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Triple Band Microstrip Patch Antenna with L Shaped Slots on Ground Plane

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Abstract

Conventional Microstrip Patch Antennas have a PEC ground plane and because of this reason its bandwidth is always narrow. In this paper, a novel triple band antenna model is presented in which L shaped patterns are etched on its ground plane making it a magnetic plane, resulting in superior radiating features due to effective elimination of surface waves (because of slots in its ground plane). The proposed antenna resonates at three frequencies, i.e., 2.36, 3.42, 4.46 GHz. This antenna has an adequate gain of 4.6, 4.5, 3.3 dBs respectively at its resonances, exhibiting linear Polarization.

Keywords: *Microstrip patch antenna, linear polarization, wireless application, triple resonances*

INTRODUCTION

Growing wireless technologies and consumers target for new features in accessories of any wireless application. The significance of antennas in any wireless application is so vital as they ensure cent percent transmission and receptions of data to required person [1]. By properly designing the pattern of radiation from any antenna one can achieve the above mentioned feature. A multi resonant antenna has become the need of the day. Several methodologies are adopted for example by creating shorts and H shaped coupling aperture on ground, triple resonances are created [2, 3]. Different slots on patch like antenna with parallel vertical slot, Inverted F, U slot on patch inducing multi resonances are seen in [4]. Different frequency patches are designed and studied in [5]. A chamfered patch with spiral etches and U slots resonating at two different wireless spectra are noted in [6]. A differential loaded patch resonating at two frequencies with RIS concept is seen in [7]. A wide band miniaturized patch for three different spectra along with prototype results are seen in [8]. In this paper CSRR slots are seen on patch.

DESIGN OF NOVEL TRIPLE BAND ANTENNA

The most popular feeding method, i.e., by means of microstrip inset feed the conventional antenna is fed. The impedance of the Microstrip line is varied by altering its width to match the 50 ohm impedance position of the patch by using the well- known equations for such design from [2]. An attempt is made to create triple resonances in a conventional patch by etching some regular

patterns in its ground plane as well as on the

Ground	60 mm X 60 mm
Two Circles on Patch of Radius	5 mm
One Triangle of Sides	7,7,10 mm
L shape Area on Ground	100 mm^2
Inset Fed Position patch.	10 mm from Edge

The specifications of the antenna
Conventional Patch size $0.3791\lambda_o \times 0.2742\lambda_o$

The substrate used is Rogers 3003 with ε_r of 3. The top view of the patch, both top, ground views using the FEM based commercial simulator are shown in Figures 1 and 2.

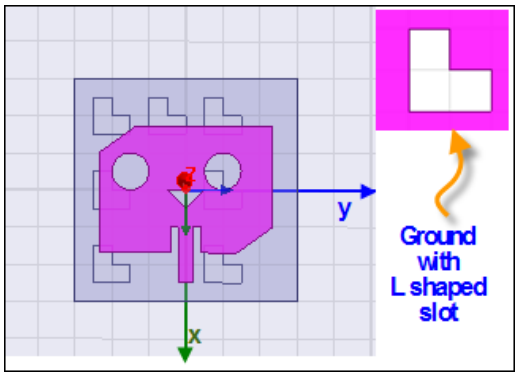

Fig. 1: *Top View of Proposed Antenna.*

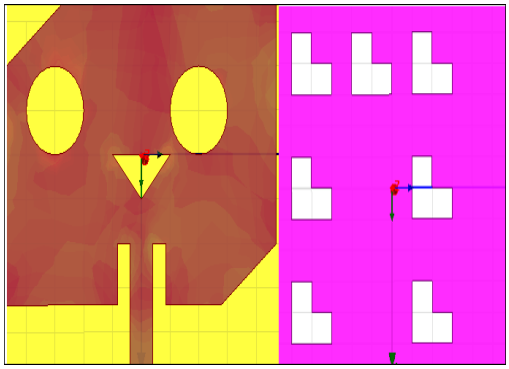

Fig. 2: *Top, Ground Layer of the Proposed Antenna.*

The inset feed position is adjusted for required resonance and return loss characteristics. The antenna resonates with adequate gain at three frequencies. The return loss at 2.36, 3.42, 4.46 GHz are -21.7 dB, -20.7 dB, -12.7 dB respectively. This is clearly depicted in the Reflection Coefficient shown in Figure 3. The first two resonances have very good impedance match while third resonance also has a good return loss suitable for commercial purposes. The gain radiation plots for both azimuthal and elevation plane are generated for the three resonant frequencies with Phi varied as 0°, 45°, 90° and they are depicted in Figures 4–6. VSWR variation is seen in Figure 7.

