Compact Dual Band Microstrip Antenna with Modified Resonating Structure for Wireless Applications W-CDMA, Wi-MAX, Wi-Fi/WLAN

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Abstract* - *In this paper, a two band linearly-polarized microstrip patch antenna is designed and simulated with Modified Resonating Structure using CADFEKO simulation software. Antenna parameters are examined in this which includes resonating frequency, impedances, VSWR, directivity, gain and bandwidth of the designed and proposed resonating structure with microstrip feed. The antenna is proposed for W-CDMA, WiMax, Wi-Fi/WLAN wireless communication applications provided with greater bandwidth of around 600-800 MHz. This paper focuses on the designing of miniature microstrip antenna with microstrip feed where analyzes the results like return loss S_{11} parameter , VSWR, impedance, directivity, gain, bandwidth and radiation pattern (including 3D pattern) E-field and H-field at 2.1 GHz and 5.77 GHz.

***Keywords*-Resonating Structure, Dual band, Microstrip Antenna, MSR, Modified Structure Resonator.**

1. INTRODUCTION

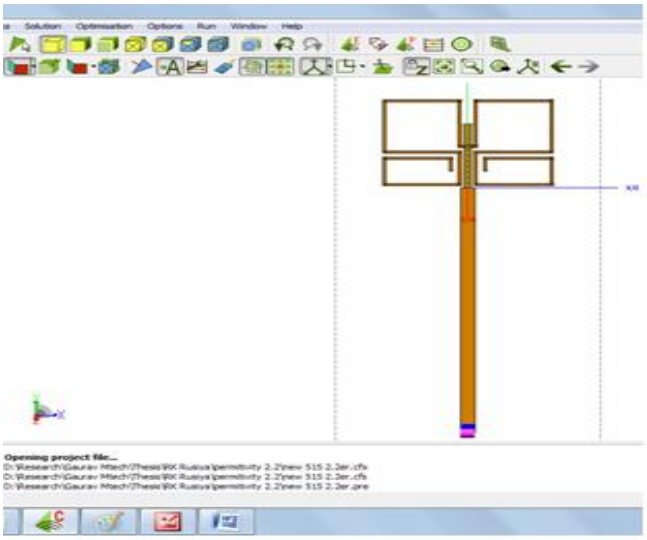
In the last years, the development of W-CDMA,WiMax and Wi-Fi/WLAN represented one of the important techniques in the information technology and communication field. As per the present trends in communication systems has been to develop minimum in cost, profile, weight commonly used dielectric material of RT_Duroid (ε_r=2.2) that are capable of maintaining high performance over a wide spectrum of frequencies [1]. With a simple and easy geometry, microstrip patch antennas provide many advantages not commonly exhibited in other antenna designs. Advantages of these microstrip resonating structures are low profile, less expensive, lightweight and simple to fabricate using recent day printed circuit board technology, compatible with microwave ckts and MMICs, and have the ability to match to resonating structures [1]. In addition, once the shape, design and operating mode of the patch are selected, prototype become very selective in terms of operating frequency, return losses, polarization, radiation pattern, gain, VSWR and impedance. This is possible with Microstrip antenna probably exceeds that of any other type of antenna segment [3]. Using the Multi Band microstrip patch antenna concept, in this paper on dual band modified Resonating Structure Microstrip antenna is proposed and simulated. There are few software available which allow the optimization of the antenna. FEKO one of the most imperious electromagnetic software which allows to designing and solving for radio signal and microwave application.The CADFEKO simulator tool computes most of the useful parameters of interest like radiation pattern, input impedance, return loss, directivity, VSWR and gain etc.

