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# Design and Simulation of Microstrip Multiband Antenna for Wireless Applications

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**Abstract:** *This paper proposes a compact sized dual band microstrip patch antenna with microstrip feed line. The patch of antenna is a rectangular shaped patch which has a circular slot in the patch for multiband operations. This antenna covers frequency bands, centered at 2.4GHz, 3.3GHz, which is useful for the C-band and X-band operations. In this paper, a microstrip patch antenna with compact size of 21x17x1.6 mm in rectangular shape. This antenna is designed on FR4 substrate (Dielectric constant=4.4) of thickness h=1.6mm with ground of size 25x10 mm. The proposed structure were simulated on CADFEKO simulation software. This proposed antenna is suitable for multiband wireless communication systems and mobile equipments.*
**Keywords:** *Microstrip antenna, dual polarization, CADFEKO.*

## I. Introduction

Recently more and more research has been carried out to provide simple and compact multiband antennas. As these devices also wants smaller dimensions for the real time application antennas need to smaller dimensions and more than one operating frequency bands while maintaining their performance. Due to this specification the demand for multiband antenna design is increasing continuously.

A new technology is needed to meet the needs of high-speed WPANs. To cover many applications with common antenna could be referred to as multiband antenna, emerging a number of applications into same. As circularly polarized waves carry information through each and every plane so the problems arises with linear polarization (LP) are completely eliminated. Multi-band systems avoid duplications of different antennas that might be used for different applications. Microstrip antennas with single band, dual band, triple band and quad band operations can be integrated into the same frame of radiating structure, reducing complexity and making system compact. Now a day's circular polarization of wave is very important factor in the antenna design industry, it eliminates the importance of antenna orientation in the plane perpendicular to the propagation direction; it gives much more flexibility to the angle between transmitting and receiving antennas, also it enhances whether penetration and mobility. It is used in bunch of commercial and military applications.

The rectangular microstrip patch antenna with circular slot is presented for Bluetooth, WLAN applications.

## II. Antenna Deign

Figure 1 shows 3-D schematic view of the proposed antenna. This antenna has a Square shaped patch is fed by a 50 Ω microstrip feed line as shown in figure 2. It also has circular shaped slot that is embedded at the middle of the patch. The dimensions of the ground plane are of 25x10mm. The antenna is designed on FR4 substrate with dimensions 21x17x1.6 mm, $\varepsilon_r = 4.4$ and tan $\delta = 0.02$. The exact amounts of dimensions are summarized in table 1.

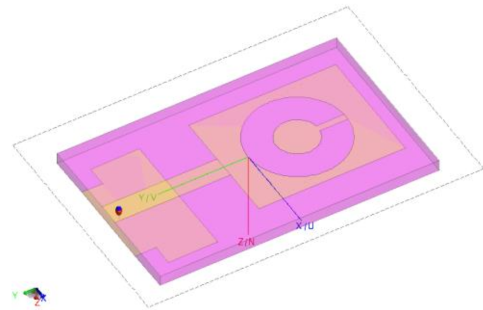

Figure 1. 3-D schematic view of proposed antenna

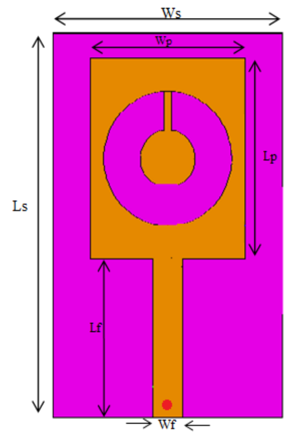


Figure 2. Top view of the Proposed Antenna

The design of the antenna is analyzed at four staged in figure 3. In the first stage of design, the antenna is configured without circular slot as indicated in figure 3(a). In this antenna a square shaped patch with dimensions 21x17x1.6 mm is connected to the 50 Ω microstrip feed line. In the second stage of design, the antenna is configured with a circular slot as indicated in the figure 3(b). In the third stage of the design, the middle portion of patch is achieved by adding one more circle as indicated in the figure 3(c). In the fourth stage of the design, a strip is added above the middle portion of the patch as shown in the figure 3(d).

