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Design and Study of G-Shaped Microstrip Antenna for WLAN Applications

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Abstract- This paper illustrates the usage of G shape patch antenna in WLAN applications. Due to transformation of telecommunication industry and rapid increase in usage of WLAN dual band antennas are preferred. This antenna resonates at single frequency i.e. 2.45 GHz and operates on 2.4 GHz and 5.2 GHz. This proposed antenna can be used for WLAN application worldwide. Due to efficient bandwidth and very less VSWR this antenna is preferred over many microstrip patch antennas. VSWR for 2.4 and 5.2 GHz is is 1.2 and 1.5 dB and bandwidth for 2.4 and 5.2 GHz is 50 and 72 MHz. Fabricated antenna have VSWR of 1.24 and 1.49 dB at 2.4 and 5.2 GHZ which is in standard range.

Keywords- Ansoft HFSS, Dual Band, G shaped patch, Microstrip Patch Antenna, WLAN.

I. INTRODUCTION

Microstrip antenna consists of patch of metal with ground plane. The size of ground exceeds than size of patch. Microstrip patch antenna resonates due to discontinuities at each abridged edge of microstrip line. Patch antenna consists of sheet of metal on substrate called FR4 . Patch antenna are easy to manufacture and amend, these have numerous applications including WLAN, military applications and satellite communication. WLAN has played significant role in growing telecommunication,, it compensates all the benefits of conventional LAN with advantage of mobility. Microstrip patch antenna due to being compact sized low weighted and producing optimum results are used in WLAN. The design of antenna gets complex when desired operational bands are dual or multi band. Many antenna shapes which comply with IEEE 802.11 WLAN standards [1-6] for dual band have been presented and many parameters are kept in mind before comparing 1 shape to another. Due to demand of faster data rate it is advantageous to use upper band i.e. 5GHz. The upper band has 3 operational frequency bands for IEEE 802.11a i.e. 5.15GHz ~ 5.25GHz, 5.25GHz ~ 5.35GHz, 5.725GHz ~5.825GHz. G shape has numerous advantages over other shapes such as it does not require band sepration technique usually called “notching”, so in the close future G shaped antennas would be favored over other microstrip antennas. Probe feed line is much suitable feeding technique due to its possibility in providing a range of required emission features of dual and multi band and uncomplicated integration with system circuit board. In this paper we have presented a Probe fed G-shaped microstrip antenna which is, appropriate for operation at both bands i.e. lower and upper band of wireless local area network (WLAN) i.e. 2.4/5.2 GHz. The proportions of G shape were cautiously chosen by using equations [7] for dual band operation. Precise antenna performances such as bandwidth, VSWR, gain and radiation pattern, distribution vector are discussed in this paper.

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II. DESIGN ANTENNA GEOMETRY

Fig 1 shows actual proportions of Probe fed G-shaped microstrip patch antenna. This antenna is fabricated on FR4 dielectric having 1.6mm depth and dielectric constant of 4.4. The actual proportions of FR4 substrate is 52 x 62 mm. This antenna is mounted on 1 side of dielectric material called substrate while other side consists of ground plane which in actual is sheet of copper. A 50 ohm Probe feed line and 2.4 GHZ is used for resonating the antenna. The G-shaped patch is operated near resonance so that impedance matching can be achieved and all the current flows into antenna. By varying different values of strip (thickness and length) and changing feeding point of antenna the operational bands varied and thus by careful assessment and calculating current distribution preferred results were achieved. Values of parameter for G shape are given in table 1.