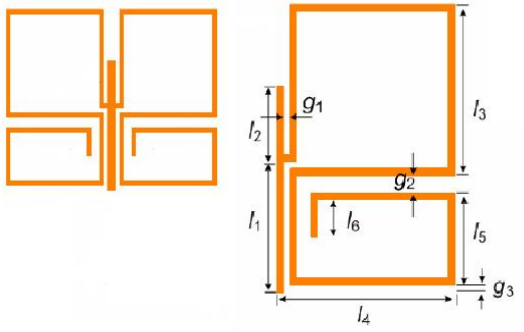
2. ANTENNA DESIGN

In particular, the microstrip antenna structure using a dual-band resonator rather than a regular one have become better due to miniaturization and good performance. However, the design methods of this antenna using the dual-mode resonating structures are not common [2]. The design of the proposed antenna is shown in Figure 1, which is designed on a RT_DUROID (ε_r = 2.2, tan loss=0.001) substrate with a height of 1.5 mm. The antenna is comprised of a feed and a resonating structure. The antenna consists of a straight metal line and the curl shaped structure metal line and infinite ground plane, in which the simple unit cell is constructed [4] as shown in Figure 1.

The magnitude of the transmission parameter S_{21} for the antenna is calculated by the commonly used electromagnetic simulation software FEKO. For example, the detailed dimensions of the antenna are listed in Table 1. The thickness of all the lines is chosen to 0.1 mm. Finally, the whole size of the resonator is a x b = 6 x 4.2 mm^2. The feed line is 11.575 mm in length and 0.45 mm in width connected with microstrip port, with line impedance 50 Ω. The simulated results are shown in Figure 2, i.e., the red line,

where two resonant frequencies 2.1 GHz and 5.77 GHz can be clearly distinguished. The resonant frequencies of the MSR (Microstrip Resonating Structure) can be shifted by changing some parameters like l1, l2, l3, l4, l5, l6 and g1, g2, g3 [3]. The selection of the dielectric material (here the Dielectric RT_DUROID ε_r=2.2, substrate of thickness 1.5 mm, is used which is common and easily available) is important for the performance characteristics of the resonator antenna. Each dielectric material has a specific dielectric constant which affects the output characteristics and desired parameters of the microstrip antenna. Thus, the dielectric substrate has an important role in the designing of any microstrip antenna [8].





l_1	1.9	l_4	2.6	g_1	0.1
l_2	1.1	l_5	1.35	g_2	0.2
l_3	2.5	l_6	0.55	g_3	0.1

Figure 1. The configuration of the proposed dual-band resonating structure microstrip antenna and

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

Resonating Frequency (GHz)	S_{11} (dB)	VSWR	Impedance (Ω)	Directivity (dBi)	Gain (dB)	Bandwidth (MHz)
2.1	-53	1.03	50.5	3.06	2.86	800
5.77	-37	1.06	51.6	4.04	3.84	600

3 SIMULATION AND RESULTS

The antenna simulation software CADFEKO, simulated and measured results of S_{11} are shown in Figure 3(a), in which two operating frequency bands are obtained for the designed antenna. The antenna is having the characteristics of the dual-band operation, i.e., a measured -53 dB S_{11} and bandwidth of 800 MHz for the lower band from 1.7 GHz. to 1.5 GHz at first resonating frequency and -37 dB S_{11} and a bandwidth of 600 MHz from 5.45 GHz to 6.05 GHz at second resonating frequency, covering the W-CDMA, WiMax and Wi-Fi/WLAN, characteristics of VSWR is shown in Figure 3 (b). The results of S_{11} return loss, VSWR and impedance are given in Table 2.

The proposed antenna covers the following wireless communication bands: W-CDMA (1885-2200 MHz) WiMax (2500-2690 MHz), Wi-Fi/WLAN (IEEE 802.11 a/h/j) HYPERLAN (5150-5825 MHz).

