

### ABSTRACT

In this paper, a notch loaded stacked ultra wide band elliptical microstrip patch antenna is proposed for Ka-band wireless communication applications. The return loss in terms of S11(dB), voltage standing wave ratio (VSWR), Gain, radiation efficiency and radiation patterns have been analyzed over the ultra wide band of frequency range of 30-40 GHz in Ka-band.

**KEYWORDS:** Return loss, VSWR, Gain, Radiation Efficiency, Radiation Pattern

### I. INTRODUCTION

Wireless communication is an acronym of communication system with antennas for past decades and has captured almost every field in advanced technology while the lower bands of frequency having been continuously depleting for last one decade as the micro strip patch antenna being advantageous for the range owing to its low profile, conformational property, low inertial mass, and arrange-able in small space [1]. In existing scenario of communication, the blue tooth, WLAN, WPAN and WWAN antennas below 11 GHz are being used but the L, S and C- bands, in near future are expected to be wholly exhausted for further use as well as demand will also go down.[2]. Phased array communication systems have been manufactured to be utilized in C and X bands. In addition to it, the systems are also required to be mended with an arrangement of single antenna to work in both the bands. It needs such an antenna to cover an appreciable wide range and a radiation pattern which corresponds to the end fire array and is aligned with main beam in direction with the axis of antenna array. For such commitment, quasi yagi - antenna, Log periodic antenna array, and bow tie antenna have been being used over the time [3]. Wireless communication frequency range for designing and fabricating ultra wide band monopole antennas in which an infinite ground or meandered ground is placed on or beneath the patch surface but they are fed with electromagnetically coupled feeding techniques. Notches on patch antennas mitigate interference with frequently used bands and the authors have designed and tested a circular patch antenna by providing a circular slot and semicircular ground but with larger dimensions.[4]

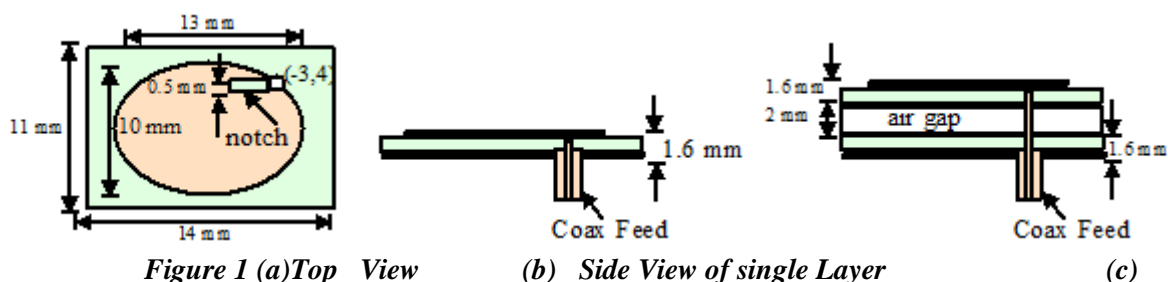


Figure 1 (a) Top View

(b) Side View of single Layer

(c)

### Stacked Layers

The proposed notch loaded stacked micro strip patch antenna has been presented in figure1 as in (a) top view of the antenna1 and antenna2 (b) side view of single layer antenna1(c) side view of stacked layers proposed antenna2. The patch of length of 13mm and width of 10mm on Fr-4 substrate having dielectric constant of 4.4 and loss tangent of 0.02 is designed and the substrate possesses length of 14mm and width of 11mm as shown in the same figure with coaxial feed point (-3,4) and a notch of length 4 mm(not shown) and width of 0.5 mm. The antenna1 possesses a single layer substrate of 1.6mm thickness and the antenna2 possesses a substrate of 1.6 mm thickness in figure1(b) with ground beneath it is stacked over another Fr-4 substrate of 1.6mm thickness with an air gap of 2 mm in figure 1(c) and position of the feed remains same in both antenna1 and antenna2.

