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A Compact Planar Monopole Wideband Antenna for ISM & WIMAX Applications with Rhombus Radiator

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Abstract: ***This paper presents a compact planar monopole wideband antenna (40×50×1.6 mm3) with rhombus shaped radiator and partial ground plane. High Frequency Structure Simulator (HFSS) tool is used to design and simulate the proposed antenna. The antenna resonates from 2.21GHz to 4.12GHz with (<-10dB), useful for the wireless communication systems operating in ISM and WiMAX bands. It suits for 2.45 GHz WLAN bands, 2.5GHz/3.5GHz WiMAX bands and other IEEE 802.11(b/g/n/ax) wireless communication services. The proposed antenna provides a bandwidth of 1.91 GHz and profile with half ground plane and Section III discusses a results of simulated and tested antenna.***

Key Words: Planar monopole wideband antenna, ISM, WIMAX, HFSS

I. INTRODUCTION

In recent years, planar monopole antennas have been opted in the wireless communication of high throughput transceiver systems. This has resulted in an interest to improve more on WLAN[1] and WiMax[2] [3] applications. It has an advantage of compact structure, convenient feeding options and cover wider bandwidth. The basic patch antennas have been transformed to planar profiles by reducing the ground plane of (0.25*lambda)[4]. Various structures like bevel[5], shorting pins[6], smooth rounded element at the end of feed line[7] and fractal elements[8] over patch surface improves a bandwidth enhancement. With the decrease in the size of the square planar antenna, the bandwidth increases. Therefore by adjusting the width of the planar antenna, we can optimize a wider impedance bandwidth[9]. The reduction of tapering leads to sharpen the gain and bandwidth, assuming a constant width and length of the antenna[10]. Many microstrip line fed antennas were proposed by researchers to acquire wider bandwidth[11][15].

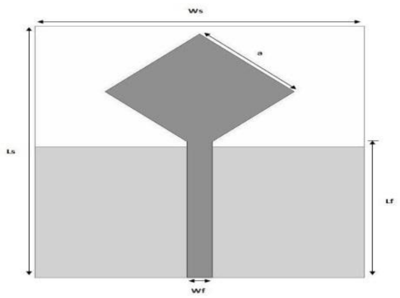

Fig (1) Proposed antenna (front view)

The simple monopole fed with microstrip line feed paper organized as: Section II gives a new planar Where, fL is the lower cut-off frequency, p and q are the diagonals of rhombus that gives total covered area of radiator.

The bandwidth to cover certain ISM and some other band near to it been achieved by amending the rhombus shape and optimizing the dimensions of the ground plane as shown in table (2.1).

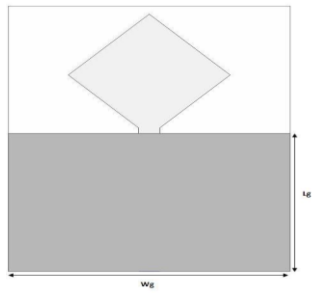

Fig (2) Proposed antenna (Back view)

Parameters	Size (mm)
Length of the ground (Lg)	26
Width of the ground (Wg)	40
Length of the substrate (Ls)	50
Width of the substrate (Ws)	40
Side of rhombus (a)	16
Length of feed line (Lf)	27
Width of the feed line (Wf)	3

Table [1] Dimensions of the proposed antenna

The reflection coefficient and VSWR characteristics for the antenna are shown in fig (3.1), (3.2).The reflection coefficient graph shows the reflection free response of <-10dB from (2.21 to 4.12 GHz).

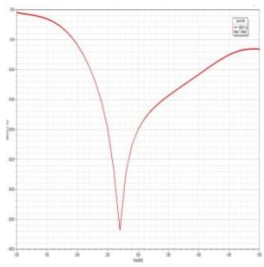

Fig (3) Reflection coefficient Vs Frequency plot

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II. ANTENNA DESIGN

The design initially initiates with a geometry of the planar rhombus monopole as depicted in fig (2.1). The proposed structure is designed using FR-4 substrate with **ε**r = 4.4, tan **δ**= 0.025 and thickness (h) = 1.6mm. The configuration of radiator and ground plane is made of copper with a thickness of 0.03 microns. The antenna has a compact size of (40×50×1.6 mm3). It is fed with a 50**Ω** microstrip line of width of 3mm. The radiator shape can be optimized by using its lower cut-off wavelength and expressed as a peak gain of 9.6dB at 2.6 GHz. The prototype is fabricated and tested. The simulated and tested results are compared. *fL* □61.9______*pq* /2 (1)

