Rahul Suvalka, Rajeshwar Lal Dua / International Journal of Engineering Research and Applications (IJERA) ISSN: 2248-9622 www.ijera.com
Vol. 3, Issue 4, Jul-Aug 2013, pp.697-700

Design & Simulation of Ring Shape Wide Band Antenna Using DGS for Wireless Application

Rahul Suvalka[1], Rajeshwar Lal Dua[2]
[1]M.Tech. Scholar CSP JNU Jaipur
[2]Head of Department JNU jaipur

Abstract

The design of a low-cost wideband microstrip antenna for wireless communication is shown in this paper. The antenna, which is microstrip-line fed, has a partial ground plane flushed with the feed line. The substrate is based on an inexpensive FR4 material. It has a rectangular split-ring slot enclosed inside a rectangular patch. The inclusion of the split-ring slot and the U-shaped slot in the partial ground plane gives resonance at multiple frequencies.

I. INTRODUCTION

Printed micro-strip antennas are suitable for satellite and communication applications as they are characterized by their low profile, small size, light weight, low cost and ease of fabrication.
Due to their simple feed methods, especially microstrip-line feed and coplanar waveguide feed, they are also compatible with wireless communication integrated circuitry . However, they suffer from inherently narrow bandwidths.

The advantage of the multi-band antennas is that it can integrate several frequency bands on a single antenna, making it useful for several frequency ranges. These multi-band antennas could contain frequency ranges from several wireless applications. [1, 2] represent two antennas working on multi-frequency bands. The antenna presented in this paper, is capable of working on triple-frequency bands, for the two different applications, WLAN and WiMAX. In [3], a UWB antenna operational over the 2-11 GHz range is presented. However, UWB antennas are prone to noise from unwanted frequencies, which could degrade the original message. On the other hand, reconfigurable antennas are designed that can control the resonance of the antenna and limit the disadvantage of UWB antennas. A frequency reconfigurable antenna is proposed in [4].Though very robust, reconfigurable antennas require the use of switching elements and their biasing lines, or other complicated reconfiguration mechanism, so they are reffered to be complex. Multi-band antennas can be thought of an intermediate solution combining simplicity and multi-frequency operation.

In [5], a trapezoidal ground is used in the design to achieve the triple-band frequencies of WLAN/WiMAX applications. In [6], a triple-band unidirectional coplanar antenna is presented, but with a large size of 100 * 60mm2. Usually, various types of configurations could be used to meet the requirements of multi-band frequency range. In [7], a meander T-shape with a long and a short arm are used to achieve multi-band frequency.

A multifractal structure is used in [8]. In [9, 10], a flared shape with V-sleeve or Y-shape is implemented to realize the multi-band operation. However these antennas have a large size comparing to the limited space of mobile wireless terminals. During the development of antenna design, slot structures have been proposed to reduce the size of the multi-band antennas. In [11], to produce dual band and multi band characteristics, the use of U-slots with a combination of an L-probe feed is used. A triangular-slot loaded multi-band antenna excited by the strip monopole is presented in [12]. In [13-15], the triple-band characteristic is designed by etching two narrow slots with different lengths on a wideband monopole antenna. The geometry and the design guidelines of the proposed antenna structures are presented in Section 2. Experimental results are presented in Section 3. In Section 4, a brief conclusion is given.

II. ANTENNA STRUCTURE AND DESIGN

The configuration of the proposed multi-band antenna is shown in Figures 1(a)-(b). The rectangular patch is the main radiating element of the antenna combined with split-ring slot enclosed inside it.

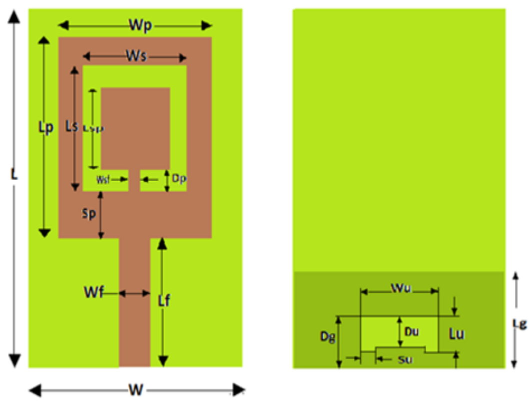


Figure 1: Geometry of the proposed antenna. (a) Front view, (b) back view.

