DESIGNING AND ANALYSIS OF A CIRCULAR SLOTTED SINGLE BAND ANTENNA FOR WLAN/BLUETOOTH APPLICATIONS

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Abstract- In this research paper, a typical single-band microstrip patch antenna with circular slot on rectangular microstrip patch forming a simple and efficient technique of design has been introduced for the betterment of bandwidth and impedance matching, also, giving the same performance at the desired resonant frequency.
The design is achieved by cutting single circular slot at the radiating element of the patch antenna. The proposed configurations are simulated using the HFSS software package, where return loss, input impedance (Z-parameter), and radiation patterns are used for the analysis of the different configurations. Compared to the conventional rectangular patch antenna slot loading antennas have good return loss, for these reasons we have associated the two techniques simultaneously in the same patch antenna for benefit. The proposed antenna shows the advantages in terms of low fabrication cost, constant radiation characteristics and hence suitable for multiple wireless applications like WLAN/Bluetooth. The study presents an investigation of the effects of without or with circular shaped slots (cut) can be used to improve the performance of a simple patch antenna operating in Wireless Local Area Network (WLAN) frequencies (2.4 Ghz).

Keywords- **WLAN, Circular Shape Slots, High Frequency Structure Simulator, Microstrip patch antenna, Return Loss, Impedance Matching, VSWR, resonant frequency.**

I. INTRODUCTION

Microstrip patch antenna is one among widely held antenna types in today's use. Frequently microstrip antennas are as well indicated as patch antennas or microstrip patch antennas. Microstrip antenna finds major application in the microwave frequency range for of their compatibility, minimalism and ease of integration, fashioning them cool to fabricate either as individual elements or as arrays. The concept of the Microstrip patch antenna was projected in 1953 by Deschamps. On the other hand, real-world antennas were industrialized in the 1970s by Munson and Howell. The exclusive asset of the patch antenna is its Two-Dimensionality. The simplest form of patch antenna entails a ground plane on one side of the substrate and a radiating patch on another side. The feed lines and the radiating elements are commonly photo etched on the substrate. Thus, it possesses precise low contour and printed circuit (photolithographic) technology can be used for fabrication proces. Radiating patch designed may be of different shapes such a rectangular, square, circular, elliptical, thin strip (dipole), triangular etc. There are numerous patterns that can be used as feed to microstrip antennas like co-axial feed, line feed, aperture coupling, proximity coupling etc.[1]
Wireless Communication is the process of transmitting radio waves or micro waves over a distance between the two points without any physical wire attachment. It encompasses various types of devices such as Bluetooth, remote control, Hand-held walkie-talkies, personal digital assistant, wireless computer mice and so on.
Worldwide Interoperability for Microwave Access is a wireless communications standard designed to provide a high speed data rates. Its capability to deliver high-speed Internet access and telephone services to subscribers enables new operators to compete in a number of different markets. In urban areas already covered by Digital Subscriber Line and high-speed wireless Internet access, WiMAX allows new entrants in the telecommunication sector to compete with established wireless operators.[2]

II. MICROSTRIP PATCH ANTENNA GEOMETRIES

Micro strip patch antenna consists of a dielectric substrate, with a ground plane on the other side. If the antenna is excited at a resonant frequency, a strong field is set up inside the cavity, and a strong current on the surface of the patch. Advantages such as less weight, low costs and capability to integrate with microwave integrated circuits technology makes the Microstrip as research interest area. The micro strip patch antenna is very well suited for applications such as wireless communications system, cellular phones. Through decades of research, it was identified that the performance and operation of a microstrip antenna is driven mainly by the geometry of the printed patch and the material characteristics of the substrate onto which the antenna is printed. It is well known that the size of the antenna will impact its performance, specifically in terms of bandwidth and gain.