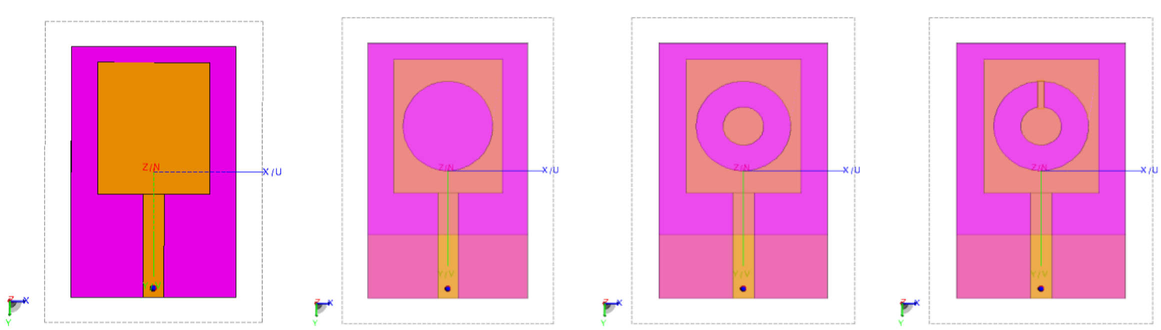

Figure 3. Antenna Designing Procedure

Table 1. Dimensions of different parameters of the antenna

| Parameter | Value | Parameter | Value |
|---|---|---|---|
| Ls | 40 | Lf | 16.5 |
| Ws | 25 | Wf | 3.2 |
| Lp | 21 | Rx | 7 |
| Wp | 17 | Ry | 7 |
| Lg | 10 | Sl | 4.5 |
| Wg | 25 | Sw | 0.9 |

## III. Simulation and Measurement Results

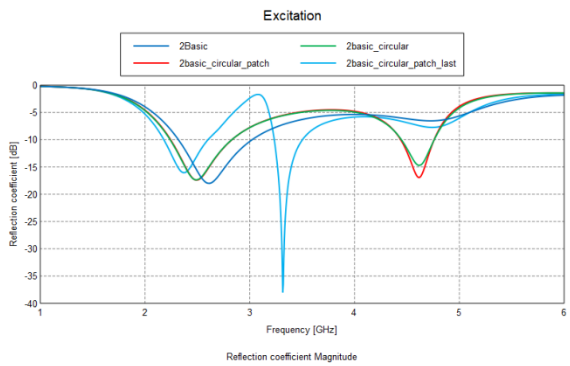


Figure 4. Reflection Coefficient of Four stages

Reflection coefficient is the phenomenon which gives the overview of reflected wave and radiated wave. -10dB is the reference line for the reflection coefficient, if wave goes beyond the reference line, then the expected band will be achieved. In this paper, as per the calculations two bands are achieved. Those two bands are of frequencies namely 2.4 GHz and 3.3 GHz.

When antenna is excited, amount of mutually coupled currents passes from immediate parasitic strips to adjacent antenna over top side of geometry with equal magnitudes. As adjacent antenna have inverted ground plane, it receives same magnitudes of current vectors with opposite trajectories within them. As an effect, coupled current cancellations on both top-bottom sides takes places as both ground planes appears themselves in inverted fashion with respect to single one.

While, parasitic strips on both sides of geometry are open-ended, they does not allow to pass any infrequent escaped currents through them and cancel outs by the phenomenon of capacitor discharging. This effect allows reducing total coupling levels henceforth improving the isolations between antennas.

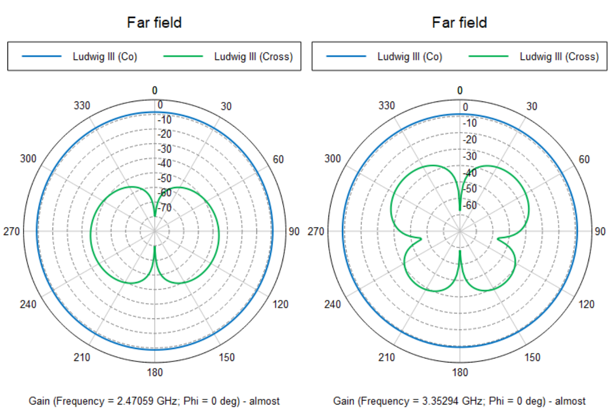


Figure 5. Radiation Patterns at 2.4 GHz and 3.3 GHz

Fig. 5 shows radiation patterns of designed antenna, obtained at frequencies of 2.4 GHz and 3.3 GHz. It is observed that, round shape indicates isotropic radiation pattern and two lobes or four lobes shapes are omnidirectional radiation pattern. Cross polarization of proposed antenna is obtained around -69dB at 2.4 GHz, and -57dB at 3.3 GHz.