## II. RESULTS AND DISCUSSION

Figure 2 shows Return loss in terms of S11(dB) versus frequency . Minimum return loss for proposed antenna2 occurs at 37.5GHz and that for antenna1 stands at 32 GHz. Impedance bandwidth is 25.33% at 37.5GHz over 30.5GHz-40GHz. and, it becomes an ultrawide band antenna whereas antenna1 does hold bandwidth but very less approximate 2%.

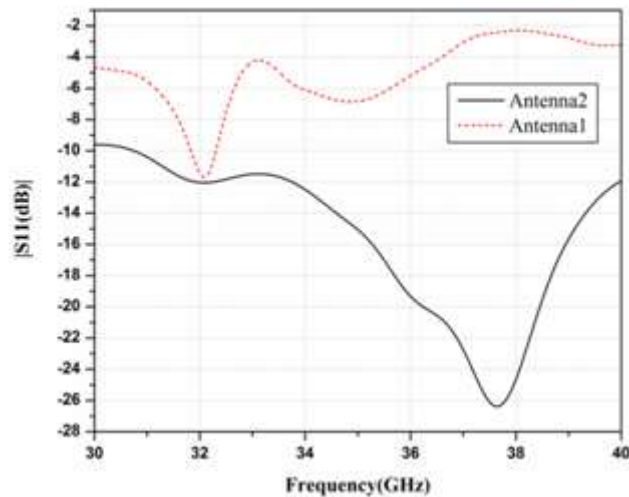


Figure 2. S11(dB) vs Frequency

Figure3 shows VSWR versus frequency graph over 30.5GHz-40GHz range .Antenna1 at 32GHz resonant frequency over its bandwidth of 31.8-32.4GHz shows VSWR at 1.7 or less than 2 but proposed antenna2 shows VSWR below 2 over its entire bandwidth.

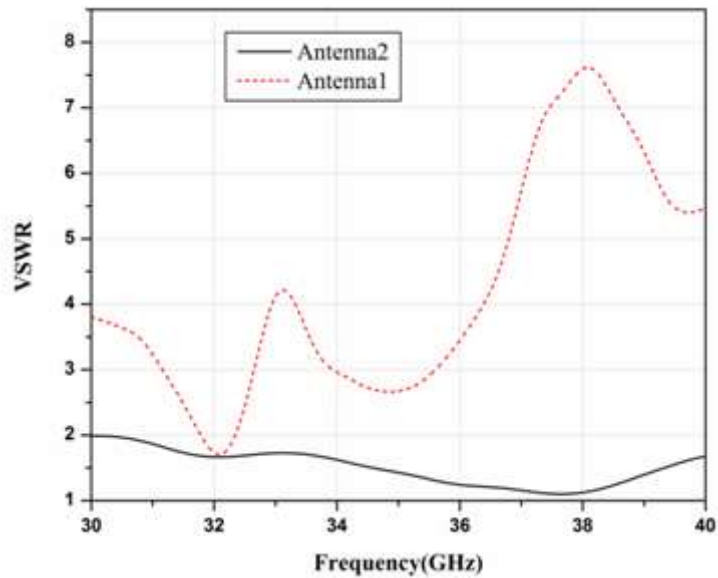


Figure3. VSWR Vs Frequency

Figure4 shows gain versus Frequency graph for proposed antenna2 and it indicates positive gain varying from zero to 7.7dB over whole bandwidth.

