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Conceptual analysis of frequency reconfigurable microstrip patch antenna for UMTS and GPS applications

KEYWORDS: Reconfigurable microstrip patch, conducting material strip, UMTS (Universal Mobile Telecommunication System)

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ABSTRACT A concept of frequency-reconfigurable microstrip patch switchable with slot antenna and conducting strip is proposed. The antenna is capable of frequency switching at two different frequency bands between GPS for navigation and UMTS (Universal Mobile Telecommunication System) for mobile communication. The patch is resonating at 2 GHz, while the slot produces two different operating frequencies like 1.575 GHz and 1.995 GHz. The conducting material strip is positioned in the slot to achieve frequency reconfigurability. Simulation results are used to demonstrate the performance of the antenna. The simulated return losses, together with the radiation patterns, gain, directivity, VSWR are presented.

I. INTRODUCTION

Traditionally wireless systems are designed for single predefined mission. Therefore, the antennas of these systems also possess some fixed parameters such as frequency band, radiation pattern, polarization, and gain. Recently reconfigurable antennas (RAs) have gain tremendous research interest for many different applications. In mobile and satellite communications, reconfigurable antennas are useful to support a large number of standards (e.g., UMTS, Bluetooth, Wi-Fi, WiMAX, DSRC) to mitigate strong interference signal and to cope with the changing environmental condition. A single RA can replace a number of single-function antennas. [4].A tuneable rectangular patch antenna is discussed, and the antenna can be reconfigured at four different operating frequencies [3]. The antenna consists of a microstrip patch and a slot in the ground-plane positions underneath the patch [2]. Concept of reconfigurability of antenna is understood by [5-7].

II. ANTENNA DESIGN

A.Antenna Description

In this section, the structure of the proposed antenna is described. Fig. 1 shows the geometry of the proposed antenna.

The antenna is fabricated on a Teflon substrate with a thickness of 2.5 mm, permittivity of 2.1 (Top view).Fig.1 (a) shows bottom view of Microstrip Patch Antenna with slot in absence (off state) as well as presence (on state)of the conducting strip. The ground plane is extruded with substrate of 99.96 X 110 mm2. The antenna is being excited with the inset feed having width and length at the center of the patch width. The slot in ground is situated at distance p of 30.98 mm. Other design parameters are given in TABLE-1.

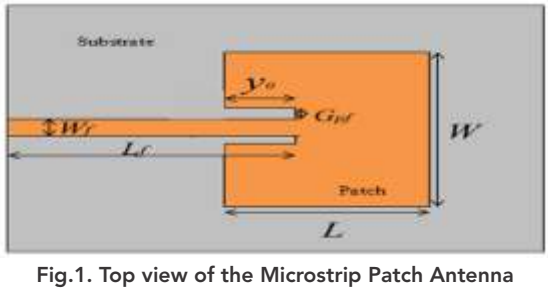

Fig.1. Top view of the Microstrip Patch Antenna

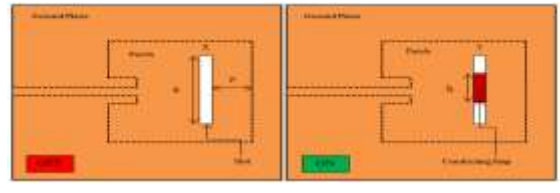

Fig.1 (a) Bottom view of the Microstrip Patch Antenna

The proposed microstrip patch antenna is capable of working on 1.575 GHz and 1.995 GHz at off and on state respectively. Here off state is without conducting strip in slot and on state is with conducting strip in it.

TABLE 1
DESIGN PARAMETER SPECIFICATIONS OF THE RECTANGULAR MICROSTRIP PATCH ANTENNA

Dielectric constant(ε_r)	2.1 Teflon (PTFE)
Substrate height(h)	2.5 mm
Length of patch (*L*)	51.16 mm
Width of patch (*W*)	60.24 mm
Length of feed (L_f)	37.5 mm
Width of feed (W_f)	9.52 mm
Length of feed insert (y_0)	13.1 mm
Gap of feed (G_{pf})	9.52 mm
Patch height(Mt)	0.035 mm
Ground height(Mt)	0.035 mm
Slot width(x)	2 mm
Slot length (a)	52.8 mm
Metal width (y)	2 mm
Metal length(b)	30 mm

I.RESULT AND DISCUSSION

The simulated return loss (S1, 1) of the proposed antenna is depicted in Fig 2. for both frequencies. The graph shows the maximum return loss of -23.992 dB and -20.912 dB at the resonant frequencies of 1.575 GHz and 1.995 GHz. The graph also depicts that at -10dB the antenna attained the

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bandwidth of 3.41% and 2.33% respectively.
The voltage standing wave ratio (VSWR) of the proposed antenna shown in Fig 3. It can be observed from the result that the VSWR value is less than 2 for whole operating band, which considered as suitable for the antenna.