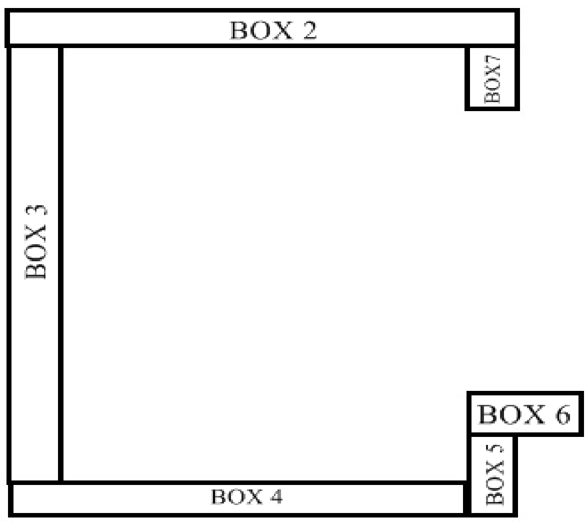

Figure 1 Geometric View of G-Shaped Antenna

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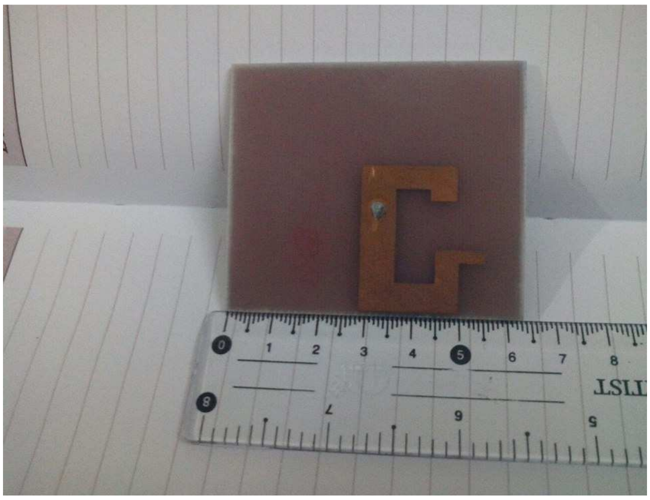
Table 1 Value of Parameters for Optimized Results

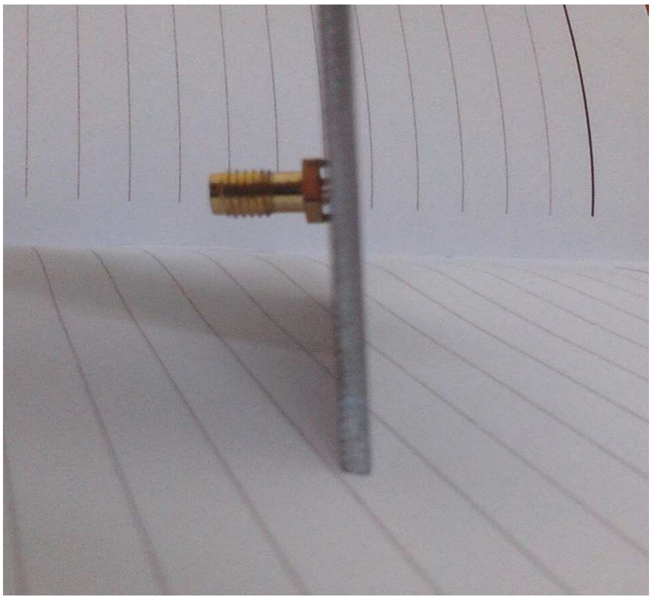
BOXES	X Plane	Y Plane	Z Plane
BOX 2	X=188.18mil	Y=-799.21 mil	Z=1.377mil
BOX 3	X=-956.69 mil	Y=295.27 mil	Z=1.377mil
BOX 4	X=-236.22 mil	Y=-822.04 mil	Z=1.377mil
BOX 5	X=-354.33 mil	Y=-196.8 mil	Z=1.377mil
BOX 6	X=106.29 mil	Y=-413.38 mil	Z=1.377mil
BOX 7	X=165.35 mil	Y=-219.68 mil	Z=1.377mil

III. ANTENNA DESIGN

In fig 2 HFSS view of G-shaped microstrip patch antenna with Probe feed for dual band is shown.



(A)



(B)

Figure 2 Hardware View of G-Shaped Antenna (A) Front View (B) Side View

IV. SIMULATED RESULTS

This designed antenna opertaes at dual band i.e. 2.42 and 5.2 GHz. The value of return loss (S11 parameter) for 2.42 and 5.22 GHz is -20.5 and -18 dB correspondingly. The bandwith at 2.42 and 5.2 GHz is 50 and 72 MHz. Return loss vs frquency graph is shown in fig 3.