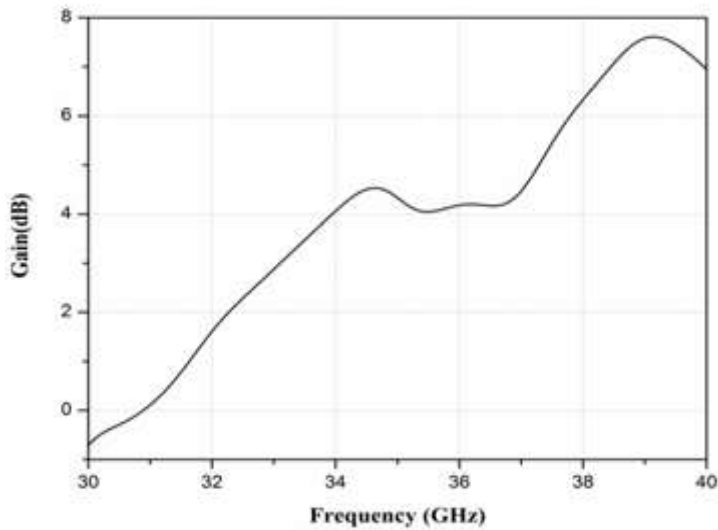


Figure 4. Gain Vs Frequency (GHz)

Figure 5 exhibits radiation efficiency variation over entire bandwidth from approximate 0.96 at 30GHz down to 0.87 at 40GHz and at resonant frequency it is at 0.91 approximate.

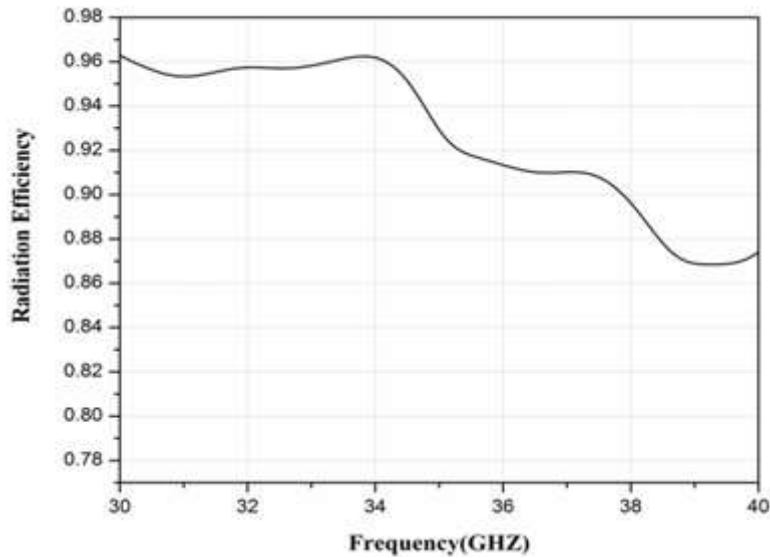


Figure5. Radiation Efficiency Vs Frequency

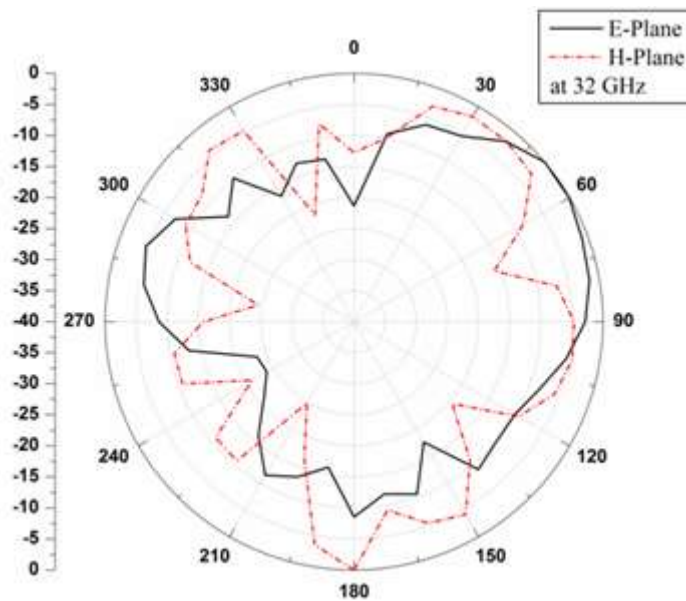


Figure6. Radiation pattern at 32GHz

Figure 6 shows radiation pattern at 32 GHz for E field in E-plane and H-Plane. The maximum in E-plane occurs at 60° and in H-plane it occurs at 180°. There exist two minima at 280° and 210° in H-plane. And there exists one minimum at 0° in E-plane.