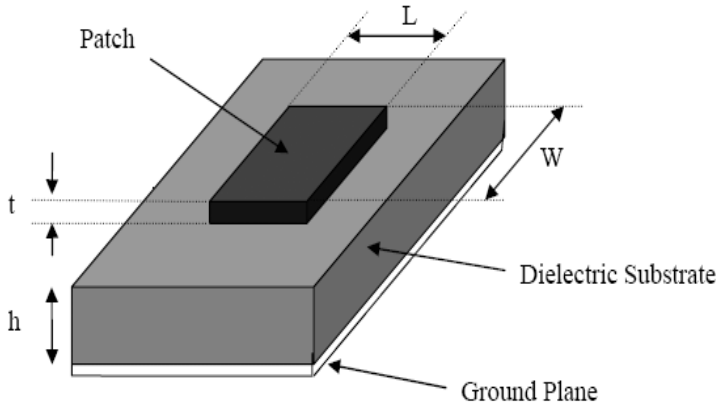

Figure 1: Structure of microstrip patch antenna

In general, antennas can be split into two main types - resonant structures (e.g. microstrip patch antennas, dipoles, loops) and travelling wave structures (e.g. horns, helixes, spirals). Conversely, resonant antennas couple energy to free space via a structure proportionate to the operating wavelength, and only efficiently over limited frequency ranges [3].

III. DESIGN & RESULT ANALYSIS

Design of proposed single band antenna using circular ring slot:

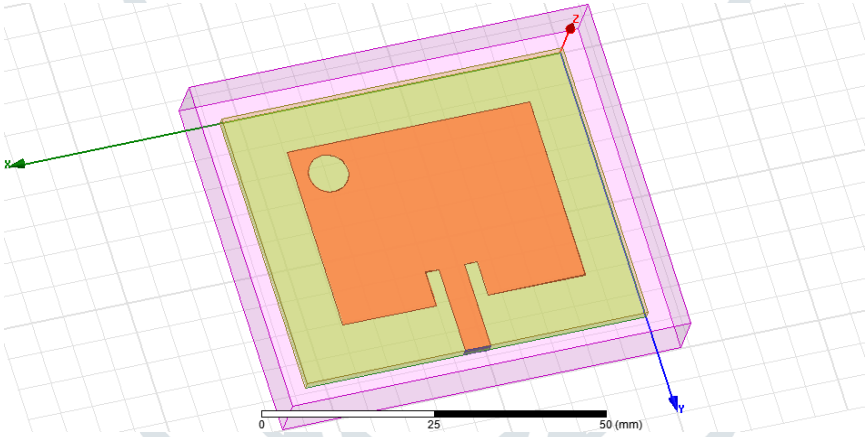

Figure 2 Design of proposed single band antenna using square ring slots

RESULTS:
The return loss plot for the designed antenna at -10 dB bandwidth using microstrip line feed is shown in figure 3 as below.

a) Observation from -10dB return loss

- Resonate at frequency = **2.4 GHz**
- Return Loss (S- Parameters) = **-46.29 dB**

