A Compact Size Reconfigurable Triple Square Ring Patch Planar Antenna

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Abstract

A compact reconfigurable microstrip slot antenna with switchable single and dual band notch functions for Multiband applications is presented in this study. The antenna is capable of exhibiting three different performances of UWB spectrum coverage, UWB coverage with single rejection of thewireless local area network (WLAN) band, UWB coverage with single rejection of the WiMAX and C-band spectrum, andUWB coverage with dual band notch function at the WLAN, the WiMAX and the C-band frequencies. Good results is achieved at different performances of the antenna. The designed antennahas a small size of 20 × 20 mm²

Keywords: *Reconfigurability Antenna, Triple Square Antenna, Planar Antenna, Patch Planar Antenna*

Introduction

The development of wireless communications and theincreasing demand for operating frequency bands have madethe radio spectrum congested and different radio systemsoverlap because of their standard frequency band allocations.The wide frequency range of the ultra-wideband (UWB)systems which because of the FCC's allocations is spreadbetween 3.1 and 10.6 GHz will cause interference in theexisting wireless communication systems, such as the wirelesslocal area network (WLAN) for IEEE 802.11a operating inthe 5.15–5.35 and the 5.725–5.825 GHz bands, WiMAXoperating in 3.3–3.6 GHz and C-band operating in 3.7–4.2GHz, hence, the UWB antenna with single and dualband-stop performances is required [1–3]. Consequently,recently, several planar microstrip monopole and slotantennas with single and multiple band notch

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performanceshave been presented [4–9]. However, these antennas havefixed band notch characteristics and in cases where there isno interference, they are unable to utilize the whole UWBfrequency band. Hence, in order to improve the performanceof the UWB system, antennas with reconfigurable structureswhich exhibit switchable band notch performances aredesirable [10–13]. The main advantage of this kind ofantennas is that they are able to utilize the whole UWBspectrum and when an interfering signal appears the antennacan change its configuration in such a way as to produce aband-notch function which eliminates the interference withthe coexistent system. Different kind of RF switches such asmetal semiconductor field effect transistor (MESFET), RFMEMS and PIN diodes can be used to create thereconfiguration of the antenna structure. Any of theseswitches has their own advantages and disadvantages [14]. In[15], RF microelectromechanical system (MEMS) are used toform a reconfigurable microstrip monopole antenna withswitchable single band notch performance, whereas in [16], aPIN diode is used for the same reason on a microstrip slotantenna. The reconfigurable antennas with switchableband-notched functions can be used in cognitive andintelligent radio systems [3].

In this paper a compact multiband antenna that capable to switching between different frequencies will be presented. The antenna in order to switch between different statusesuses of two pin diodes.

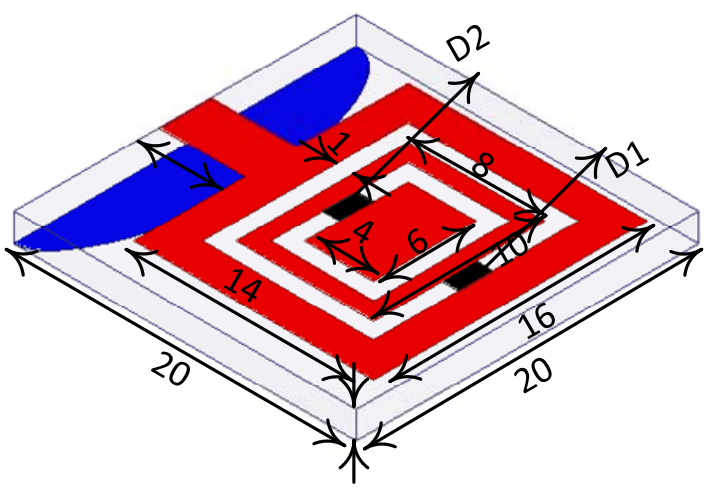

Fig.1 configuration of antenna structure

The proposed reconfigurable microstrip slot antenna configuration with its design parameters is shown in Fig. 1, which is printed on an FR4 substrate with a thickness of 0.8 mm, a permittivity of 4.4 and a loss tangent of 0.018. As observed in Fig. 1, the basic antenna structure consists of a half elliptical ground, a microstrip feed-line and a square radiating patch. In the design procedure of the Multiband microstrip antennas, the basic antenna structure must be designed so as to have a multi-resonance performance in the Multiband spectrum and then by modification of the antenna structure such as cutting slots or notches with suitable dimensions on the metallic parts of the antenna additional resonances can be excited in order to improve the bandwidth of the antenna. Also, addend characteristics such as band-notch function can be introduced to the performance of the antenna through etching slots with proper dimensions on the metallic sections of the antenna. All dimension of antenna is created on Fig.1.

