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Design of Compact UWB Rectangular Patch Antenna for WiMAX/WLAN Applications

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Abstract-This paper proposes a design of rectangular slot antenna with defected ground structure (DGS) loaded. DGS is used for improving the parameters of microstrip antenna .The designed antenna has compact size of 33(L) ×35.5(W) ×1.6(H) mm^3. The proposed antenna is designed and fabricated on glass epoxy substrate FR-4 with dielectric constant 4.4 and loss tangent 0.02.The proposed design has the return loss of less than -10dB and VSWR < 2 dB for desired operating bands. The antenna shown two distinct bands I from 3.0 GHz to 4.2 GHz, and II from 5.2 GHz to 6.2 GHz, which cover WiMAX (f_c = 3.5 GHz), and WLAN (f_c = 5.8 GHz) respectively. The measured results of the antenna can achieved a total bandwidth (2.1GHz - 10.7GHz) 8.6GHz for UWB applications. The proposed antenna is simulated using CST V.12microwave studio software using 50Ω strip-feed line.

Keywords - Defected Ground Structure (DGS), Ultra Wide Band (UWB), Worldwide Interoperability for Microwave Access (WiMAX), Wireless Local Area Network (WLAN), Voltage Standing Wave Ratio (VSWR)

I. INTRODUCTION

The recent development in communication system such as different application works over different frequency bands like GSM/UMTS/DCS/PCS/IMT, Bluetooth, ISM, WiMAX, and WLAN etc. Gain enhancement and size reduction are the major considerations for practical applications of microstrip antennas. Satellite and wireless communication often require antenna with compact size, low cost, ease of construction and capable of operating more than one band of frequency. This technique is focused much into the design of patch antenna.

In 2002, FCC permits a 3.1GHz -10.6GHz unlicensed frequency range use as an ultra-wide band (UWB) transmission. This UWB have short range communication up to few tens of meters with high data rate without influence on other systems. Microstrip antenna has advantages such as low profile, conformal, lightweight, simple realization process and low manufacturing cost.However,the general micro strip antennas have some disadvantages such as narrow frequency, low bandwidth and low efficiency.

In order to overcome the disadvantage of narrow bandwidth, several techniques are employed. Enhancement of the performance to cover the demanding bandwidth is necessary. There are numerous and well-known methods to increase the bandwidth of antennas, including increase of the substrate thickness, the use of a low dielectric substrate, the use of various impedance matching and feeding techniques and the use of multiple resonators. However, a number of microstrip antennas with different geometrics have been experimentally characterized to reduce the size and enhance the bandwidth for UWB (WiMAX/WLAN) applications [1-4].

Impedance matching plays an important role in antenna design. By properly choosing the location and size of the tuning stub, a wide impedance bandwidth can be achieved [8]. The bandwidth of the planar antennas can be extended using embedded slits for reliable multiband RF communications [9].

This research is focused on designing of planar strip-fed rectangular patch antenna with DGS loaded. Various methodologies such as changing the thickness of substrate, position of tuning stubs in to the patch etc, has been carried out in order to get better results [5-7]. In this paper, a rectangular slot antenna is proposed for UWB applications. The structure of antenna is discussed in section II. Simulated result analyses of WiMAX/WLAN bands are discussed in section III and finally, conclusion is given in section IV.

Table 1.Performance Comparison of Proposed Antenna with Other Reported Antennas

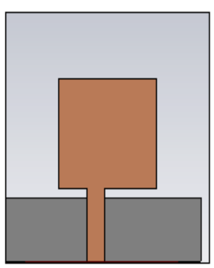
Ref	Size (mm x mm)	Operating Band:UWB Resonant frequencies : (WiMAX/WLAN)
[1]	70×80	1.8GHz,4.5GHz,7GHz
[3]	56×45	2.4GHz,3.5GHz and 5.8GHz
[4]	35×35	3.5GHz,5.7GHz,8.3GHz
[5]	57×77	3.2GHz,4.2GHz ,6.9GHz
[7]	40×40	3.4GHz,5.5GHz,7.8GHz
Proposed	33×35.5	2.1GHz,3.5GHz,5.8GHz ,7.5GHz

II. ANTENNA STRUCTURE

Fig. 1 shows the schematic representation of the proposed antenna with DGS loaded. The rectangular shaped radiating tuning stub patch is fabricated on outer rectangular substrate. The tuning stub of the proposed antenna is empirically tuned to derive the good antenna performance and produces wide bandwidth with Omni-directional radiation pattern. The radiating patch is connected to a 50Ω strip feeding transmission line. The dimensions of proposed antenna have been shown in table 2.

