VOL. 2, NO. 11, October 2011 ISSN 2079-8407
Journal of Emerging Trends in Computing and Information Sciences

http://www.cisjournal.org

Comparative Analysis of Exponentially Shaped Microstrip-Fed Planar Monopole Antenna With and Without Notch

M. Venkata Narayana[1], I.Govadhani[2], K.P.Sai Kumar, K. Pushpa Rupavathi
[1].Associate professor KLUniversity
[2].Associate Professor KLUniversity
{venqut@gmail.com, govardhanee@gmail.com}

ABSTRACT

This paper describes the comparision of a microstrip-fed monopole ultra wideband antenna with and without notch. In case of notch the notch-band characteristics is achieved by C- shaped ring resonator. The paper gives better understanding of antenna parameters such as return loss, VSWR etc., and its variation in performance of antennawith and without notch. Also presents the effect of parameters of antenna with notch on gain. Finally, simulation is done using Ansoft HFSS software. Measurements indicate that antenna operates in the band from 2.25 -10.2GHz and has band-rejected characteristics in 5.16-5.85GHz which covers wireless Local Area Network band.

Keywords: *monopole ultra wideband antenna, ring resonator, comparision, VSWR, return loss*

1. INTRODUCTION

In recent years, antenna design for Ultra-Wideband (UWB) systems has attracted increasing interest due to the appealing properties of this new communication standard. It is a well-known fact that planar monopole antennas present really appealing physical features, such as simple structure, small size and low cost. Additionally, planar monopoles are compact broadband omnidirecctional antennas, and are also non-dispersive. Due to all these interesting characteristics, planar monopoles are extremely attractive to be used in emerging UWB applications, and growing research activity is being focused on them.

The federal Communication Commission (FCC) allocated the unlicensed 3.1-10.6 GHz band for commercial applications of UWB technology. the planar monopole antennas are good options for portable UWB devices. Over the UWB frequency band there exist other wireless systems operating bands, such as the 5.2 GHz (5150 GHz-5350 MHz) and 5.8 GHz (5725–5825 MHz) bands, which might cause interference with the UWB system. A UWB antenna with band rejection characteristics is considered necessary, to overcome this disadvantage.

In this paper, the exponential shaped cut patch patch and upper edges of the ground plane are optimized to enhance the performance of antenna. to eliminate the limited WLAN band (5.15~5.825GHz), a down turned C-shaped ring that can enforce antenna resonance at center frequency of WLAN, is etched to the bottom layer of the antenna. the comparision of this exponential shaped cut patch antenna with and without notch are clearly gives the better understanding of performance features of antenna affected due to interference.

2. ANTENNA GEOMENTRY

The structure of the antenna without notch is shown in Fig.1 and with notch is shown in Fig.2 The antenna, is implemented by a Rogers RT/duroid 5880 substrate with 0.7874mm thickness and relative dielectric constant of 2.22.

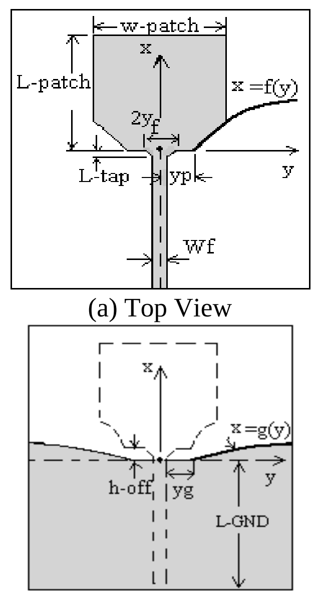

Fig. 1: Geometry of the exponentially shaped MicroStrip-fed planar Monopole Antenna without notch.

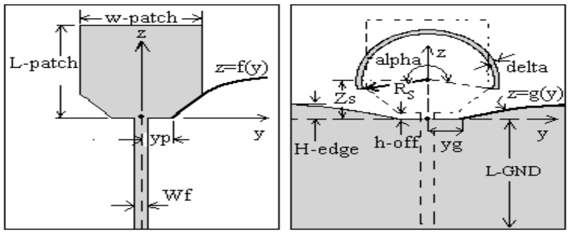

Fig. 2: Geometry of the MicroStrip-fed Planar Monopole Antenna with notch.(a) Exponentially shaped lower edges of patch antenna. (b) Exponentially shaped upper edges of ground plane

The antenna is composed of three main sections, rectangular patch with two cuts; microstrip feed trace with tapered transition to patch (Fig. 2(a)), and a partial ground plane with exponential curved upper edges (Fig. 2(b)). The simulations and optimizations are based on Ansoft HFSSv11. The exponentially shaped upper edges is used to cover only the microstrip feed line. achieving a notch at the WLAN center frequency (5.5GHz), a C-shape ring, on the back of the substrate is used Fig. 2(b). This ring and the exponentially shaped patch radiator can operate as a resonator at 5.5GHz. By tuning the C-shaped ring parameters as length of the ring (*Rs*, *alpha*), the distance of upper edge of ring with upper edge of patch (*Zs*), and then the width of the ring (*delta*) the notched frequency and notched depth can be adjusted.