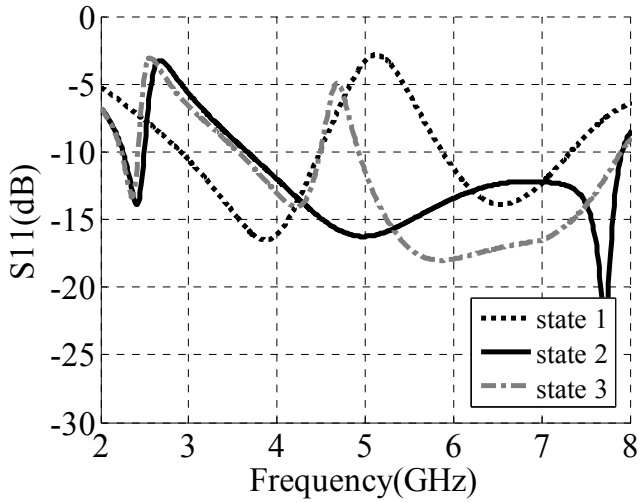

Fig. 2. Simulated S_{11} of the proposed reconfigurable Multiband antenna for different biasing statuses of the PIN diodes in Table 1.

Table 1.various state of PIN diodes

State	Diode 1	Diode 2
1	OFF	OFF
2	ON	OFF
3	ON	ON

The simulatedresults are obtained by using Ansoft Simulation SoftwareHigh Frequency Structure Simulator (HFSS) [17].Fig. 7 shows therealized antenna and its simulated S11 characteristics fordifferent on and off statuses of the PIN diodes are presentedin Fig. 2.

The simulated pattern of the fabricated antenna including the co-polarization and cross-polarization in the H-plane (X−Z plane) and E-plane (Y−Z plane), respectively, for its dual band notch performance at three various frequencies is depicted in Fig. 3. As observed in this figure, the antenna has suitable radiation in a wide range of frequencies and also the radiation patterns in the X−Z plane are almost Omni-directional. As observed in this figure, for the dual band-notch performance of the antenna, the gain drops dramatically at the notched frequency bands.

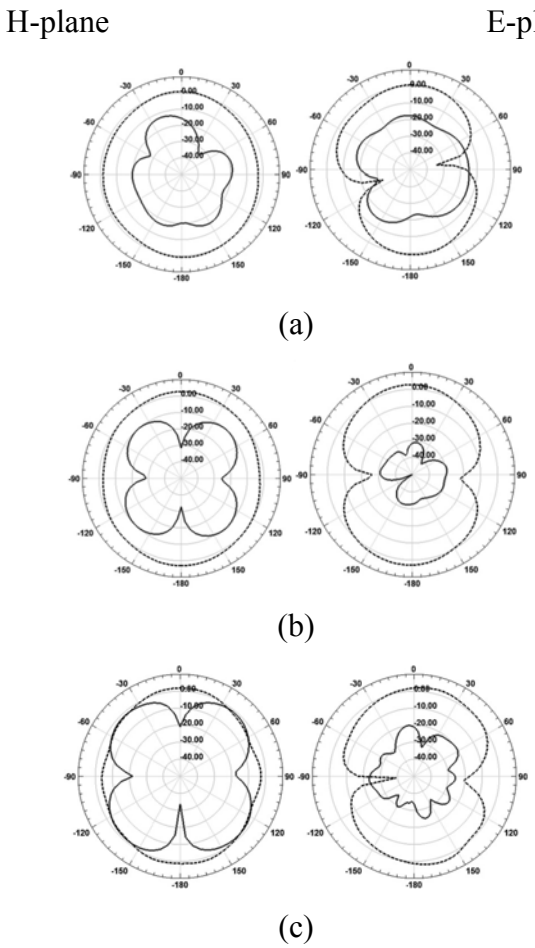

Fig. 3 Simulated radiation patterns for the dual notch band performance of the proposed antenna at(a: 2.4 GHz, b: 4 GHz and c: 5.5 GHz)

Conclusion

In this paper, a novel compact reconfigurable printed slot antenna with switchable single band notch and dual band notch performances has been proposed for the broad band applications. In the proposed antenna, wider and improved impedance bandwidth especially at the higher frequency band is obtained by cutting two modified notches on the feed-line. Switchable single and dual band notch functions are obtained by cutting the modified slots on the feed-line and embedding two PIN diodes along the slots. By changing the bias statuses of the PIN diodes, the antenna is able to switch between its various frequencies responses.

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