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DUALBAND OPTIMIZED MICROSTRIP ANTENNA WITH MODIFIED RESONATING STRUCTURE USING CADFEKO

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ABSTRACT: In this paper, a dual band linearly-polarized microstrip patch antenna is designed and simulated with Modified Resonating Structure using CADFEKO antenna simulation software. Antenna parameters are examined in this which includes resonating frequency, bandwidth, VSWR and impedances of the designed and proposed resonating structure with microstrip feed. The antenna is proposed for GPS/GSM, Wi-Fi/WLAN wireless communication applications provided with greater bandwidth of around 500 MHz. This paper focuses on the designing of miniature microstrip antenna with microstrip feed and analyzes the results like return loss S_{11}, VSWR, impedance, Bandwidth and radiation pattern E- field and H-field at 1.65 GHz and 3.64 GHz.

Keywords: Resonating Structure, Dual band, Microstrip Antenna, CADFEKO, Modified Structure Resonator.

I.INTRODUCTION

In the last few years, the development of GPS/GSM and Wi-Fi/WLAN represented one of the principal techniques in the information and communication field. As per the present situation in communication systems has been to develop low cost, low profile antennas, minimum weight commonly used dielectric materials that are capable of maintaining high performance over a wide spectrum of frequencies [1]. With a simple geometry, patch antennas offer many advantages not commonly exhibited in other antenna configurations. Advantages are low profile, inexpensive lightweight and simple to fabricate using modern day printed circuit board technique, compatible with microwave and millimetre-wave integrated circuits (MMIC), and have the ability to conform to resonating structures[1]. In addition, once the shape and operating mode of the patch are selected, designs become very selective in terms of operating frequency, return losses, polarization, radiation pattern, VSWR and impedance. That is possible with Microstrip antenna probably exceeds that of any other type of antenna element [3]. Using the Multi Band Resonator concept in this paper on dual band modified Resonating Structure Microstrip antenna is designed and simulated. There are few software available which allow the optimization of the antenna. CADFEKO one of the most imperial electromagnetic software which allows to designing and solving for radio and microwave application. It works based on methods of moments (MOM) .The CADFEKO simulator tool computes most of the useful parameters of interest such as radiation pattern, input impedance, return loss, VSWR and gain etc.

II.ANTENNA DESIGN

In particular, the antenna structure using a dual-mode resonator rather than a conventional one have become better because of miniaturization and good performance. However, the design procedures of this antenna using the dual-mode resonators were not common [2]. The configuration of the proposed antenna is shown in Fig. 1, which is designed on a FR4 (ε_r = 4.4, tangent loss=0.01) substrate with a thickness of 1.5 mm. The antenna is comprised of a feed element and a resonating structure. The MSR consists of a straight metal line and the modified structure shaped metal line and infinite ground plane, to construct the simple unit cell [4] as shown in Fig. 1(a) and (b). The magnitude of the

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transmission parameter S_{11} for the MSR is calculated by the commercial electromagnetic solver CADFEKO. For example, the detailed dimensions of the MSR are listed in Table 1. The width of all the lines is chosen as 0.1 mm. Finally, the whole size of the resonator is a x b = 3 x 4.2 mm^2. The feed line is 11.575 mm in length and 0.45 mm thick connected with microstrip port, line impedance is 50 ohm.