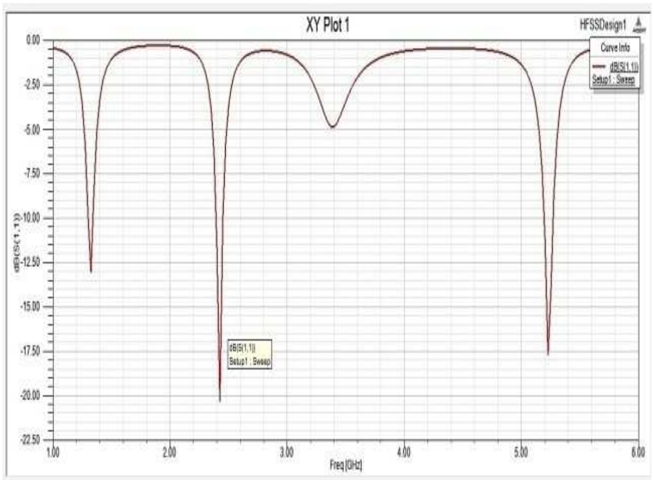


Figure 3 Return Loss of Proposed Antenna (HFSS Results)

Hardware results show that simulated and calculated values are almost equal i.e. value of return loss at 2.4 and 5.2 GHz is -20.37 and -19.49 dB. Hardware results are shown in fig. 4

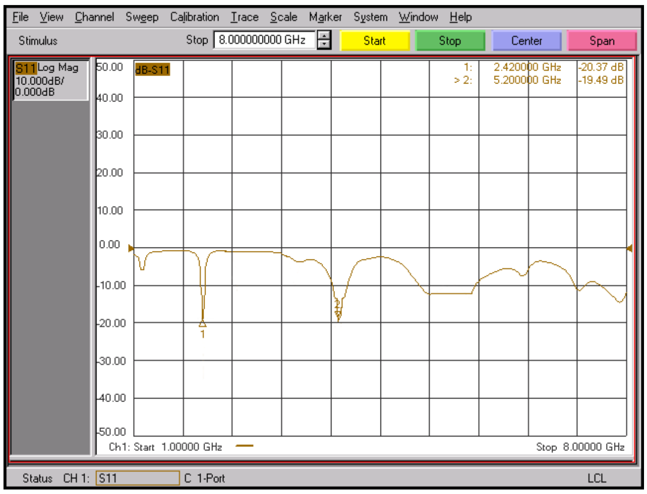


Figure 4 Return Loss of Antenna (Hardware Results)

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The principle value of VSWR lies between 1-2 dB. The VSWR of our projected G-shaped patch antenna for 2.42 and 5.2 GHz is 1.2 and 1.5 dB. The VSWR vs frequency graph is shown in fig 5.

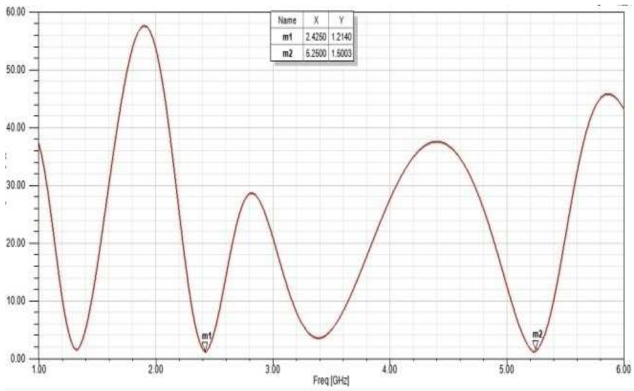


Figure 5 VSWR of Proposed Antenna (HFSS Results)

The hardware results show that VSWR of G shaped patch antenna are less than 1.5 dB. Value of VSWR at 2.4 and 5.2 GHz is 1.24 and 1.49 dB. Hardware results are shown in fig. 6

Figure 6 Hardware Results for VSWR

Radiation pattern of our proposed G-shaped patch antenna shows directivity of 6.20 dBi and main lobe direction is 2 degree. Graph between frequency and directivity is shown in fig 7.