The proposed printed-type antenna is based on a 1.6 mm-thick FR4 epoxy substrate with dimensions 25mm * 38 mm, fed by a 50Ω-microstrip feed line with a width of 3mm and a length of 12.06 mm. The partial ground plane is located on the backside of the dielectric substrate, shown in Figure 1(b), where a U-shaped slot is illustrated.
Figures 2(a)-(d) represents the design evolution of the proposed antenna.

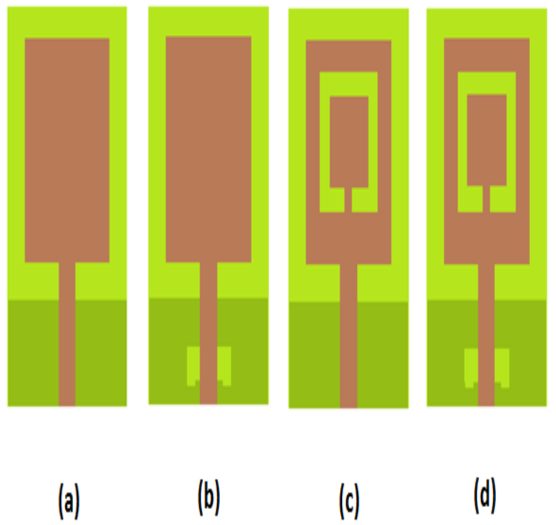


Figure 2: (a)-(d) The evolution of the antenna design.

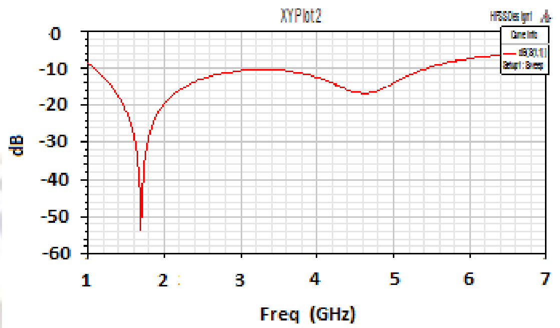
Initially, the antenna in Figure 2(a) consists of a rectangular patch along with a partial rectangular ground. In Figure 2(b), the ground plane is defected by etching a U-shaped slot, under the 50Ω microstrip feed line, without adding a split-ring slot in the rectangular patch. In Figure 2(c), the antenna added a split-ring slot in the rectangular patch along with a partial ground plane . Finally, in Figure 1(d), the two slots were added to the design to achieve resonance in the multi frequency bands. The dimensions of the patch, the ground, and the two slots are optimized to obtain these desired functional frequency ranges using Ansoft HFSS. The dimensions shown in Table 1 for both upper and lower part.s

Table 1: The antenna dimensions (in mm).

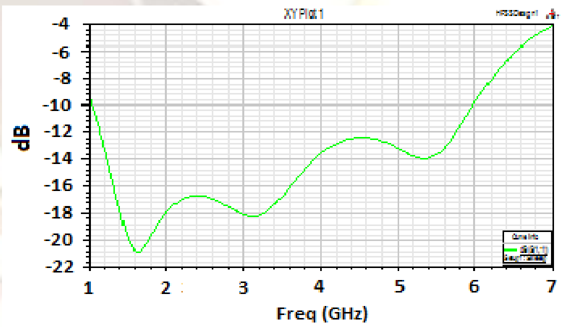
Parameter	Size (mm)	Parameter	Size (mm)	Parameter	Size (mm)
W	25	Lf	12.06	Lu	3
L	38	Wfs	0.9	Su	1
Wp	18	Dp	2.10	Dg	5.5
Lp	21	Sp	4.4	Du	2.5
Lsp	7.9	Wu	7.5	Ws	12
Wf	3	Lg	9	Ls	12.10

III. RESULTS AND DISCUSSION

The computed and measured reflection coefficient plots are given. Fig. 3(a) shows the reflection coefficient of antenna that consist of rectangular patch along with a partial rectangular ground,

