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SRR Inspired Multiband Antenna for Wireless Applications

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***Abstract*: This paper is present a compact hexagonal-shaped split ring radiating monopole characteristics. This antenna is designed on a 24 × 22.5 × 0.8 mm^3 FR-4 substrate and achieves the WLAN (2.7, 5.5 GHz Band) and Upper WiMAX Band (3.7 GHz) application. In this range this is increased a bandwidth of 53.1 MHz which is center at 2.7 GHz, 93.1 MHz centered at 3.7 GHz and 83.1 MHz centered at 5.5 GHz. The proposed patch antenna is simulated with the help of appropriate simulator. In all the operating range radiation patterns are stable.**

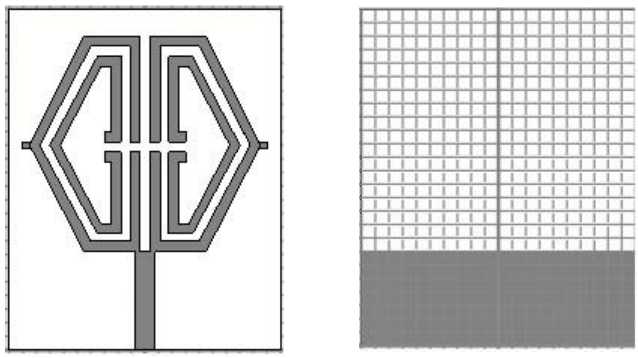
Key words: Hexagonal split ring radiating element, patch antenna, WiMAX, WLAN.

1. INTRODUCTION

This antenna is suitable to operates many wireless range has become greatest importance to complete the ranges of wireless device growth. Few of the existing geometries include CPW-fed square ring slot antenna [1] furthermore achieving number of resonating modes, this antenna is must be effective, small size, and easy to simulate. S-shaped strip and a crooked U shaped strip [2], this designed single antennas deserve a chance to complete the above mentioned challenge. Y-shaped monopole with meandered split ring slot [3], Wireless local area network (WLAN: 2.7, and 5.5GHz) these are the wireless range and the Upper WiMAX range is (3.7 GHz).

Asymmetric coplanar strip (ACS) fed monopole [4], and microstrip fed slot antenna [5]. Attraction of these antennas gives the interesting experiment to making antenna. Recently, metamaterial inspired structures like split ring resonators (SRRs) [6] and their complementary structures [7] are also used for WLAN/WiMAX band creation. However, many of these antennas lack either compact size [1–3, 5, 6] or simple design geometry [2–5], compared with the proposed structure. Multiband antenna using CSRR proposed in Ref. 7, is simple in design and compact.

In this paper, a compact triple band patch antenna compact for a WLAN (2.7/5.5 GHz) and WiMAX (3.7 GHz) application. This antenna design is easy with good radiating frequency band.



(a) (b)

Figure 1 Proposed Antenna Structure (a) Front view (b) Back view

2. PROPOSED ANTENNA DESIGN

This antenna design involved a wide band hexagonal monopole antenna fed by a 7.2 × 1.2 mm^2 microstrip line as shown in Figure 1. This is designed on a 24 × 22.5 × 0.8 mm^3 low cost FR-4 substrate with a relative dielectric constant of 4.4 and loss tangent of 0.002. This antenna has a wider bandwidth from 1 GHz to 8 GHz. While in this sequence to make many bands from this wide band, these modified element is made two pairs of concentric split rings facing each other as shown in Figure 2.

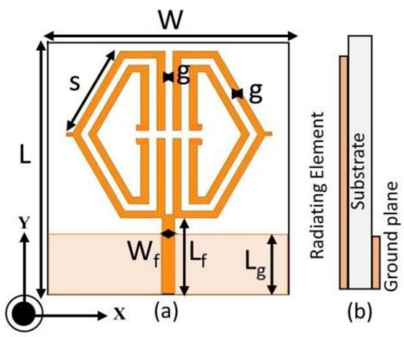


Figure 2 Geometry of the proposed antenna. (a) Top view (b) Side view

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Table 1 dimension of proposed antenna

Parameter	L	W	S	g	Wf	Lf	Lg
Dimension (mm)	20	25	0.8	0.75	1.5	7.2	7

The width of the rings and the slots within rings (g) is maintained identically. In this antenna there are two upper band resonant along with a small shift in lower band. This particular arrangement of this design antenna is shown in Figure 2 and its dimensions are given in Table 1.

3. RESULT ANALYSIS

Simulation is done by using the simulation software (CST). In which frequency the antenna should be work which is determined by the width of feed (W_f) of the conventional hexagonal monopole antenna. We have studied three different cases on this parameter split: (a) two concentric closed rings, (b) case a, along with splits in the outer rings, (c) case b, along with splits in the inner rings (proposed case). This Figure 3 shows the return loss characteristics of the proposed case of the antenna. The three bands appear at 2.7 GHz, 3.7 GHz, and 5.5 GHz for wireless communication application. In proposed design the two concentric rings, inner ring splits and the outer ring splits account for the creating bands around 2.7 GHz, 3.7 GHz, and 5.5 GHz, respectively. In this figure shows the three frequency bands at 2.7, 3.7, 5.5 GHz of this designed simulated surface antenna.