3. STUDY OF ANTENNA PARAMETERS

The effects of main parts of the proposed antenna with notch consist of: the radiating element (cut-shaped patch), ground plane, and notch element (C-shaped ring) on the impedance bandwidth of the antenna, are discussed and without notch the effect of the ground plane and patch and feed section need of optimisation are also discussed. The patch is optimized for best return loss performance and bandwidth. The feed section is optimized for improving matching microstrip line to patch. The ring is optimized by tuning its four parameters the angle of *alpha*, the radius of *Rs*, rear C-shaped ring widths *delta*, and *Zs* (the distance between upper-edge of patch from center of C-shaped ring), in terms of maximum achievement of VSWR.

4. RESULTS AND COMPARISION

The simulated return loss of proposed antenna without notch is shown in Fig. 3 and with notch is shown in Fig. 4. The VSWR for both cases are shown in Fig. 5 and Fig. 6 respectively. Both are accepting the UWB range but using notch offers the advantage of UWB communication without any interference from WLAN band. From the results shown in figures clearly gives that VSWR and return loss curves of antenna with notch are rejecting the WLAN band and in that band the antenna is not acceptable and thereby no radiation. The other parameters are also optimized with notch such as peak directivity, peak gain, radiated power and they are given in table I below at 7GHz because from 7GHz onwards or higher we will get spurious radiation. The simulated and measured radiation patterns without notch are shown in Fig 7 and Fig.8, with notch is shown in Fig. 9 and Fig. 10.

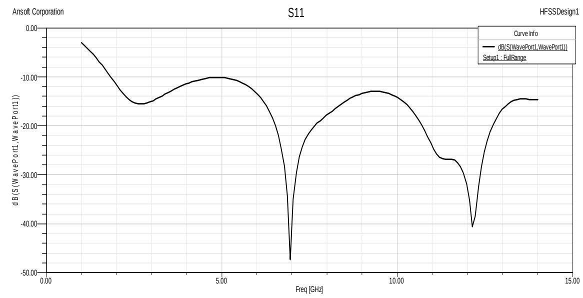

Fig. 3: Simulated return loss of antenna without notch

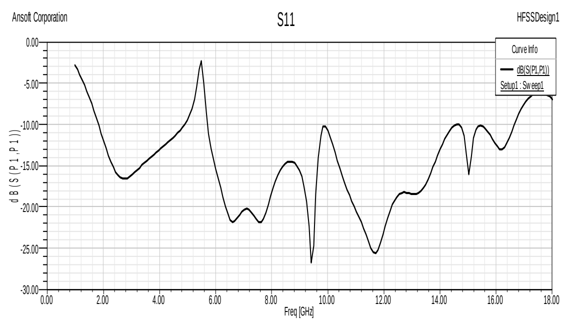

Fig. 4: Simulated return loss of antenna with notch

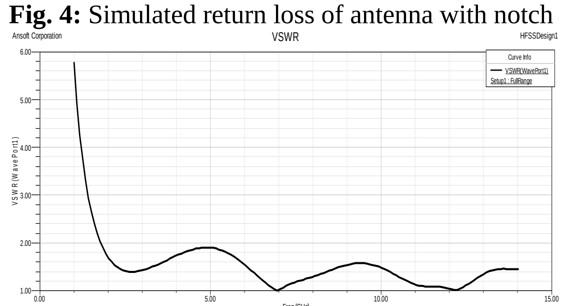

Fig. 5: Simulated VSWR of antenna without notch

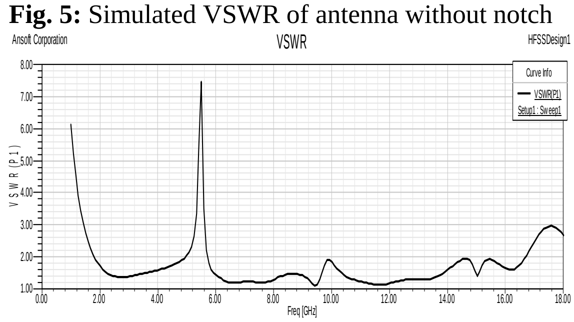

Fig. 6: Simulated VSWR of antenna with notch

TABLE I: Computed Antenna parameters with and without notch at 7GHz

Parameter	**Value(without notch)**	**Value(with notch)**
Peak directivity	1.091	2.701
Peak Gain	1.097	2.687
Radiated power	1.005	0.987
Radiation efficiency	1.0047	0.9948

5. CONCLUSION

Comparision of a microstrip-fed planar Ultra-wideband antenna with and without notch has been performed for UWB applications. To achieve notch-band caharacteristics we use an optimized rear C shaped ring as resonator. Without notch we have found that the exponentially cutting of lower edges of patch and extended upper edge of partial ground plane as exponential curvature (and tapering feed) causes an excellent performance of return loss at middle and the end of UWB-band. With notch we found that resonator rear C-shaped ring and exponential cutting of lower edges of patch and extended upper edge of partial ground plane have an excellent performance of return loss over the entire UWB band, excluding the notched band.