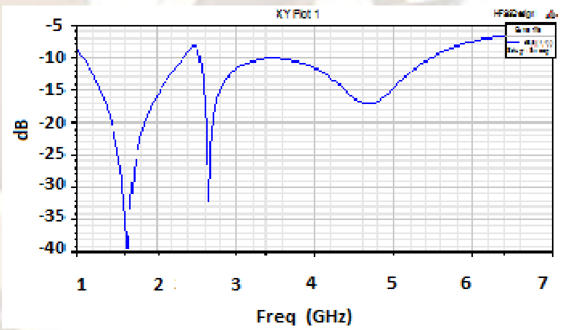


3(a). Basic design



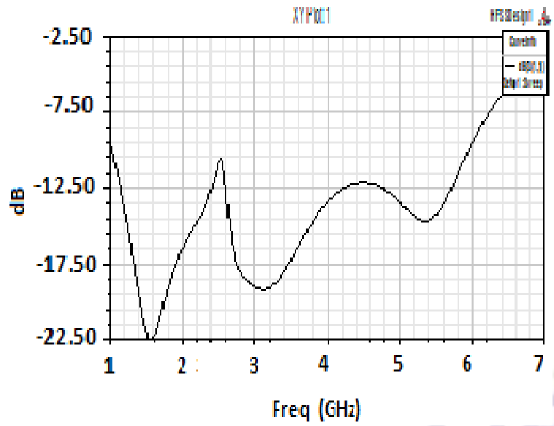
3(b). Iteration with slot in ground plane

when the ground plane of the antenna is defected by etching a U-shaped slot. The U-shaped slot in figure 3(b) gives resonance at multiple frequencies.



3(c). Iteration with patch ring

The inclusion of the split ring slot leads to the exicition of an additional coverage without increasing size where the current will be divided between the rectangular patch and the split ring slot gives more resonance frequency. Shown in graph 3(c)-



3(d). Iteration with both U slot and ring

Finally, to achieve ultra wide band, two slots are added to the design of the antenna as shown in fig.3 (d). Iteration with both U-slot and ring provides larger bandwidth compare to all the three designs.

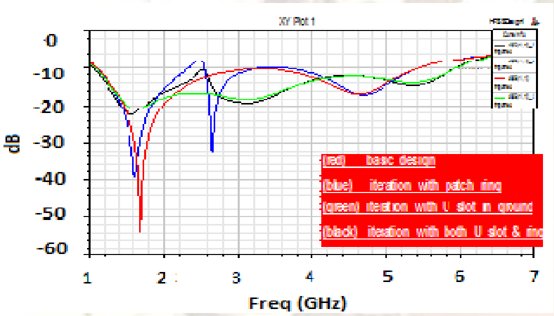
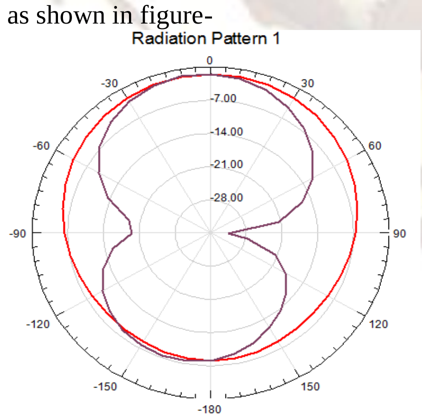


Figure 3: Simulated reflection coefficient of each design.

From the measured results, it is seen that for the wireless applications, the antenna covers multi frequency bands. Due to its geometry as a printed monopole, and the use of the partial ground plane, the antenna has omni-directional radiation patterns, as shown in figure-



IV. CONCLUSION

In this paper, a novel wide band antenna suitable for wireless applications is proposed. Using a split-ring slot implanted in the rectangular patch and a U-shaped slot etched on a partial ground plane, the multi resonant modes with excellent impedance performance are achieved. The compact size, multi-band frequency, excellent radiation patterns, and a simple structure helps in making this antenna suitable for practical wireless communication.

REFERENCES

[1] Du, Y. and A. Zhao, "An internal quad-band antenna for oval-shaped mobile phones," *IEEE Antennas Wireless Propag. Lett.*, Vol. 9, 830-833, 2010.

[2] Liu, C.-L., Y.-F. Lin, C.-M. Liang, S.-C. Pan, and H.-M. Chen, "Miniature internal pentaband monopole antenna for mobile phones," *IEEE Antennas Propag. Mag.*, Vol. 58, No. 3, 1008-1011, 2010.

[3] Al-Husseini, M., Y. Tawk, A. El-Hajj, and K. Y. Kabalan, "A low-cost microstrip antenna for 3G/WLAN/WiMAX and UWB applications," *Proceedings of International Conference on Advances in Computational Tools for Engineering Applications*, 68-70, Zouk Mosbeh, Lebanon, July 2009.

[4] Al-Husseini, M., A. Ramadan, A. El-Hajj, and K. Y. Kabalan, "A reconfigurable antenna based on an ultrawideband to narrowband transformation," *PIERS Proceedings*, Moscow, Russia, August 2012.

[5] Thomas, K. G. and M. Sreenivasan, "Compact triple band antenna for WLAN/WiMAX applications," *Electron. Lett.*, Vol. 45, No. 16, 811{813, 2009.