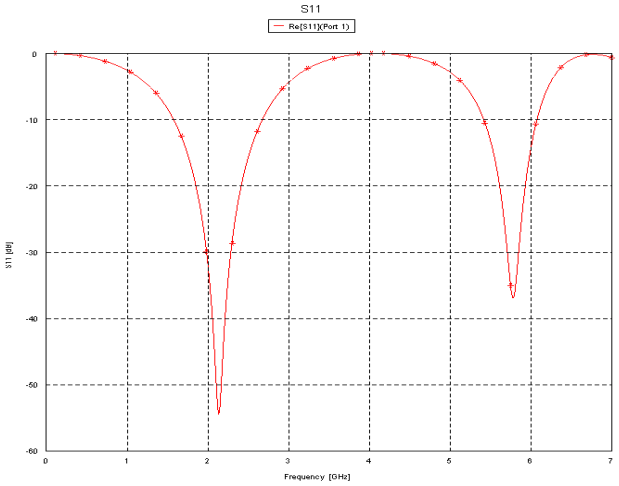


Figure 3 (a) Simulated results of *S*11 parameter

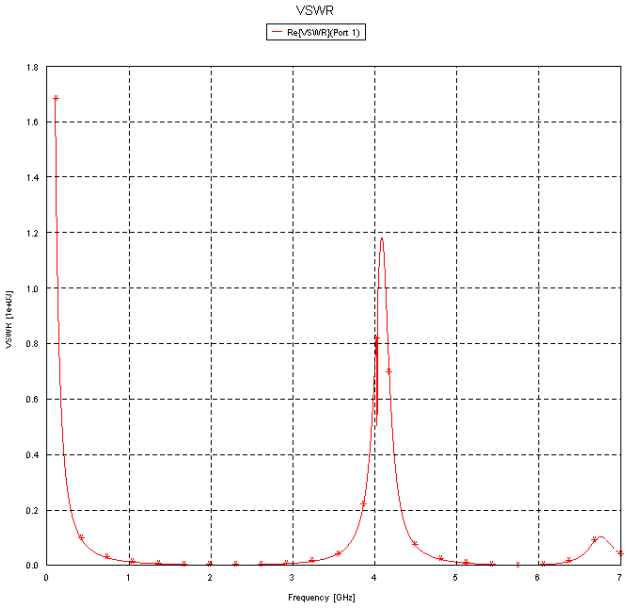


Figure 3 (b) VSWR for proposed dual band antenna

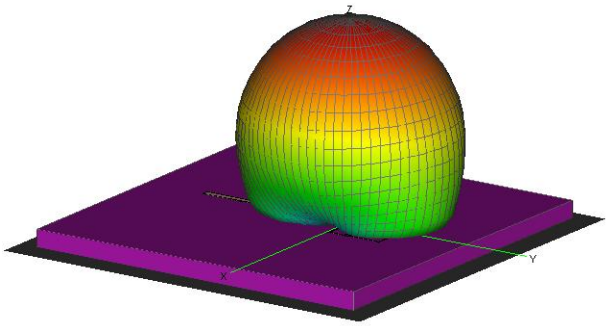


Figure 4. shows the radiation pattern at 2.10 GHz

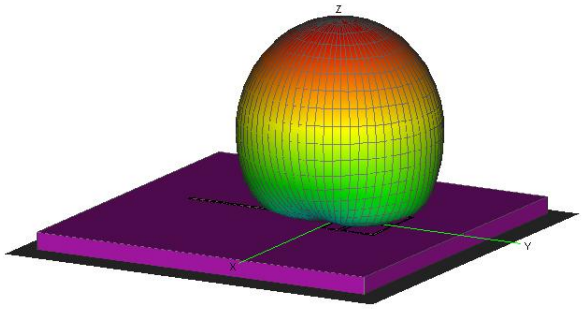


Figure 5. shows the radiation pattern at 5.77 GHz

The simulated radiation patterns for the proposed dual-band modified structure for microstrip antenna are plotted in Figures 4 and 5, The measured radiation patterns for both frequencies include the polarization in the azimuthal direction (xy - plane) and the elevation direction (xz and yz-planes) when operating at 2.1 and 5.77 GHz for GPS/GSM and WLAN /Wi-Fi applications.

4 CONCLUSION

We have designed and simulated two band microstrip antenna with modified resonating structure which has a resonating frequency of 2.1 GHz and 5.77 GHz with return loss of -53 dB and -35 dB. This miniature dual band antenna has wide application in W-CDMA, WiMax, Wi-Fi/WLAN of wireless communication. Advance optimizations are also possible to achieve required operating frequencies.The unique feature of this microstrip resonating structure antenna is its compact and small size to get better performance. This paper presents a configuration for the Microstrip Patch Antenna for different wireless Applications, which provides a higher bandwidth and gain without using special techniques [7].

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