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Design a multiband Rectangular ring antenna using DGS for WLAN, WiMAX Applications

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Abstract: The proposed antenna presents the design and analysis of triple rectangular ring antenna with Defected Ground Structure (DGS). The antenna used DGS to reduce the size of antenna. In this paper antenna enhance its performance in the area of WiMAX, WLAN and IMT band. The range of band (2.55-3.82 GHz), (4.84-6.0 GHz) and (7.01-7.30 GHz). This design represents multi band frequency with wide band width and better return loss due to DGS effect. In this design patch is made in the shape of rectangular ring and using FR-4 substrates with dielectric constant of 4.4 and tangent loss 0.0009 respectively. The Design is simulated with the help of Computer Simulation Technology Microwave Studio Version 10.0 (CST MWS V10.0). The design and performance are studied in term of improved return loss and band width.

Keyword: Rectangular ring, Defected Ground Structure, Multiband, Wideband, Multiband, WLAN/WiMAX.

I. INTRODUCTION

In recent years, the micro strip patch antenna is used in wireless communication system. Micro strip patch antenna used due to its properties like a low profile, light weight and easy to fabricate [1]. The microstrip patch antenna has a narrow bandwidth, typically 5% of center frequency and half space radiation [2]. They have many method applied in microstrip patch antenna like a high permittivity using dielectric substrate, gap in patch and defect in ground plane. The electromagnetic band gap (EBG) and photonic band gap (PBG) using they improve the performance of radiation pattern and surface wave propagation then increasing the gain of antenna.

Defected ground structure have been proposed and applied in microstrip patch antenna. In this proposed antenna using defected ground structure means resonant gap or slot in the ground plane. The slot in ground plane improves the performance of antenna and reduces the size of antenna. There are variety of slot cut in the ground plane like rectangular shape, H-shape, t-shape and I-shape. The DGS Structures perturb and spread in ground plane which influence the current flow in antenna. This proposed antenna is Omni directional and the bandwidth of this antenna is suitable for various frequency bands. This designed antenna fulfill the requirement of areas like industrial, scientific and medical [ISM].The Omni directional antenna having less gain and then cover the more area and increasing the capacity of receiving signal in multipath direction[3].This type of antenna is most useful in wireless communication. Omni direction antenna the RF wave in radiated in one direction and the absent the 360º horizontal pattern.

In this proposed antenna defected ground structure applied in the ground plane and embedded gap in ground plane. Antenna has rectangular ring work as a patch and the defect in the ground plane which reduces the size of antenna and harmonics in ground plane. This design covers the WLAN, WiMAX, IMT and X bands. In this paper triple rectangular ring microstrip antenna is proposed to analysis the parameter such as voltage standing wave (VSWR), current distribution and return loss of antenna.

II. ANTENNA DESIGN

In this proposed antenna we using FR-4 substrate and dielectric constant $\varepsilon_{r=}$ 4.4 and tangent loss δ =0.0009 in this antenna defected ground plane and rectangular rings are connected to the bridge the dimension specification of the rectangular ring microstrip patch antenna is list in

Table I. Design specification

Specification	Dimensions (mm)
Substrate ($W_s \times L_s$)	55 × 44 × 0.8
Line feed ($L_f \times W_f$)	20 × 2.07
Ground ($L_g \times W_g$)	10×10
DGS ($L_g \times W_d$)	20×1.48
L_1	27.6
L_2	15.6
L_3	9.0
W_1	36.0
W_2	19.7
W_3	12.2
D_1	2.6
D_2	1.3
D_3	0.65
L_b	7.8
W_b	6.0

In this antenna using some equations to design the patch, the resonant frequency (f_r) The length of patch and width of patch expressed as [4];

$$\varepsilon_{reff} = \frac{\varepsilon_r + 1}{2} + \frac{\varepsilon_r - 1}{2}\left[1 + 12\frac{h}{w_p}\right]^{\frac{-1}{2}} \qquad (1)$$

$$w_p = \frac{c}{2 f_r}\sqrt{\frac{2}{\varepsilon_r + 1}} \qquad (2)$$

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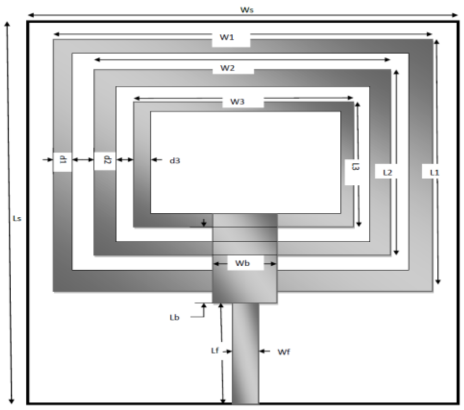
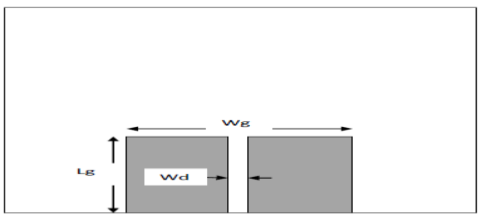
$$L_p = \frac{c}{2 f_r \sqrt{\varepsilon_{reff}}} - 2\Delta L \qquad (3)$$

$$\Delta L = \frac{h(0.412)(\varepsilon_{reff} + 0.3)(\frac{w_p}{h} + 0.264)}{(\varepsilon_{reff} - 0.3)(\frac{w_p}{h} + 0.8)} \qquad (4)$$



