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A MULTI-BAND SLOTTED CIRCULAR PATCH MICROSTRIP ANTENNA FOR NUMEROUS WIRELESS APPLICATIONS

Mohd Shibly, Prashant Kumar, Prabhakar Choubey, Prashant Nigam,
Department Of Electronics And Communication Engineering,
Galgotias College Of Engineering And Technology, Greater Noida, India

Mohd.Shibly@Galgotiacollege.Edu , Prashantkumar.18gcebec061@Galgotiacollege.Edu , Prabhakarchoubey.19gcebec129@Galgotiacollege.Edu , Prashantnigam.18gcebec004@Galgotiacollege.Edu

Abstract— *This work includes designing with investigation on the subject of Circular Microstrip patch antenna containing different slots having multi-band notch characteristics which is used in different applications such as 2.4GHz to 5.8 GHz for the Wi-Fi, 5.1 to 5.8 GHz for WLAN, 3.4 to 3.6 GHz for WIMAX, 5G Application (3.3 to 3.8 GHz) and Defence and T.V. broadcasters. This antenna is designed to work at multiple frequencies such as 3.5, 5.4 and 7.9 GHz frequencies. The design is excited by feed of 50ohm and manufactured on lossy substrate FR-4 which have measurements length = 40, width = 40mm and height = 1.6mm having 4.4 permittivity with 0.25δ. For designing purpose we are using CST MWS software.*

Keywords —Multiband, FR-4, WLAN, WIMAX, CST MWS, WI-FI, 5G.

I. INTRODUCTION

Multiband Microstrip patch antennas have multiple frequency bands covering various applications such as WI-FI, WIMAX, Bluetooth, Defence, Military etc. Multiband Microstrip Patch antennas are designed using various patches such as square patches, rectangular patches, circular patches, elliptical patches, etc. Microstrip patch antennas have various advantages such as less weight, less volume, cheaper in cost, low profile, dimensions are small, easy manufacturing, etc.
ne half-duplex transceiver to transmit or to and better prospects. Multiband Microstrip patch antennas contain metallic patch placed above the substrate(dielectric sheet) and below the substrate ground plane is there. There are various frequency bands having different applications. 2.4 to 5.8 GHz frequency bands are used for WI-FI and Bluetooth,
5.1 to 5.8 GHz frequency bands for WLAN, 3.4 to 3.6 GHz for WIMAX, 3.3 to 3.8GHz for 5G Application. All these applications can be easily achieved by Multiband Antennas.

Multi-band antenna is proposed by making slots in the circular patch. However, slots cutting in the patch won't increase the antenna's proportion [1-2]. Different shapes and size are selected for microstrip antennas such as semicircular, circular[3], square [4], pentagonal, elliptical, hexagonal along with rectangular. Performance of different shapes of microstrip antennas can be also analysed by calculating different parameters by taking same center frequency[5]. Slots that are made can be C-shaped slot(operating at 2.4 GHz for WLAN)[6], T-slot(for Wimax)[7], H-slot(for Wimax)[8], U- Shaped slot[9], etc. For 5G purposes, Microstrip antenna is operated in C-band frequency[10] and at the center frequency
3.5 GHz[11]. Applications of multiband antenna is investigated by notches[12]. Mentioned designs of antenna have high bandwidths, they are small in size, have simple structures of antenna, easy

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manufacturing and desired properties of antenna radiation. In this paper, we have designed multi-band circular Microstrip patch antenna having circular patch on Substrate FR-4(lossy) which works at central frequencies 3.5, 5.4 and 7.9 GHz with return loss of -12.2dB, -13.3dB and -16dB respectively for various applications like WI-FI, WLAN, WIMAX, 5G Application. The suggested patch antenna, which is designed manipulating circular patch having 50ohm feed. Feed is facile to manufacture. Ultra-Wide Band antennas are noise producing which can break the craved signal quality. In modern days, new wireless devices operates in collective frequencies. So nowadays to decrease the fare of overall design of antenna, it is crucial that single antenna should display multiple frequency bands. Therefore, antennas having multiband features are far relevant in spite of UWB ones. The work in this paper is completed in six sections: I.Introduction, II. Antenna Design, III. Results, Conclusion, V. Acknowledgement, VI. References.

