quarter-wavelength or a half-wave length. However, these simpler approximations of slot length as a function of frequency do not give a close match for different slot lengths and their positions inside the patch. The surface currents and voltage distributions for a dual-band U-slot-cut on rectangular microstrip antennas are studied over a wide frequency range. It was observed that the slot does not introduce any mode, but reduces the higher-order orthogonal mode resonance frequency of the patch and, along with the fundamental mode, realizes the dual-band response. In this paper, formulation proposed by [13, 14] for U-slot were utilized and an antenna has been designed for 1.8 and 2.4 GHz dual-band applications with reasonable gain. The technique has been extended to design third resonance also at 2.95 GHz. Results are obtained by using Computer Simulation Technology (CST) software.

Section 12.2 describes the parameter values that were considered in the final design of the antenna. The simulated results of the final design were produced in Sect. 12.3. Section 12.4 overviews the fabrication of the antenna and its characteristics which were further contrasted with the simulated results in Sect. 12.5. The reason for the slight variation of the simulated and the fabricated result are also discussed in the later part of Sect. 12.5.

12.2 Antenna Design

The length, width, return loss, VSWR of the patch antenna can be calculated from the Eqs. (12.1)–(12.6) narrated in Ref. [15]. Where L and W are the length and width of the patch, c is the velocity of light, ε_r is the dielectric constant of substrate, h is the thickness of the substrate, $f_{o.}$ is the target center frequency, ε_e is the effective dielectric constant and ρ is the radiation coefficient.

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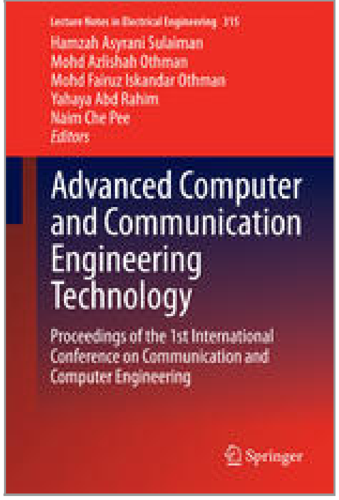
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