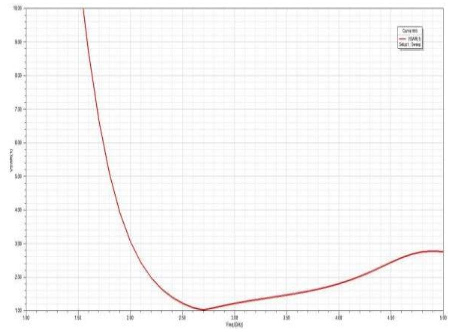

Fig (4) VSWR Vs Frequency plot

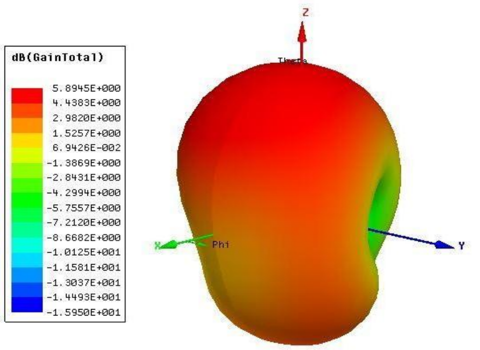

Fig (5) Gain in Db

III. RESULTS AND DISCUSIONS

The simulated results for gain (dB) is shown in fig (3.2) respectively. It can be observed that maximum of 5.8dB as normalized in polar plot representation with Omni-directional radiation pattern.

The peak realized gain characteristic of rhombus planar monopole antenna is displayed in fig (3.4). The maximum realized gain of 14.5dB is attained at frequency of 1.9GHz. In the other case of resonant frequency range (2.21-4.12GHz), the crest of 9.6dB at 2.6 GHz is obtained. As the antenna would be well for ISM band of (Wi-Fi and WiMax) wireless communications, the obtained gain can be more valuable in our acceptable limit

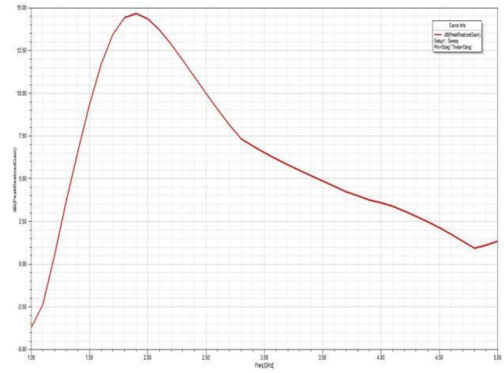

Fig (6) Peak realized gain Vs Frequency plot

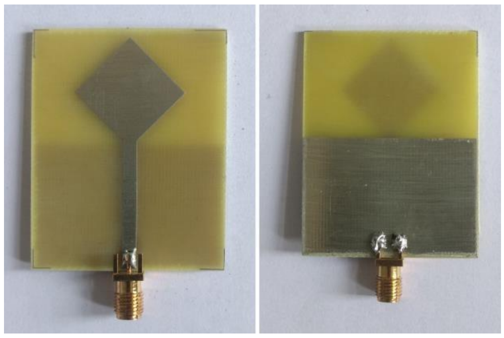

Fig (7) Fabricated image of proposed antenna (Front view & Back view)

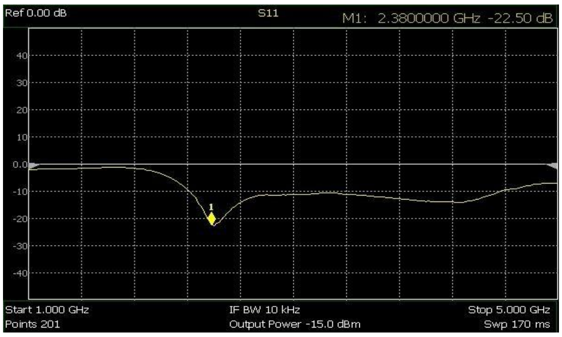

Fig (8) Measured Reflection coefficient in VNA

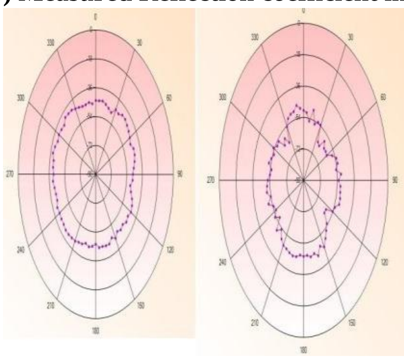

Fig (9) E plane and H plane field radiation at 2.4GHz

The fabricated antenna with a FR-4 substrate is shown in fig (3.5). The radiation pattern for E and H- Field at one of

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the resonant frequencies are shown in fig 3.7. Through the anechoic environment, we analysed that the proposed antenna of E –Field are achieved at 2.4 and 3.5 GHz which is desirable for the ISM applications.