[6] Li, R. L., T. Wu, and M. M. Tentzeris, "A triple-band unidirectional coplanar antenna for 2.4/3.5/5-GHz WLAN/WiMax applications," *Proceedings of IEEE Antennas Propag. Soc. Int. Symp.*, 1-4, Charleston, SC, June 1-5, 2009.

[7] Chang, T. N. and J.-H. Jiang, "Meandered T-shaped monopole antenna," *IEEE Trans. Antennas Propag.*, Vol. 57, No. 12, 3976-3978, 2009.

[8] Manimegalai, B., S. Raju, and V. Abhaikumar, "A multifractal cantor antenna for multiband wireless applications", *IEEE Antennas Wireless Propag. Lett.*, Vol. 8, 359-362, 2009.

[9] Augustin, G., P. C. Bybi, V. P. Sarin, P. Mohanan, C. K. Aanandan, and K. Vasudevan, "A compact dual-band planar antenna for DCS-1900" PCS/PHS, WCDMA/IMT-2000, and WLAN applications," *IEEE Antennas Wireless Propag. Lett.*, Vol. 7, 108-111, 2008. 612 PIERS Proceedings, Moscow, Russia, August 19-23, 2012

[10] Liu, W.-C. and C.-F. Hsu, "Dual-band CPW-fed Y-shaped monopole antenna for PCS/WLAN application," *Electron. Lett*., Vol. 41, 390-391, 2005.
[11] Lee, K. F., S. L. S. Yang, and A. A. Kishk, "Dual- and multiband U-slot patch antennas," *IEEE Antennas Wireless Propag. Lett*., Vol. 7, 645-647, 2008.
[12] Augustin, G., S. V. Shynu, P. Mohanan, C. K. Aanandan, and K. Vasudevan, "Compact dual-band antenna for wireless access point," *Electron. Lett.*, Vol. 42, 502-503, 2006.
[13] Cai, L. Y., G. Zeng, and H. C. Yang, "Compact triple band antenna for Blue-tooth/WiMAX/WLAN applications," *Proceedings of International Symposium on Signals,Systems and Electronics*., 1-4, Nanjing, China, September 17-20, 2010.
[14] Krishna, D. D., M. Gopikrishna, and C. K. Aanandan, "A CPW-fed triple band monopoleantenna for WiMAX/WLAN applications," *Proceedings of the 38th Eur. Microwave Conf.*,897{900, Amsterdam, Netherlands, October 2008.
[15] Liu, H.-W., C.-H. Ku, and C.-F. Yang, \Novel CPW-fed planar monopole antenna for WiMAX/WLAN applications," *IEEE Antennas Wireless Propag. Lett.*, Vol. 9, 240-243, 2010.

Authors Profile

Rahul Suvalka has completed his **B.E.**. in Electronics and Communication Engineering. from Gyan Vihar College ,Jaipur affiliated to University of Rajasthan and he is pursuing his **M.Tech**. in CSP (COMMUNICATION & SIGNAL PROCESSING) from JNU, JAIPUR. His area of interest are Antennas, Wireless systems and Filter design.

Professor **Rajeshwar Lal Dua** a Fellow Life Member of IETE and also a Life member of: I.V.S & I.P.A former "ScientistF"(Deputy Director) of the Central Electronics Engineering Research Institute (CEERI), Pilani has been one of the most well known scientists in India in the field of Vacuum Electronic Devices for over three and half decades. His professional achievements span a wide area of vacuum microwave devices ranging from crossed-field and linear-beam devices to present-day gyrotrons.

He was awarded a degree of M.Sc (Physics) and M.Sc Tech (Electronics) from BITS Pilani. He started his professional carrier in1966 at Central Electronics Engineering Research Institute (CEERI), Pilani. During this period, indigenous know how was developed for several types of fixed frequency and tunable magnetrons of conventional and coaxial type. He headed the team for the production of specific Magnetrons for defense and transferred the know how to industries for further production. He also has several publications and a patent to his credit.

In 1979 he visited department of Electrical and Electronics Engineering at the University Of Sheffield (UK) in the capacity of independent research worker, and Engineering Department of Cambridge University Cambridge (UK) as a visiting scientist. After retirement as scientist in 2003 shifted to Jaipur and joined the profession of teaching and from last eight years working as professor and head of electronics department in various engineering collages. At present he is working as head and Professor in the department of Electronics and communication Engineering at JNU, Jaipur.