(1)



(2)

Fig. 1: Front view and Fig. 2: Bottom view of proposed antenna

In this antenna we cut the three rectangular rings show in fig.1 .we optimize the three rectangular rings to get required resonant frequency and wide bandwidth. The length of bridge patches and inner rectangular rings have been optimized to control the bandwidth of microstrip antenna and defect in the ground plane give the good return loss and reduce the harmonics. The width of feed line is optimizing to obtain 50 Ω characteristics impedance matching. The nominal length of feed line is optimizing using this equation [4];

$$z_o = \frac{60}{\sqrt{\varepsilon_{reff}}} \ln(\frac{8h}{w} + \frac{w}{4h})\Omega \qquad (5)$$

The length of ground plane and length of feed line is same the defected ground structure etched on ground plane and located symmetrical with feed line but it cause misleading 50Ω so it was require to optimizing the width of ground plane the DGS structure has been applied to improve the gain and get wide bandwidth [5] and it will discuss at section III.

III. SIMULATION AND RESULTS

The following parameters have been observed on simulating the proposed antenna design using CST Microwave Studio 2010.

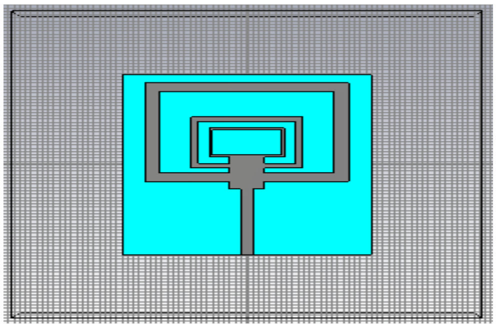


Fig. 3. Simulated design of the antenna

A. RETURN LOSS

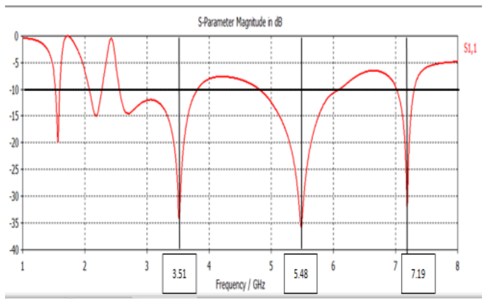


Fig. 4. Plot of return loss vs. frequency

The proposed antenna obtain multiband frequency first resonate frequency (3.51 GHz) with band width 1267MHz (2.55-3.85 GHz) and second resonate frequency at (5.48 GHz) with band width at 1150 MHz (4.84-6.00 GHz) The value of S_{11} at 3.51 GHz is around -34.24 dB and 5.48 GHz is around at -35.81dB and they cover up the WLAN,WIMAX and IMT band. The third resonate frequency (7.19 GHz) with band width 290 MHz (7.01-7.30 GHz) and the S_{11} is -31.24 dB. This band covers the X band and which are used in satellite and radar.

B. VSWR

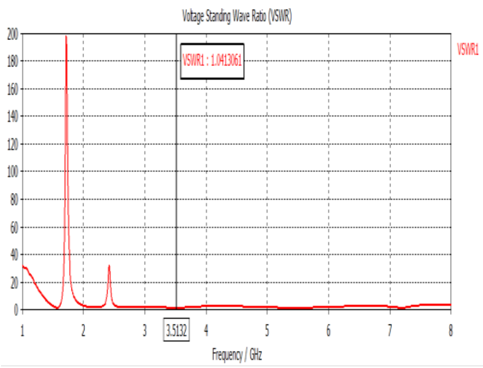


Fig. 5. VSWR at frequency 3.51 GHz

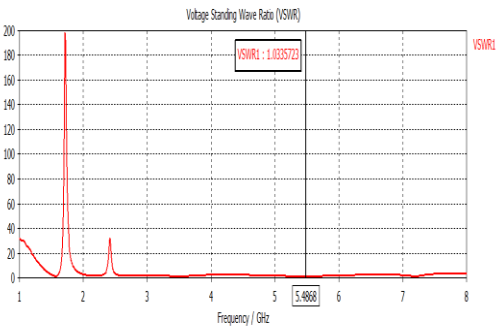


Fig. 6. VSWR at frequency 5.48 GHz

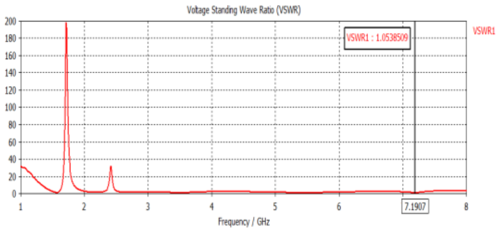


Fig. 7. VSWR at frequency at 7.19 GHz

The above Fig.5, Fig.6 and Fig.7 show the proposed antenna VSWR is less than 2 this reason is acceptable value and there is less power reflected back to source.