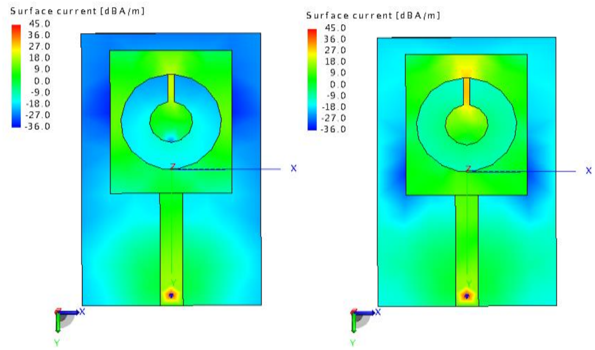


Figure 6. Current Distribution of the proposed antenna at 2.4 GHz and 3.3 GHz

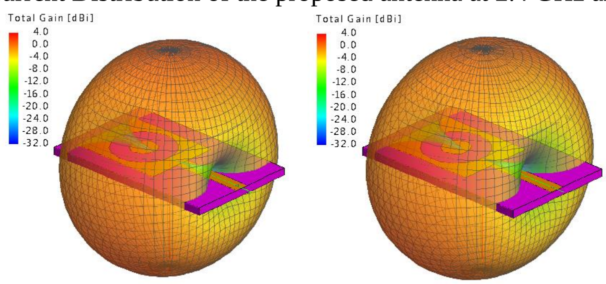


Figure 7. Simulated 3-D far-field radiation patterns at (a)2.4 GHz and (b)3.3 GHz

## IV. Conclusion

In this paper, dual band microstrip antenna is designed for three frequency bands of 2.4 GHz, 3.3 GHz. A square shaped patch is utilized in this antenna. Also, 5.1 GHz is achieved by employing few stubs on ground plane. The antenna is fed by a 50 Ω microstrip line. The configuration of the proposed antenna has been implemented on FR4 substrate with the thickness of 1.6 mm. According to measured results, two bands are obtained. As the reflection coefficient is less than -10 dB, omnidirectional and isotropic radiation patterns and high gain is appropriate for wireless applications.

## References

[1]. Constantine A. Balanis, Antenna Theory Analysis and Design 3rd edition John Wiley & Sons, Hoboken, NJ, 2005.
[2]. S. I. Latif, L. Shafai, S. K. Sharma, "Bandwidth enhancement and size reduction of microstrip slot antennas", IEEE Trans. Antennas Propag, vol. 53, no. 3, pp. 994-1003, Mar. 2005.
[3]. K.P .Ray and Girish Kumar, Broadband Microstrip Antenna, Artech House, Boston London.
[4]. R. Garg, P. Bhartia, I. Bahl, and A. Ittipiboon, Microstrip Antenna Design Hand- book. Artech House: Bonon2001.
[5]. M. Sumitha et al., A Compact Tri-band Dual Polarized corner truncated sectoral patch antenna, IEEE Trans. Antennas Propag. 63 (2015) 5842.
[6]. B. R. Sanjeeva Reddy and D. Vakula, compact zig-zag shaped slit microstrip antenna with circular defected ground structure for wireless applications. IEEE Antennas Wirel. Propag. Lett 14 (2015) 678.
[7]. S. K. Sharma, J. D. Mulchandani, D. Gupta and R. K. Choudhary, triple band metamaterial inspired antenna using FDTD Technique for WLAN/WiMax applications . Int. J. RF Microw. Compact aided eng. 25 (2015) 688.
[8]. A. Mishra. et. Al, Compact dualband reactangular microstrip patch antenna for 2.4GHz/wireless applications Wirel.Netw. 21 (2015) 347.
[9]. J. Malik, A. Patnaik and M. V. Kartikeyan, A Compact Dual-Band Antenna with Omnidirectional radiation pattern, IEEE ANTENNAS WIRELESS PROPAG. LETT. 14 (2015) 503.
[10]. M. Rezvani, P. Mohammadi, A dual- polarized reflector antenna with λ/2 printed dipoles for femtocell applications, 2019 JINST 14 P02004.
[11]. L. Asadpor, T. Ghorbani and M. Rezvani, A compact multilayer wide band and high gain circularly polarized antenna, 2018 JINST 13 P10003.