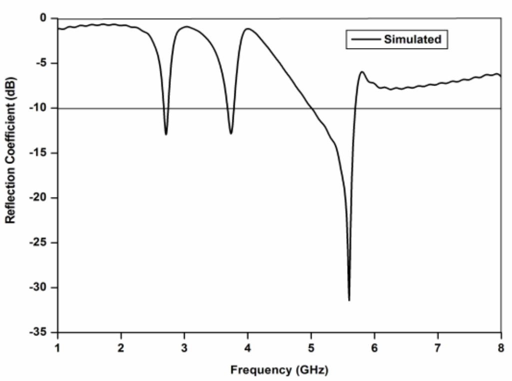


Figure 3 S Parameter of Proposed Antenna

Hence, a parametric study on W_f is performed initially and is shown in Figure 4 during parametric study regarding variation in W_f at 1.5, 1.8, 2.4, and 3.0mm. It is observed that, for W_f = 1.5 mm, the impedance bandwidth is wide, sweeping around 3 GHz from 2.6 GHz to 5.7 GHz. When the width is increase this band is divided into two parts.

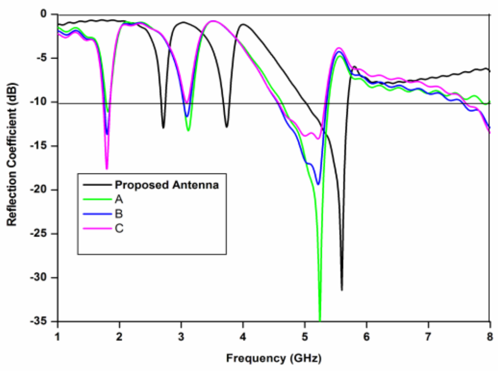


Figure 4 Simulated return loss characteristics for various feed width (W_f)

For parametric study regarding gap (g) between the split rings is obtained by variation at g= 0.70, 0.75, 0.80, 0.85, 0.90 respectively shown if figure5. It is observed that optimized impedance matching is created at g= 0.75mm at this condition it achieves triple band characteristics for wireless application.

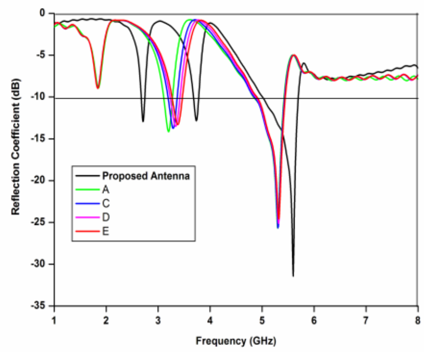
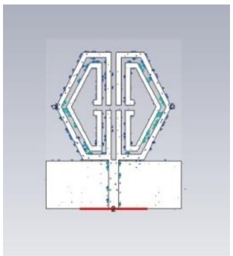


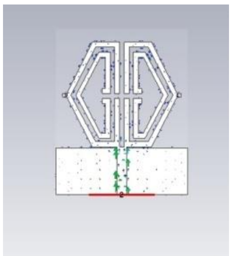
Figure 5 Simulated return loss characteristics for various slot width (g).

Figure 6 represent simulated surface current distribution at the resonant frequencies of 2.7GHz, 3.7GHz, and 5.5GHz respectively.

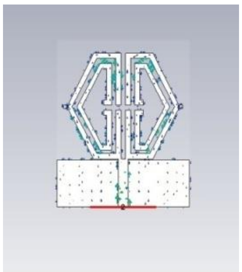
Figure 6 (a) indicate maximum current distribution is present along the periphery of split rings whereas at 3.7GHz distribution is allocated maximally across the feed line. Figure 6 (c) current distribution at higher frequency of 5.5GHz shows surface current distribution is defined across the inner and outer split rings so higher resonant band is created due to split rings.



(a)



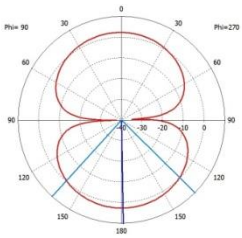
(b)



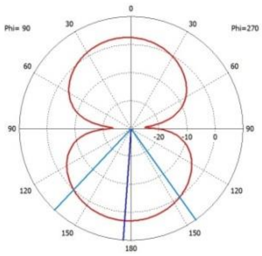
(c)

Figure 6 Simulated surface current distribution of the proposed antenna at the frequencies (a) 2.7 GHz, (b) 3.7 GHz, (c) 5.5 GHz

The simulated data is first resonant at 2.7 GHz with a bandwidth of 53.1 MHz second resonant at 3.7 with 93.1 MHz bandwidth and the third resonant at 5.5 GHz with 83.1 MHz bandwidth this simulated results are good. A consistent omnidirectional radiation is observed in the H plane for all the operating frequencies and a nearly bi-directional pattern is observed along the E plane. Peak gain of 2.5 dBi, 2.14 dBi, 3.3 dBi, and 3.5 dBi are inferred around 2.7, 3.7, and 5.5 GHz frequencies. Thus, the radiation and resonant behavior of the antenna are found satisfactory making the antenna suitable for wireless communication devices.



(a)



(b)

(c)

Figure 7 Radiation Pattern for (a) 2.7GHz (b) 3.7 GHz (c) 5.5 GHz

4. CONCLUSION

This is a triple band monopole antenna for WLAN 2.7 and 5.5 GHz upper WiMAX 3.7 GHz these applications are present in this paper. This antenna design is very easy. There is a two pairs of hexagonal concentric split rings of radiating element. In this designed antenna the surface current distribution and the radiation pattern of the entire operating band is good for wireless application.

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