C. CURRENT DISTRIBUTION

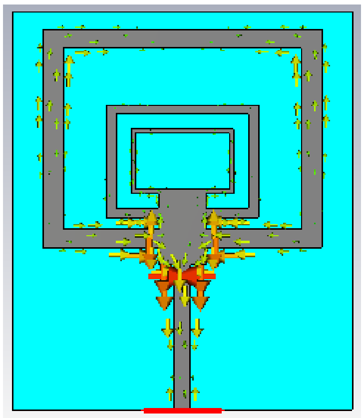


Fig. 8. Current density at 3.51 GHz

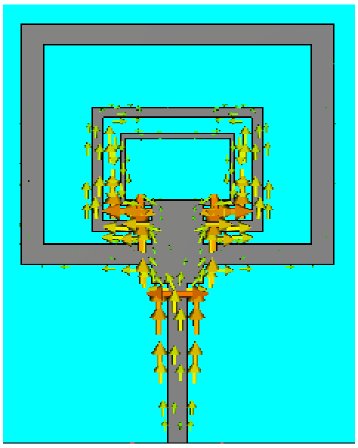


Fig. 9. Current density at 5.48 GHz

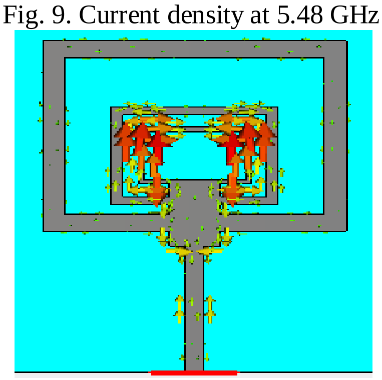


Fig. 10. Current density at 7.19 GHz

Current analysis of antenna is shown in figure in fig.8 show current distribution at resonate frequency 3.51 GHz which is lower frequency band that occur due to the bridge patch and outer ring of rectangular patch which effect the lower frequency band in Fig.9 which show the current distribution at resonate frequency 5.48 GHz which show the bridge patch and inner most rings are responsible for the middle band frequency in Fig.10 current distribution at 7.19 GHz the inner most rings are responsible for upper band.

IV. CONCLUSION

In this paper, multiband WLAN, WiMAX and IMT has been suggested in which triple rectangular rings have been loaded in patch. Antenna performance is obtained by CST microwave studio 2010 have been analyzed. The antenna gives a wide bandwidth, better return loss adding defect in ground and optimizing the width of ground we get a good impedance matching and also reduction in harmonics that occur during optimization. The future development the work focusing on implementing the different array patch technique and different patch shape to optimal the performance of antenna.

REFERENCES

[1] J. R "comparative study of microstrip patch antenna for wireless communication application," International journal of innovation, management and technology, vol.1, pp.2010.

[2] M. T. Islam, M. N Shakib , N. Misran and T. S. Sun "broadband microstrip patch antenna," European journal of scientific research, vol.27, no.2 ,pp.174-180, 2009.

[3] Cisco system, Inc "Cisco - wireless, LAN (WLAN)," 27 Feb 2007.

[4] B.C.A, Antenna Theory: Analysis and Design, 3rd edition ed.., Hoboken, new jersey.: A John Wiley & sons,INC.,2005

[5] C. Mouloud, A. Arab and D. Mokrane, "Rectangular patch antenna performances Improvement Employing Slotted Rectangular for WLAN Application," International journal of computer science Issues, vol. 8, no.3, pp.254-258, 2011

[6] C. A. Balanis, "Antenna theory analysis and design," 2nd edition, John Wiley & sons, Inc, New York, 1997.

[7] J. kaur, R. Khanna and M. V. Kartikeyan, "Comparison of Un-slotted and Slotted rectangular MSA for Wireless Applications," MIT Int. J. Electronics and Comm. Engg , vol. 1, pp. 57-59, 2011.

[8] N. Ahuja, R. Khana and J. Kaur. "Dual Band Defected Ground Microstrip Patch Antenna for WLAN/WiMax and Satellite Application," Int. J. Computer Applications pp. 48-22, 2012.

[9] J. Kaur, R. Khanna, and M. V. Kartikeyan, "Design of co-axial fed broadband single layer rectangular microstrip patch antenna for wireless applications," J. Eng. Technol., vol. 3, pp. 71-75, 2013.

[10] J. Kaur, M. V. Kartikeyan, and R. Khanna, "Design of a Multi-Frequency Wideband Microstrip Patch Antenna for 5.2/5.5/5.8 GHz Wireless Applications," presented at the Proceedings of National Conference on Recent Trends in Microwave Techniques and Application (MICROWAVE- 2012), Jaipur, Jul 30-Aug 1, 2012.

[11] J Kaur, R Khanna, and M V Kartikeyan, "Novel dual-band multistrip monopole antenna with defected ground structure for WLAN/IMT/BLUETOOTH/WiMAX applications," Int. J. Microw. Wireless Technol., vol. 6, pp. 93-100, Feb 2014.