II. ANTENNA DESIGN

The design is made up of components which consist of ground, substrate along with patch. This design is integrated on lossy substrate FR-4 having 4.4 permitivity, 0.025 loss tangent, 40mm length, 40mm width and 1.6mm thickness. Diameter of circular patch is 25mm. All dimensions of proposed antenna is taken in millimeters (mm). Slots are made in the circular patch to achieve the desired frequency bands.

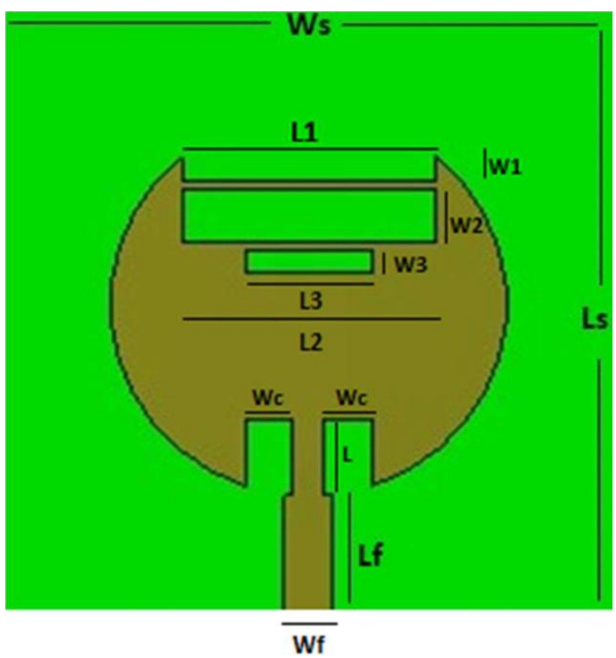

Figure1: Front view of designed multiband circular patched microstrip antenna

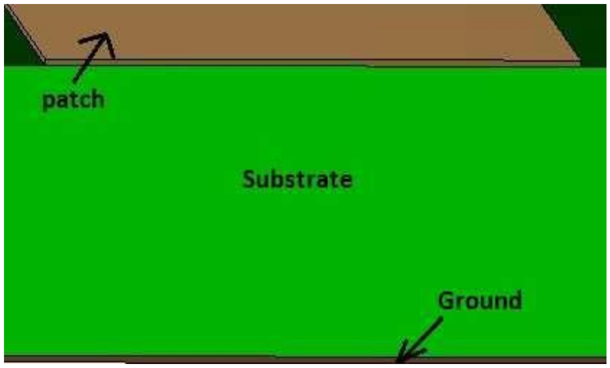

Figure2: Bottom view of designed multiband circular patched microstrip antenna

Table 1: Measurements of design

Parameters	Values(mm.)
Ground extent(Lg)	40
Ground Width(Wg)	40
Substrate Length(Ls)	40
Substrate Width(Ws)	40
Diameter of Patch(D)	25
Feed extent(Lf)	7.5
Feed breadth(Wf)	3
Upper Slot Length(L1)	16
Upper Slot Width(W1)	4.5
Medium Slot Length(L2)	16
Medium Slot Width(W2)	3.5
Bottom Slot Length(L3)	8
Bottom Slot Width(W3)	1.5
Substrate Thickness	1.6
Inset Feed Line Length(L)	5
Width of Cuts(Wc)	3

III. RESULTS

A Circular patched Multiband Microstrip antenna, is implemented and investigated in the paper. Here, proposed design i.e. constructed with help of software CST Microwave Studio Suite. S-Parameter, VSWR and Radiation patterns in a 0.5 to 10GHz frequency range are analysed in this paper. Antenna works at three different frequency bands. The examined results are shown below :

A. Return Loss

The reflection loss of antenna design after simulation for 3.5, 5.4 and 7.9GHz as displayed inside Figure3 is -12.2dB, -13.3dB and -16dB respectively.