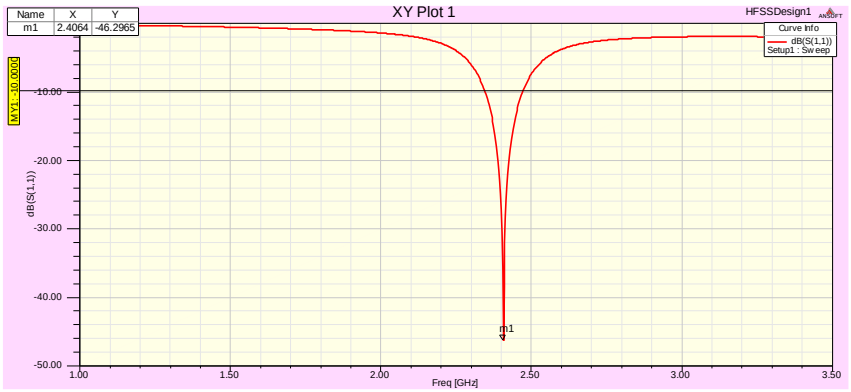

Figure 3 Simulated return loss

b) Observation from VSWR

VSWR at resonant frequency 2.4 GHz=1.0097

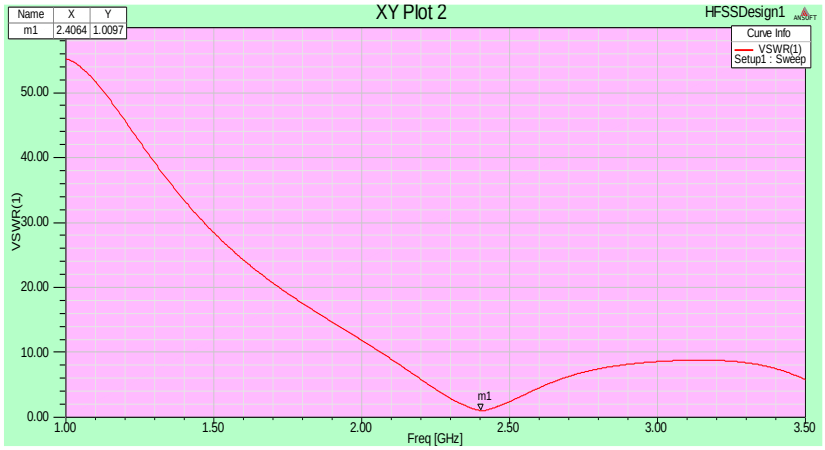

Figure 4 VSWR plot

c) Smith Chart

It is observed from the smith chart that the value of impedance in this smith chart is 1.0083×50 (characteristic impedance) = 50.415 ohm at resonant frequency.

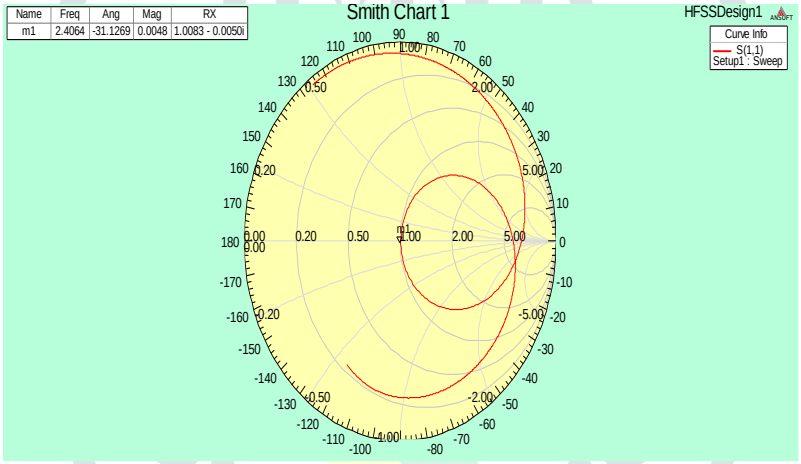

Figure 5 Smith Chart plot

Conclusion between Reference Antenna and Proposed Antenna:

Thus a compact microstrip patch antenna has been designed for full filling the requirements of WLAN/Bluetooth applications at 2.4 GHz frequency. The measured and simulated results are in good match. To meet the miniaturization requirement microstrip patch antennas has been designed.

Table 1 Difference Table between Reference and Proposed antenna

ANTENNA	**Resonant Frequency (GHz)**	**Return Loss**	**VSWR**
Reference Antenna	2.4	-38 dB	1.01
Proposed Antenna	2.4	-46.29 dB	1.009

IV. CONCLUSION

In this research paper, initially a square patch of antenna is taken. In this attempt, a circular shaped slot based microstrip patch antenna is proposed and designed. The functional characteristics of the proposed antenna namely return loss, VSWR and radiation pattern are investigated. The designed antenna is resonating at 2.4 GHz, and the return loss and VSWR about, -46.29 dB and 1.0029 respectively.

The overall size of the proposed antenna is 53 mm × 44 mm. The size of the proposed antenna is small and meets the requirements for WLAN applications. Hence it could be incorporated for WLAN applications. Parametric analysis has been applied to obtain antenna characteristics. Characteristics of antenna are analyzed by changing substrate thickness, changing feeding technique, change of substrate.

VI. REFERENCES

[1] C.A. Balanis, "Antenna Theory (Analysis and Design)", Second Edition, John Wiley & Sons., 2001.

[2] Zuhura Juma Ali, "A Miniaturized Ultra Wideband (UWB) Antenna Design for Wireless Communications" International Journal of Scientific & Research Publications, Vol 4, Issue 7, July 2014.

[3] A. Gnandeep reddy, k. Gopivasanth kumar, "Design And Simulation Of A L And U-Shaped Slot Compact Planar Monopole Antenna", International Journal of Science, Engineering and Technology, Vol. 8, No. 11, 2014.

[4] Ajay Kumar Dwivedi, Brijesh Mishra, Anil Kumar, "Quad Bands U-shaped Slot Loaded Probe Fed Microstrip Patch Antenna", IEEE, 2015 Second International Conference on Advances in Computing and Communication Engineering.