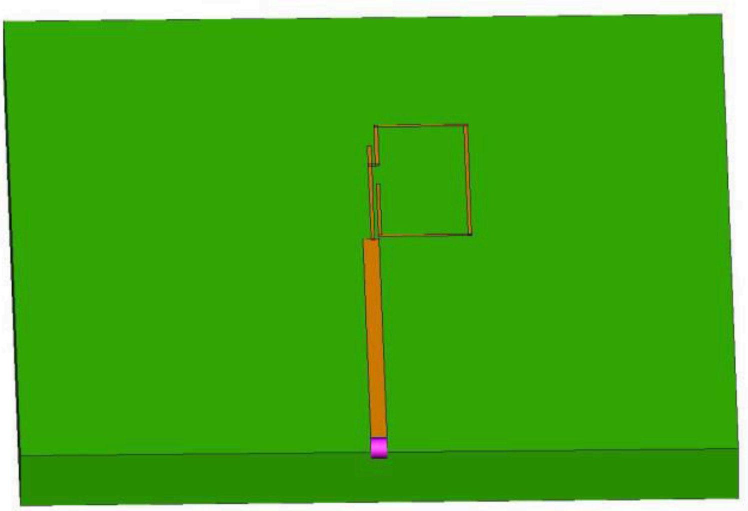

Fig. 1 (a) The proposed dual-band resonating structure microstrip antenna

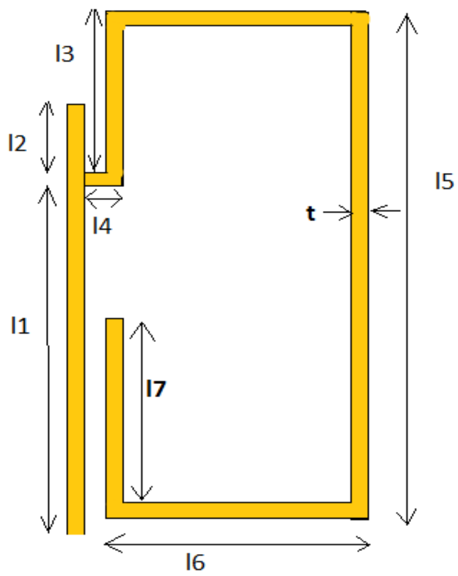

Fig. 1(b) The configuration resonating structure

The simulated results are shown in Fig. 2, i.e., the red solid line, where two resonant frequencies 1.6 and 3.6 GHz can be clearly distinguished. The resonant frequencies of the MSR can be shifted by changing some parameters like l3, l4, l7 [3]. The selection of the dielectric material is important for the performance characteristics of the resonator antenna. Each dielectric substrate has a specific dielectric constant which in turn affects the output characteristics of the antenna. Thus, the dielectric material plays an important role in the designing of any antenna [8]. Here the Dielectric FR4 substrate of thickness 1.5 mm is taken which is common and easily available.

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l1	4.2	l5	6
l2	1.1	l6	2.6
l3	2.2	l7	2.8
l4	0.3	t	0.1

Table .1 Dimensions of the MSR (units: mm)

III.SIMULATION AND RESULTS

The CADFEKO-simulated and measured magnitudes of *S*11 are shown in Figure 3(a), where two operating frequency bands are obtained for the proposed antenna. The antenna exhibits the characteristics of the dual-band operation, i.e. ameasured *-37* dB bandwidth of 450 MHz for the lower band from 1.4 GHz. to 1.85GHz, a bandwidth of 500 MHz from 3.4 GHz to 3.9 GHz, covering the GPS/GSM and the Wi-Fi/WLAN , characteristics of VSWR is shown in Figure 3 (b). The results of return loss, VSWR and impedance are given in Table 2.

Resonating Frequency (GHz)	Return Loss S_{11} (dB)	VSWR	Impedance (Ω)
1.65	-37	1.6	51
3.64	-31	1.1	52

Table .2 Return Loss, VSWR and Impedance at Resonating frequencies.

The proposed antenna covers the following wireless communication bands: GPS (1565-1585 MHz) GSM 1800 (1710-1885 MHz), PCS (1850–1990 MHz), Wi-Fi/WLAN (IEEE 802.11 y) (3650-3700 MHz).