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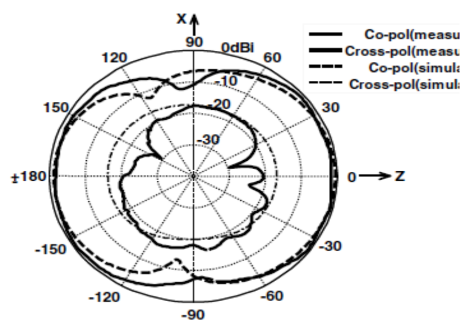
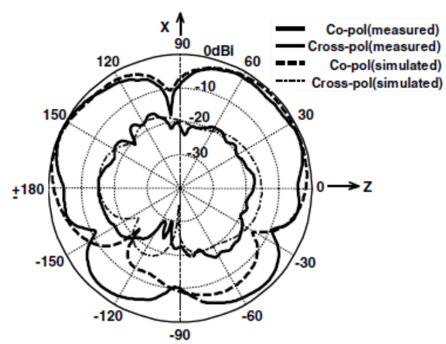
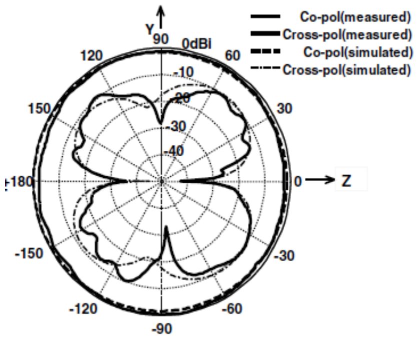


(a)



(b)

Fig. 7: Simulated and measured E-Plane (xz-plane) Radiation Patterns of proposed antenna without notch at: (a) 3GHz, (b) 7GHz



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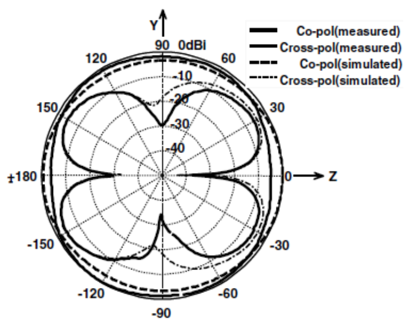
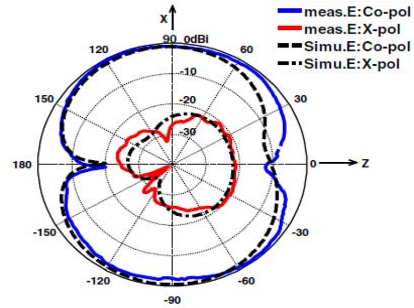
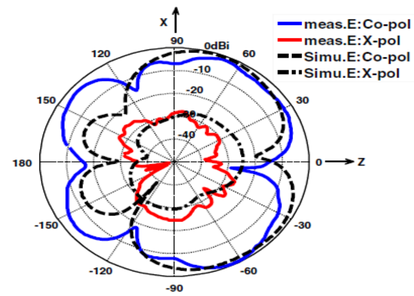


(b)

Fig. 8: Simulated and measured H-Plane (zy-plane) radiation patterns of proposed antenna at: (a) 3GHz, (b)7GHz

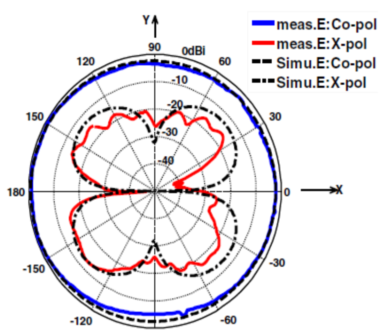


(a)

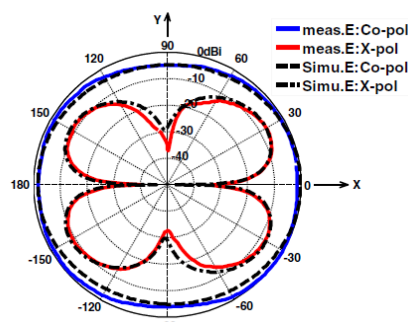


(b)

Fig. 9: Measured and simulated E-Plane (xz-plane) Radiation Patterns: (a) 3.5 and (b) 7GHz.



(a)



(b)

Fig. 10: Measured and simulated H-Plane (xy-plane) Radiation Patterns: (a) 3.5 and (b) 7GHz