[5] Udit Raithatha, S. Sreenath Kashyap & D. Shivakrishna, May 2015, "Swastika Shaped Microstrip Patch Antenna for ISM Band Applications" international journal IRJET.

[6] Chandra Bhan, Ajay Kumar Dwivedi, Brijesh Mishra, Anil Kumar, "Quad Bands U-shaped Slot Loaded Probe Fed Microstrip Patch Antenna", IEEE, 2015 Second International Conference on Advances in Computing and Communication Engineering.

[7] Gurpreet Kaur, Er. Sonia Goyal, "Effect of Height on Edge Tapered Rectangular Patch Antenna using Parasitic Stubs and Slots'', International Journal of Engineering Trends and Technology (IJETT) – Volume 34 Number 8- April 2016.

[8] R.K. Sharan, S.K. Sharma, " A .Gupta, R.K Chaudhary, An Edge Tapered Rectangular Patch Antenna with Parasitic Stubs and Slot for Wideband Applications, Wireless Pers Commun Vol 86, pp 1213–1220, 2016.

[9] M. Tarikul Islam, M. Samsuzzaman, M. Z. Mahmud, M.T. Islam, "A Compact Spectacles Shaped Patch Antenna for UWB Applications", 9th International Conference on Electrical and Computer Engineering, IEEE, 20-22 December, 2016, Dhaka, Bangladesh.

[10] B. Zoubiri, A. Mayouf, F. Mayouf, S. Abdelkebir and T. Devers, "Rectangular Microstrip Antenna Gain Enhancement Using Elliptical EBG Structure", IEEE 2016 7th International Conference on Sciences of Electronics, Technologies of Information and Telecommunications (SETIT).

[11] M.M.Ali, "Rectangular with Half Circle Cut-out MPA for C-Band Application**",** Proceedings of the 2017 4th International Conference on Advances in Electrical Engineering (ICAEE) 28-30 September, Dhaka, Bangladesh

[12] R. Kiruthika T. Shanmuganantham Rupak Kumar Gupta A Novel Dual Band Microstrip Patch Antenna with DGS for X-band Applications IEEE International Conference on Computer, Communication, and Signal Processing (ICCCSP-2017)

[13] Mohamed Tarbouch and Abdelkebir El Amri, "Compact CPW-Fed Microstrip Octagonal patch antenna with H slot for WLAN and WIMAX Applications", 5090-6681-0/17/2017 IEEE

[14] T.Shanmuganatham, "Design of Multi Utility Multi Band Microstrip Calculator Shaped Patch Antenna Using Coaxial Feed", IEEE International Conference on Computer, Communication, and Signal Processing (ICCCSP-2017)

[15] L.Chandiea, K.Anusudha, "Performance analysis of Pentagon shaped Microstrip Patch Anenna", IEEE International Conference on Computer, Communication, and Signal Processing, 978-1-5090-3716-2/2017 IEEE

[16] G.Sreedhar Kumar, "Dual-Band Tunable Adapted E-Shaped Microstrip Patch Antenna", 2017 2nd IEEE International Conference On Recent Trends in Electronics Information & Communication Technology (RTEICT), May 19-20, 2017, India

[17] Abhinav Srivastav, Sourabh Chandra, "Design of PLUS-slot Microstrip Patch Antenna for Bluetooth and Wi-MAX applications**,** 2nd IEEE International Conference On Recent Trends in Electronics Information & Communication Technology (RTEICT), May 19-20, 2017, India.

[18] Qassim Nasir, "Patch Antenna Performance Improvement Using Circular Slots"**,** 2nd IEEE International Conference On Recent Trends in Electronics Information & Communication Technology pp-2123-2128, July 2017 IEEE.

[19] I. Kaur, A. K. Singh, J. Makhija, S. Gupta and K. K. Singh, "Designing and Analysis of Microstrip Patch Antenna For UWB Applications," *2018 3rd International Conference On Internet of Things: Smart Innovation and Usages (IoT-SIU)*, Bhimtal, 2018, pp. 1-3.

[20] S. Singh, G. Bharti and P. K. Bharti, "Microstrip Circular Patch Antenna with Partial Ground Structurefor X-Band Applications," *2018 3rd International Conference for Convergence in Technology (I2CT)*, Pune, 2018, pp. 1-4.