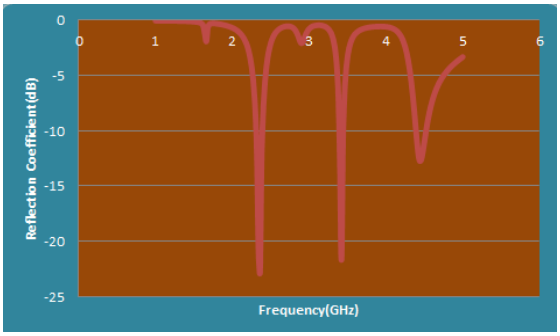

Fig. 3: *Reflection Coefficient of Proposed Antenna.*

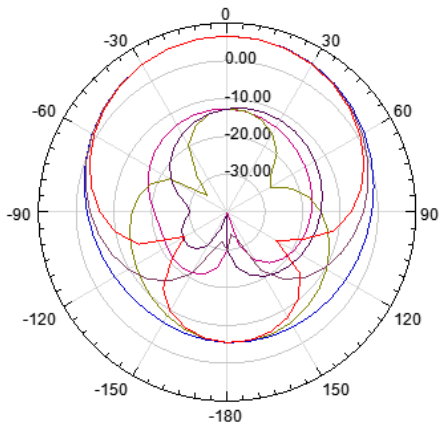

Fig. 4: *Gain Pattern of Proposed Antenna.*

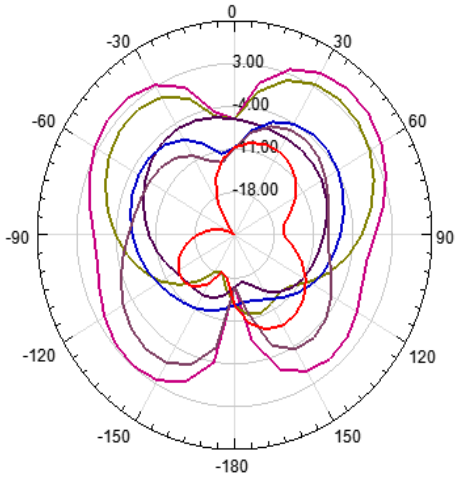

Fig. 5: *Gain Pattern of Proposed Antenna.*

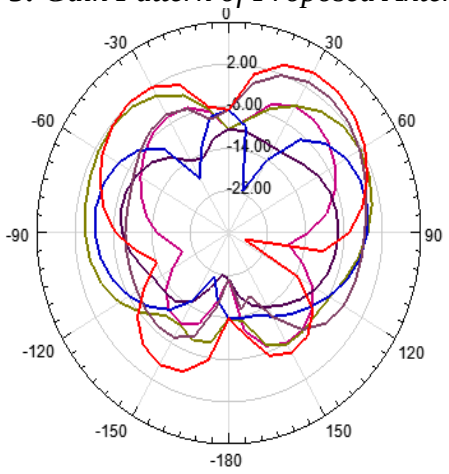

Fig. 6: *Gain Pattern of Proposed Antenna.*

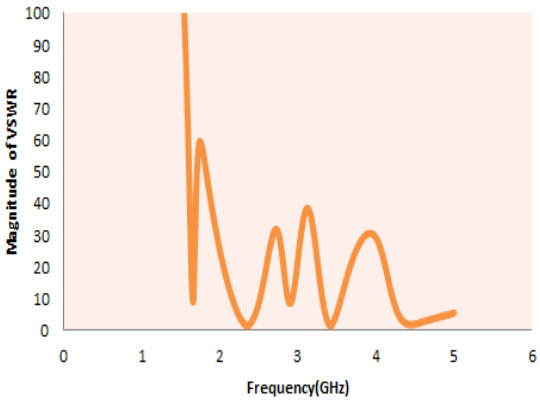

Fig. 7: *VSWR Characteristics of Proposed Antenna.*

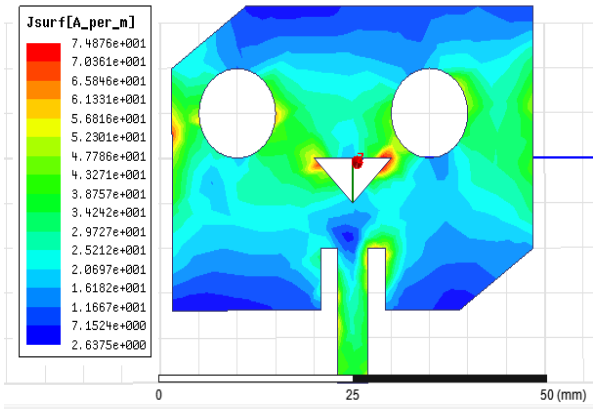

Fig. 8: *Surface Current Distribution on Patch of Proposed Antenna at 2.36 GHz.*

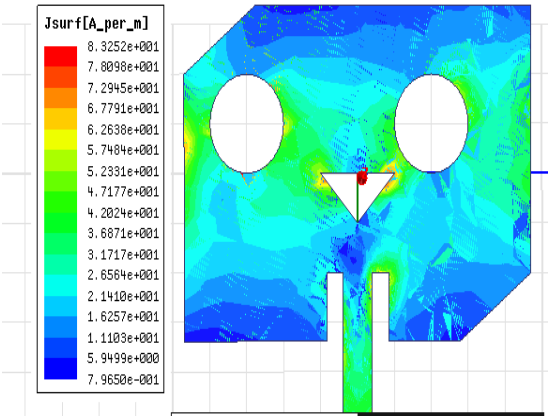

Fig. 9: *Surface Current Distribution on Patch of Proposed Antenna at 3.42 GHz.*

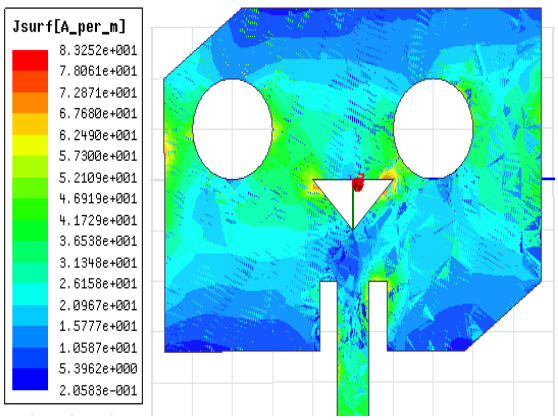

Fig. 10: *Surface Current Distribution on Patch of Proposed Antenna at 4.46 GHz.*

The distribution of current on patch and the radiation of the patch depend upon the dimension of slots cut over it (creating the three resonating frequencies). The surface current distributions at the three frequencies are seen in Figures 8-10. The simulated antenna parameters at these frequencies are given below:

At First Resonance (2.36 GHz)

	Quantity	Value
1.	Max U	0.36961(W/sr)
2.	Peak Directivity	4.75676
3.	Peak Gain	4.6695
4.	Peak Realized Gain	4.64477
5.	Radiation Efficiency	98%

At Second Resonance (3.42 GHz)

	Quantity	Value
6.	Max U	0.365727(W/sr)
7.	Peak Directivity	4.7724
8.	Peak Gain	4.62727
9.	Peak Realized Gain	4.59597
10.	Radiation Efficiency	96.5%

At Third Resonance (4.46 GHz)

	Quantity	Value
11.	Max U	0.266997(W/sr)
12.	Peak Directivity	3.45175
13.	Peak Gain	3.54535
14.	Peak Realized Gain	3.35526
15.	Radiation Efficiency	95%

CONCLUSION

A triple band antenna for on demand frequency spectra is presented. The prominent feature of this antenna is there is not much compromise in its pattern, gain and bandwidth. The pattern is also Omnidirectional and this antenna Can very easily be fabricated using PCB techniques. Use of cheap substrate makes it cost effective.

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