Table 2.Dimensions of Proposed Antenna

Parameters	Dimensions(mm)	Parameters	Dimensions(mm)
Wsub	33.0	Lsub	35.5
Wp	15.8	Lp	15.7
Wf	02.8	Lf	10.5
Wslot	31.5	Lslot	26.5
Wg	01.0	Lg	09.0
Ɛr	04.4	h	01.6



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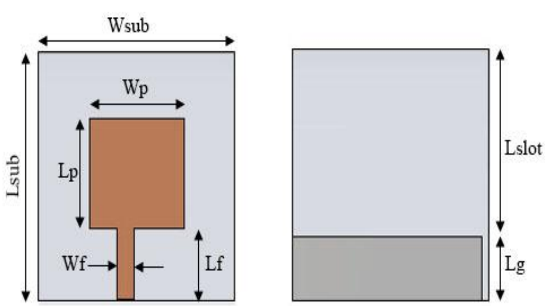


(b) (c)

Figure1: Geometry of Proposed Antenna, (a) Antenna Structure, (b) Top view (c) Bottom view

III. SIMULATED RESULTS AND DISCUSSIONS

This section discusses and analyzes simulated results of proposedantennas.The return loss curve of antenna is plotted as Fig.2.The simulated return loss against the frequency for the antenna, where fairly good agreements between them have been achieved. The measured antenna impedance bandwidth with | S_{11}|<-10dB (or VSWR<2) is from 2.1GHz to 10.7 GHz.

The VSWR analysis is presented in Fig. 3. The antenna achieved VSWR, which is less than to be 1.2dB at 3.5GHz and 5.8 GHz respectively for WiMAX and WLAN applications.

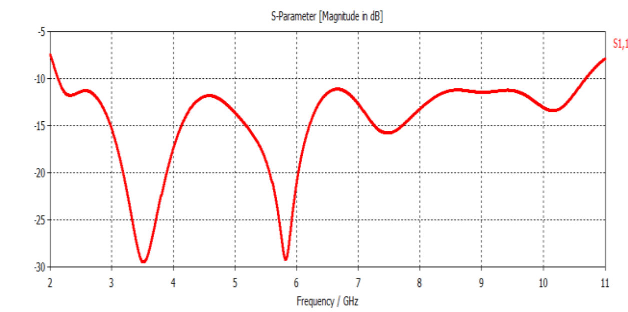


Figure 2: Return loss of proposed antenna

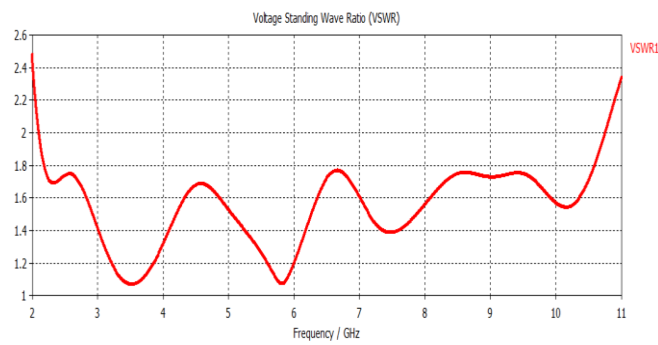
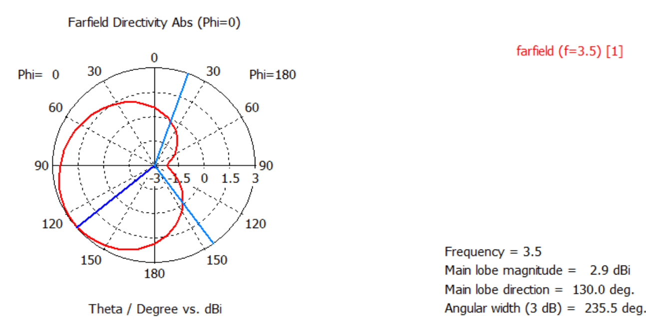
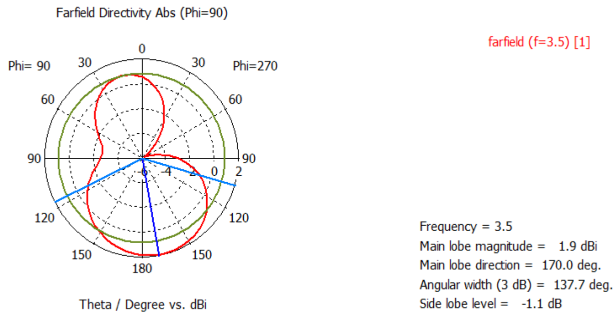