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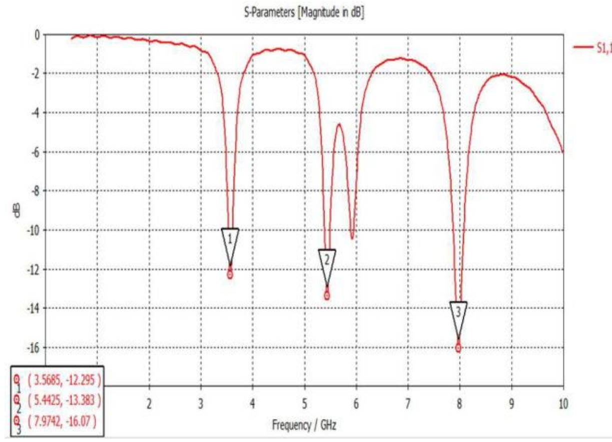

Figure3: Return loss graph of designed antenna

B. VSWR Calculation

The VSWR stand for voltage wave standing ratio which is equal to the maximum voltage on the line upon minimum voltage. VSWR of designed antenna is displayed in Figure4. The obtained values of VSWR are 1.6dB, 1.5dB and 1.3dB at 3.5GHz, 5.4GHz and 7.9GHz respectively.

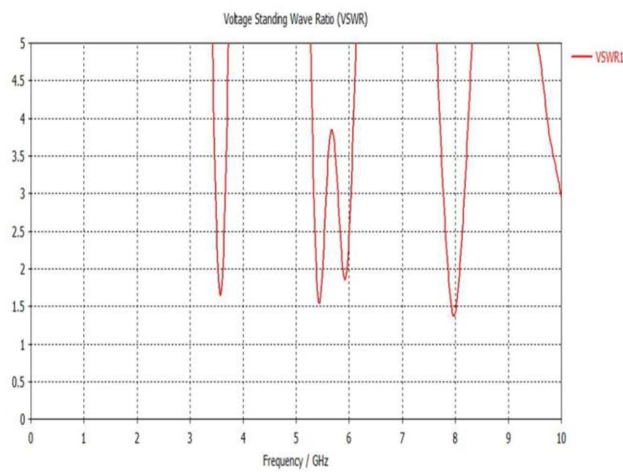

Figure4: Stimulated VSWR of proposed antenna

C. Radiation Patterns

The radiation pattern for farfield refers to the directional (angular) dependence of the strength of the radio waves from the antenna or different sources. Radiation pattern of design for both gain as well as directivity are shown in Figures 5, 6, 7, 8, 9 and 10 at 3.5GHz, 5.4GHz and 7.9GHz frequencies.

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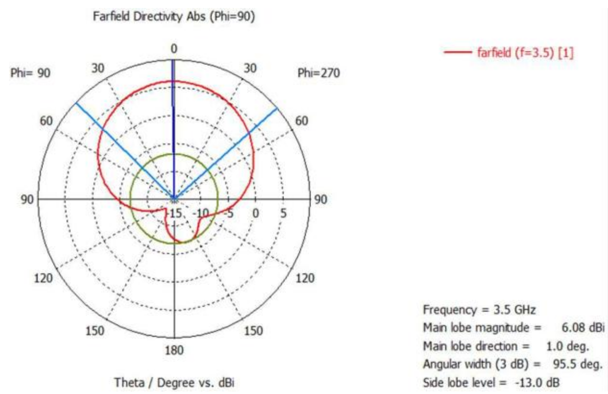