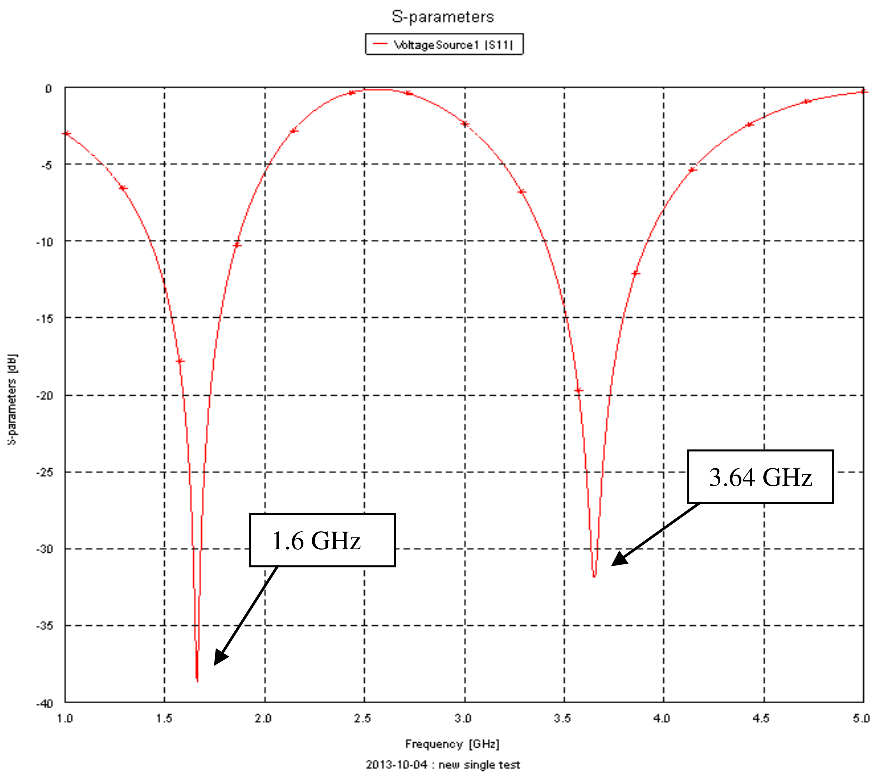

Fig. 3(a) Simulated results of *S*11 parameter

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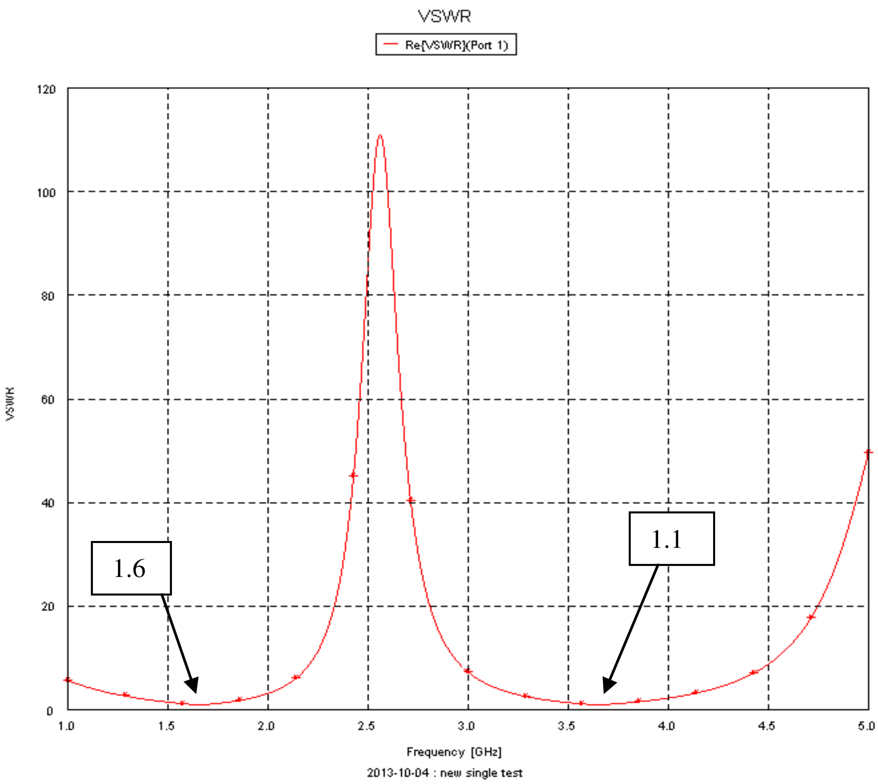

Fig. 3(b) VSWR for proposed dual band antenna

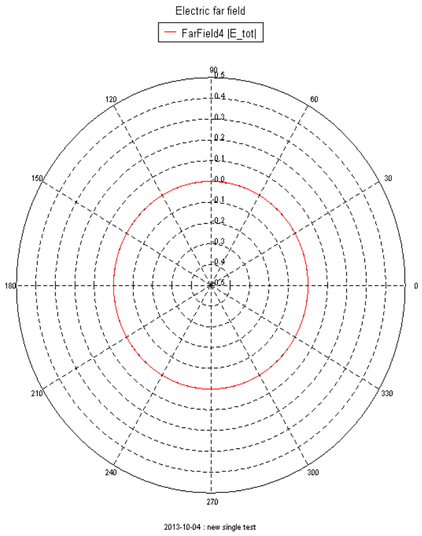

Fig.4(a) E-plane (xy-plane)

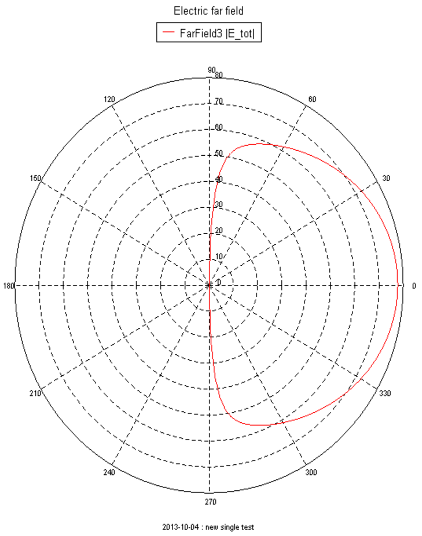

Fig. 4(b) E-plane (yz-plane)