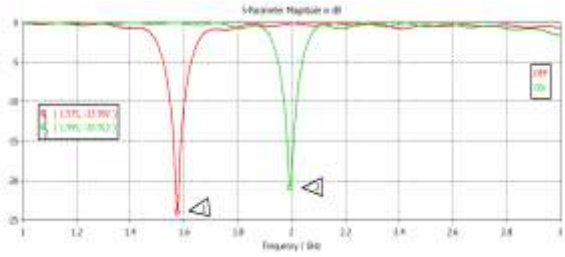


Fig.2. Return loss (S1, 1) of the proposed antenna

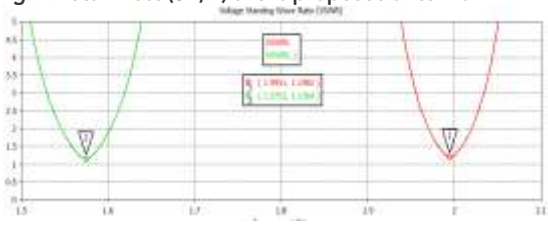


Fig.3.VSWR of the proposed antenna

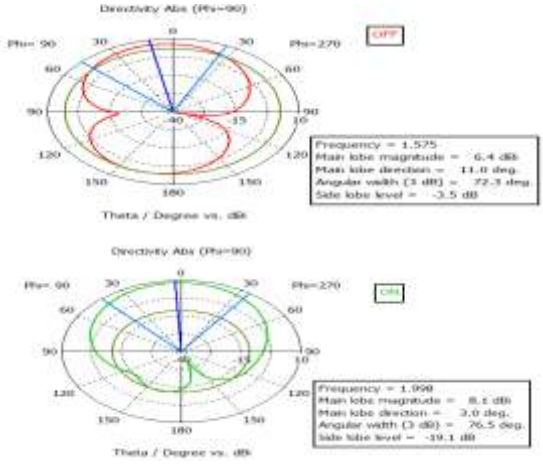
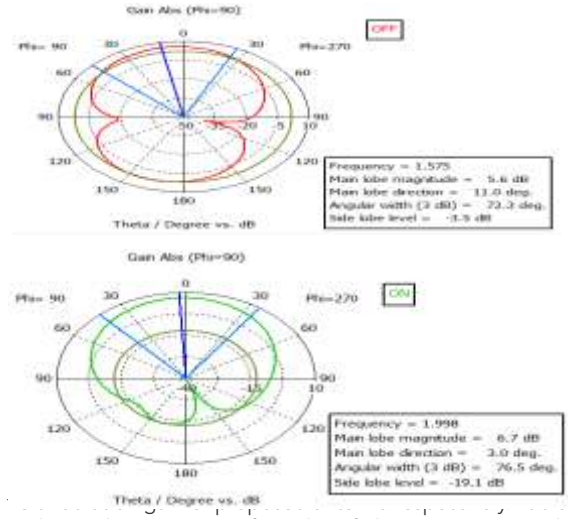


Fig.4. Far field radiation directivity of proposed antenna



2 shows the summary of results of the microstrip patch antenna.

TABLE 2
MICROSTRIP PATCH ANTENNA PARAMETERS

PARAMETERS	RESULTS	
	ON STATE	OFF STATE
Resonant frequency (fr)	1.995 GHz	1.575 GHz
Return loss (RL)	-20.912 dB	-23.992 dB
Bandwidth(B.W.)	46.77 MHz	53.52 MHz
Gain (G)	6.7 dB	5.6 dB
Directivity (D)	8.1 dBi	6.4 dBi
Efficiency (E)	82.71 %	87.5 %

I.CONCLUSIONS

In this paper, conceptual analysis of reconfigurable microstrip patch antenna for UMTS has described and their simulated results are shown like vswr, gain, return loss. By using different diodes return loss can be shift hence resonance frequency can also be changed. This reconfigurable antenna can be further modified RF MEMS switches for speedy switching purpose.

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