After getting S11 results through Vector network analyser (VNA), the comparison of simulated and measured results are listed in the table [3.1].

Geometry	Simulated	Measured
Impedance Bandwidth(GHz)	2.21-4.12	2.21-4.57
VSWR	1	1.1
Reflection coefficient (Γ)	-37dB	-22dB

Table [2] Comparison of simulated and measured results (proposed antenna)

IV. CONCLUSION

A miniaturized structure of planar monopole antenna has been presented and exhibits a S11 of < -10dB in (2.2-4.1GHz) frequency range. An introduction of rhombus shaped radiator along with simultaneous adjustments of geometry leads to considerable wide bandwidth of 1.91GHz. This antenna is capable of covering the existing ISM (2.4GHz), WiMax (2.5/3.5GHz) and the future low band 5G and its possible extension frequencies. Through measured results, the reflection coefficient is achieved <-10dB from (2.2-4.8GHz). The fabricated prototype is tested and results are compared. Gain improvement can be achieved by incorporating two or more element array structure with suitable spacing[12]. Overall size reduction of the array can be achieved by introducing suitable EBG structures between the array elements[13].

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REFERENCES

1. "A Novel Wideband Antenna for UMTS and WLAN Bands: Employing a Z- shaped Slot and a Folded T-shaped Ground Branch to Widen Bandwidth," Antennas Propag. Soc. Int. Symp., vol. 1, pp. 2–5, 2008.
2. H. W. Liu, C. H. Ku, and C. F. Yang, "Novel CPW-fed planar monopole antenna for WiMAX/WLAN applications," IEEE Antennas Wirel. Propag. Lett., vol. 9, pp. 240–243, 2010.
3. Ashokan, R.Karthikeyan, Vinothkumar,"Design and analysis of a circular etched fractal antenna for LTE,WiMax and UWB Applications", International conference on telecommunication technology and management(ICTTM-2015)
4. C. A. Balanis, "Antenna theory: a review," Proc. IEEE, vol. 80, no. 1, pp. 7–23, 1992.
5. R. B. Waterhouse et al., "Control Of The Impedance Bandwidth Of Wideband Planar Monopole Antennas Using A Beveling Technique," vol. 30, no. 4, pp. 229–232, 2001.
6. M. Ammann and Z. N. Chen, "A Wide- band Shorted Planar Monopole with Bevel," IEEE Trans. Antennas Propag., vol. 51, no. 4, pp. 901–903, 2003.
7. Z. N. C. M.J.Ammann, "Wideband Monopole antennas for Multi-Band systems," IEEE Antennas Propag. Mag., vol. 45, no. No.2, pp. 146–150, 2003.
8. J. P. Gianviffwb and Y. Rahmat-samii, "A Novel Antenna Miniaturization Technique , d Applications," vol. 44, no. 1, 2002.
9. E. Lee, P. S. Hall, and P. Gardner, "Compact wideband planar monopole antenna," Electron. Lett., vol. 35, no. 25, 1999.
10. A.M. Abbosh, "Gain and Bandwidth Optimization of Compact UWB Tapered Slot Antennas," vol. 2, no. 3, pp. 222–225, 2007.
11. Y. F. Liu, K. L. Lau, Q. Xue, and C. H. Chan, "Experimental studies of printed wide-slot antenna for wide-band applications," IEEE Antennas Wirel. Propag. Lett., vol. 3, no. 1, pp. 273–275, 2004.
12. Nikitha Prem EK, R Karthikeyan, "Tripple Band Notched UWB Antenna Array," International Conference on GreenEngineering and TechnologiesIC-GET, 2016.
13. Nikitha Prem EK, R Karthikeyan, "Tripple Band Notch UWB antenna array with EBG structure", Interantional conference on wireless communications, Signal Processing and Networking(WiSPNET-2016), IEEE-Xplore Digital Library.
14. Uma Maheswari. S1, Vasanthanayaki.C2," Secure And Enhanced Information Encoding In Matrix Barcode", Journal Of Advanced Research In Dynamical And Control Systems, Vol. 9, No 6 , pp. 1926-1936, 2017.
15. S.Aruna devi ,Vijeta Iyer, "A Study on M/M/C Queue Model under Monte Carlo simulation in Traffic Model", International Journal of Pure and Applied Mathematics, Volume 116, No. 12 , 2017, pp. 199-207. UWB Antenna Using Compact Multilayer FSS," pp. 100–103, 2014.
16. N. Kushwaha et al., "Design Of A High-Gain Ultra-Wideband Slot Antenna Using Frequency Selective," vol. 56, no. 6, pp. 14