Figure7 presents a radiation pattern at 37.5 GHz for Electric field in E-plane and H-Plane. Maxima coincide in E-plane and H-plane at 0° and a minimum occurs at 150° in E-Plane and that at 300° in H-Plane.

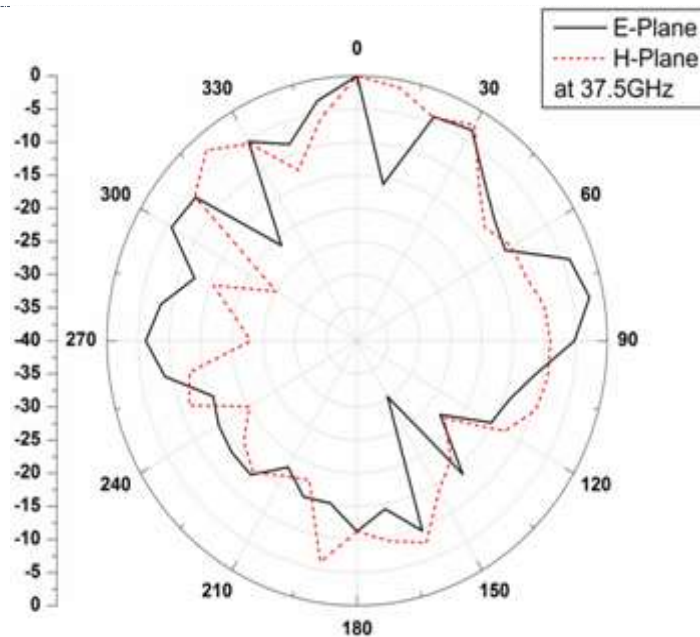


Figure7. Radiation Pattern at 37.5GHz

Figure 8.exhibits a radiation pattern at 40 GHz in which maxima for E-Plane and H-Plane electric field occur at 0° and a minimum point in E-Plane occurs at 10° and that at 290° in H-Plane.

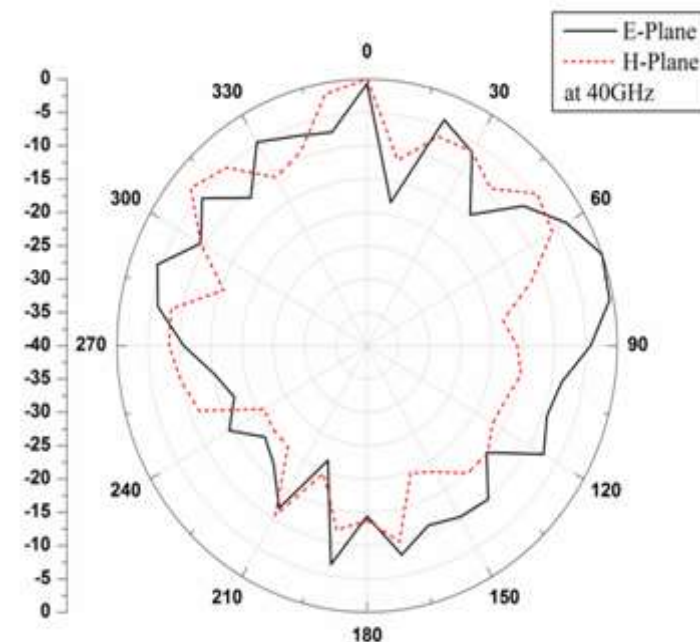


Figure8. Radiation Pattern at 40GHz

### III. CONCLUSION

In this work, antenna1 is designed at single layer of FR-4 substrate in which S11(dB) provides much return loss in comparison to proposed antenna2 that has presented an ultra wide band of 25% bandwidth over 30.5-40GHz frequency with high efficiency and enough gain for Ka-band wireless communication applications. The results have been taken from simulations carried out by HFSS.



#### IV. REFERENCES

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