Figure 3: VSWR of proposed antenna

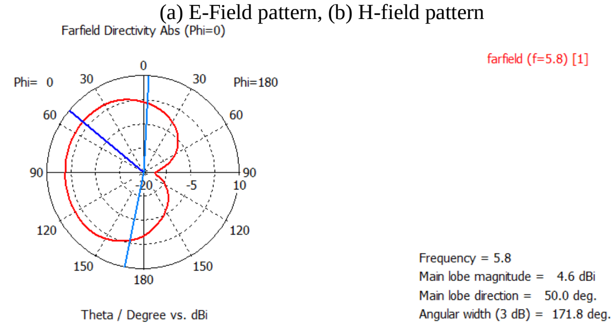


(a)

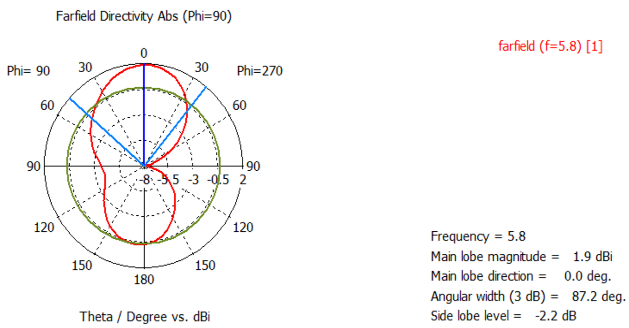


(b)

Figure 4: Radiation pattern of proposed antenna at 3.5 GHz, (a) E-Field pattern, (b) H-field pattern



(a)



(b)

Figure 5: Radiation pattern of proposed antenna at 5.8 GHz, (a) E-Field pattern, (b) H-field pattern

IV. CONCLUSION

A small rectangular microstrip patch antenna has been proposed for UWB applications. By introducing a rectangular tuning stub patch with a proper position and dimensions on substrate, a wide bandwidth from 2.1GHz -10.6GHz with VSWR<2 is achieved. The measured simulated results have shown good agreements with return loss, VSWR, and impedance bandwidth at 3.5GHz and 5.8GHz respectively for WiMAX and WLAN applications.

REFERENCES

[1] Sajjad UR Rahman and Majeed A. S. AlkanhalL, "*Design and System Characterization of Ultra-Wideband Antennas with Multiple Band-Rejection*", *IEEE Access* 2017

[2] X. Gao and Z. Shen, "*UHF/UWB Tag Antenna of Circular Polarization*", *IEEE Trans Antennas propagation*, Vol64, No.9, Sept 2016

[3] Kai Da Xu, Y.H. Zhang, Ronald J. Spiegel, Y. Fan, William T. Joines, Qing Huo Liu, "*Design of a stub- loaded Ring-Resonator slot for Antenna Application*" *IEEE Trans Antennas Propag.* Vol.63, No.2, Feb 2015

[4] Debdeep Sarkar, Kumar Vaibhav Srivastava and Kushmanda Saurav, "*A compact Microstrip-Fed Triple Band Notched UWB Monopole Antenna*",*IEEE Antennas and Wireless Propagation* Letters,Vol.13,2014

[5] Foad Fereidoony, Somayyeh Chamaani, and Seyed A. Mirtaheri, "*UWB Monopole Antenna with Stable Radiation Pattern and Low Transient Distortion*" *IEEE Antennas and Wireless propagation* Letters, Vol.10, 2011

[6] Ahmed S. Elkorany, Ghidaa T. Ahmed, Demyana A. Saleeb "*ADouble Rotated ESSRs*" ADVANCED ELECTROMAGNETICS, Vol. 7, JAN 2018

[7] Hari Shankar Mewara , Deepak Jhanwar, Mahendra Mohan Sharma ,Jitendra Kumar Deegwal, "*A Novel Hammer-Shaped UWB Antenna with Triple Notched-Band for Rejecting RLS, WLAN and XSCS bands*" ADVANCED ELECTROMAGNETICS, Vol. 6, NO. 4, OCTOBER 2017

[8] Mohammad Alibakhshi – Kenari, Mohammad Naser – Moghadasi, R.A. Sadeghzadeh, Bal S.Virdee Ernesto Limiti. "*Bandwidth Extension of Planar Antennas Using Embedded Slits for Reliable Multiband RF Communications*", International journal of electronics and communication, Vol.70, pp. 910-919, 2016.

[9] J-Y Sze, J-C, Wang and C-C Chang, "*Axial-Ratio Bandwidth Enhancement of Asymmetric – CPW – Fed Circularly Polarized Square Slot Antenna*", Electronic Letters Vol.44,No 18, 28th August 2008.

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