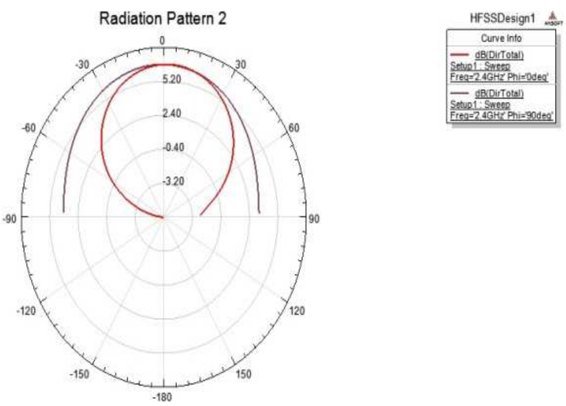
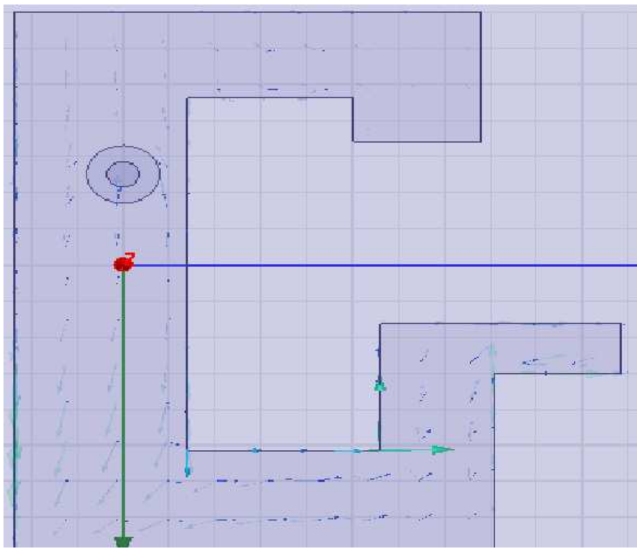
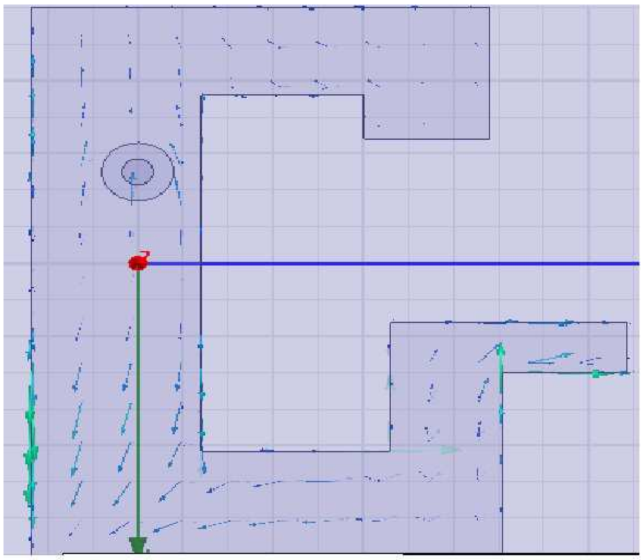


Figure 7 Directivity of Proposed Antenna

Current distribution vector on surface of patch controls the opertional frequency bands of antenna, so by controlling current on surface on patch we can control the operational bands. Current vector of 2.42 and 5.2 GHz are shown in fig 6.



(A)



(B)

Figure 6 Current Distribution Vector for (A) 2.42 GHZ (B) 5.2 GHz

Smith chart shows relation between antenna impedence and frequency. Graph of smith chart is shown in fig 7.

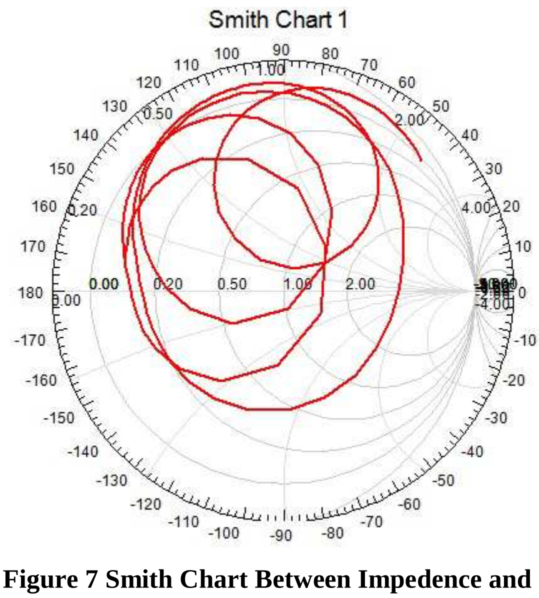


Figure 7 Smith Chart Between Impedence and Frequency

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V. CONCLUSIONS

In this paper we have proposed a solution to increase in demand of WLAN user all over the world. This antenna operates at dual band with single resonating frequency. VSWR achieved is according to standard of IEEE 802.11, bandwidth achieved through this antenna is much greater than achieved before. This antenna can be integrated with RF transmitter and Receiver to form front end system.

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