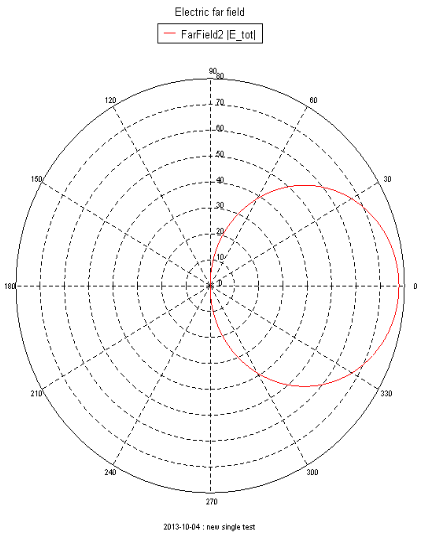

Fig. 4(c)H-plane (xz-plane)

Fig 4. Shows the radiation pattern at 1.65 GHz for the (a) E-plane the xy-plane and the yz-plane) and the H-plane (the xz- plane).

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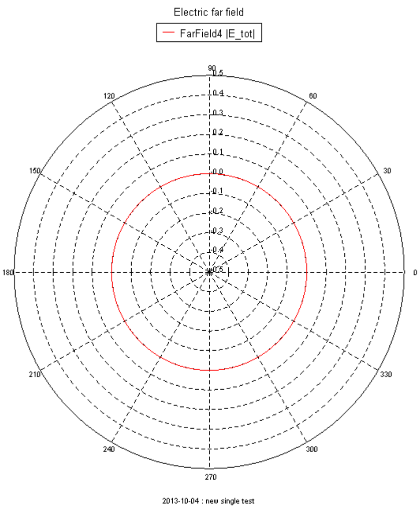

Fig. 5(a) E-plane (xy-plane)

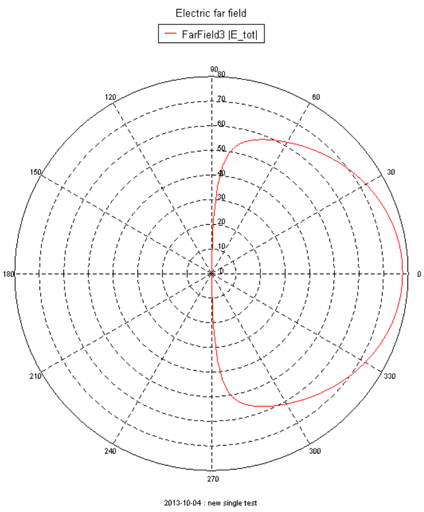

Fig. 5(b) E-plane (yz-plane)

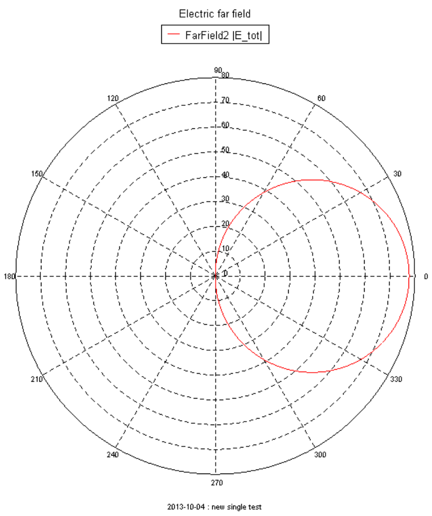

Fig. 5(c) H-plane (xz-plane)

Fig. 5 Shows the radiation pattern at 3.64 GHz for the E-plane (the xy-plane and the yz-plane) and the H-plane (the xz-plane).

The simulated radiation patterns for the proposed dual-band modified structure resonator microstrip antenna are plotted in Fig. 4 and Fig. 5, where the three principle planes are shown at the frequencies of 1.6 GHz and 3.64 GHz respectively. The measured radiation patterns for both frequencies including the polarization in the azimuthal direction (xy - plane) and the elevation direction (xz and yz-planes) when operating at 1.65 and 3.64 GHz for GPS/GSM and WLAN /Wi-Fi applications. Because of the symmetry in structure in xz-plane, symmetrical radiation patterns are seen in the xz and yz-planes in the plots. In addition, a monopole-like radiation patterns with nearly omnidirectional radiation in the azimuthal plane are observed [5].

IV.CONCLUSION

We have designed and simulated dual band microstrip antenna with modified resonating structure which has a resonating frequency of 1.65 GHz and 3.64 GHz with return loss of -37 dB and -31 dB. This miniature dual band antenna has wide application in GPS/GSM, Wi-Fi/WLAN of wireless communication. Further optimizations are also can be done to achieve desired resonating frequencies. The unique feature of this antenna is its compact and small size to get higher performance. This paper presents a geometric configuration for the modified rectangular resonator microstrip patch antenna for different wireless applications, which provides a mean to get higher directive gain and maximum radiation efficiency without using special techniques [7]. The responses are considered to be acceptable as the measured results are quite similar to the simulated circuit.

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