Figure5: Radiation Pattern for directivity at 3.5GHz

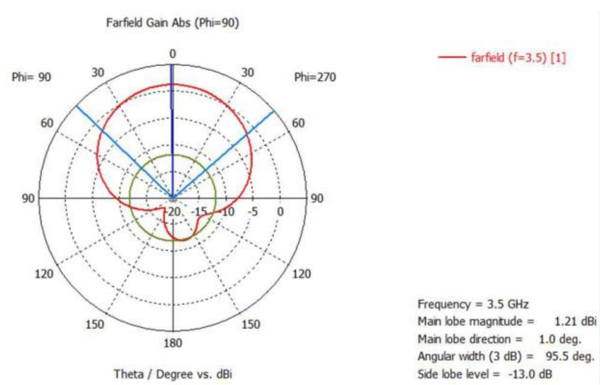

Figure6: Radiation Pattern for gain at 3.5GHz

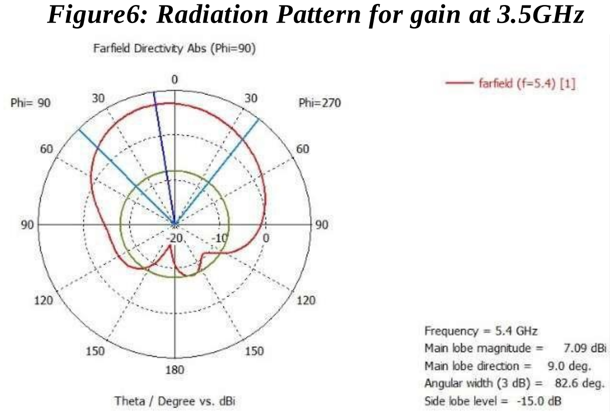

Figure7: Radiation Pattern for directivity at 5.4GHz

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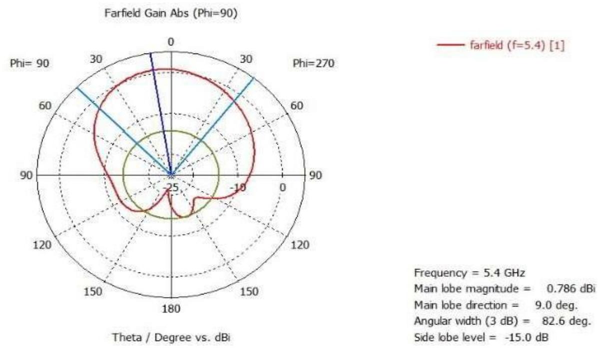

Figure8: Radiation Pattern for gain at 5.4GHz

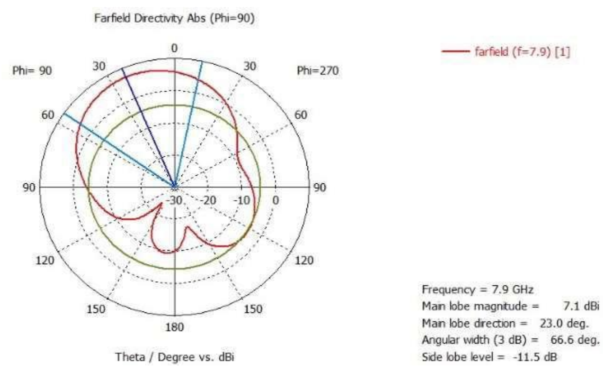

Figure9: Radiation Pattern for directivity at 7.9GHz

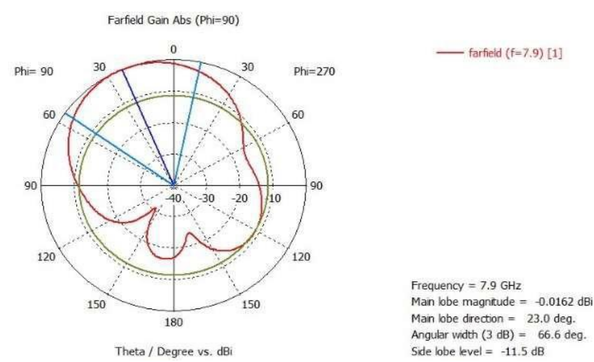

Figure10: Radiation Pattern for gain at 7.9GHz

IV. CONCLUSION

This includes designing and investigation of a Circular patched Multiband Microstrip antenna for use in various applications such as 2.4GHz to 5.8 GHz for the Wi-Fi, 5.1 to 5.8 GHz for WLAN, 3.4 to 3.6 GHz for WIMAX, 5G Application (3.3 to 3.8 GHz) and Defence and T.V. broadcasters. The results like VSWR, S- parameter and radiation patterns for gain and directivity are analysed.

By making slots of specified length and width, Antenna's performance got improved so that it can work in different applications at different frequencies. This Multi-Band Microstrip Patch Antenna is more efficient than UWB Antennas.

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