

**Bandwidth Improvement in Hexagonal Micro strip Patch Antenna with
suspended structure.**

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Abstract—This paper signifies a bandwidth improvement technique of hexagonal micro strip patch antenna for dual band. Due to addition a notch in a hexagonal micro strip patch antenna tunes it for two different frequencies 1.9GHz(used in PCS mobile applications) and 2.4GHz (used in Bluetooth application) and due to suspended nature of hexagonal antenna improve bandwidth of antenna.The hexagonal nature of the antenna makes it circularly polarized.

Index Terms — Hexagonal patch antenna, Bandwidth, Dual band, Notch

I. INTRODUCTION

Micro strip patch antenna used for many applications because of their many advantages ,like low contour ,light weight, small size, can be easily integrated with electronic circuits. Now a day's wireless communication system supports many applications.

The conventional methods for bandwidth improvements are multiplaner antenna, stacked antenna , different shape used for multiple applications. In Rectangular Micro strip Patch Antenna for 2.4 GHz Communication by Defected Ground Structure can improve the bandwidth to 100MHz [9]. Square Shaped Micro strip Patch Antenna at 2.45GHz can get the 6.53 MHz Bandwidth [10]. The three patches stacked together with slit and 'I' slot used to get triple operating frequencies for GPS applications. This three patches are tunes for L1 (1.575 GHz), L2 (1.227 GHz) and L5 (1.176 GHz) achieved 2.0%, 1.5%, and 1.7% bandwidth [2]. The dimensions and position of the duo-triangular patch and shifting the probe feed co-ordinates achieved the dual band witch achieved 7.68% and 36.56% bandwidth [4]. In rectangular patch antenna using slots and shorting pins achieved the triple band antenna at frequencies 2.4 GHz, 3.5 GHz and 5.7 GHz. With bandwidth improvement 3.7% ,3.7% &1.5% respectively [5]. The dielectric pallet used for multiple applications is designed .Using the coupling between the radiator and ground plane[6]. In the design of a gap .coupled modified square fractal 3.7% at micro strip patch intended design has an impedance bandwidth of 85.42% around [7].

The above methods used to tune the antenna for multiple bands and bandwidth improvement. This paper proposes a novel circular polarized hexagonal micro strip patch antenna design based on notch with coaxial feed for 1.9GHz and 2.4GHz frequencies. This antenna can be used for personal mobile communication applications as well as Bluetooth applications.

In this antenna design the separation of two bands with good impedance bandwidth and axial ratio with circular polarization obtained .The design is simulated using the HFSS software.

This paper is organized as follows section II describes the antenna design; Section III represents the simulation results and discussion, section IV conclusion.

II. ANTENNA DESIGN

The geometry of the proposed antenna is hexagonal with coaxial probe feed [8] shown in fig 1. This antenna is designed for a 2.4GHz frequency so that the resonance frequency (fo) is selected 2.4GHz. Putting resonance frequency in formula.

1. Calculation of the width of Patch (W)-

$$W = \frac{c}{2f_o \sqrt{\frac{(\epsilon_r + 1)}{2}}}$$

For $c=3 \times 10^8$ m/s, $f_o=2.4$ GHz, $\epsilon_r=4.4$

We get $W=38.22$ mm

2. Calculation of effective dielectric constant

$$\epsilon_{r_{eff}} = \frac{\epsilon_r + 1}{2} + \frac{\epsilon_r - 1}{2} \left[1 + 12 \frac{h}{W} \right]^{-\frac{1}{2}}$$

For $\epsilon_r=4.4$, $h=1.6$ mm, $W=38$ mm

We get $\epsilon_{reff}=3.99$

3. Calculation of Length of Patch (L)-

$$L_{eff} = \frac{c}{2f_o \sqrt{\epsilon_{r_{eff}}}}$$

For $c=3 \times 10^{11}$ mm/s, $\epsilon_{reff}=3.99$, $f_o=2.4$ GHz

We get $L_{eff}=30.25$ mm

Due to fringing the dimension of the patch as increased by ΔL on both the sides, given by

$$\Delta L = 0.412h \frac{(\epsilon_{r_{eff}} + 0.3) \left(\frac{W}{h} + 0.264 \right)}{(\epsilon_{r_{eff}} - 0.258) \left(\frac{W}{h} + 0.8 \right)}$$

For $W=36.4$ mm, $h=1.53$ mm, $\epsilon_{reff}=3.99$

We get $\Delta L=0.70$ mm

Hence the length the of the patch is: $L = L_{eff} - 2\Delta L = 28.4$ mm

5. Calculation of Substrate dimension-

$L_s = L + 2 \times 6h$

$W_s = W + 2 \times 6h$

The width, length, effective dielectric constant, substrate dimension is calculated for a hexagonal patch of the antenna with FR4 dielectric material. The hexagonal shape of the patch rather than rectangular patch is selected for design for bandwidth improvement. In this section we compare the simulated results of the hexagonal micro strip patch antenna and rectangular micro strip patch antenna.

III. SIMULATED RESULTS AND DISCUSSION

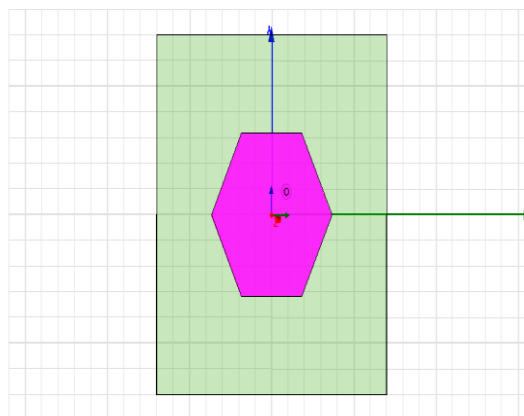


Figure 1: Geometry of Hexagonal patch Antenna.

Following simulated results of hexagonal micro strip patch shows that 70 MHz bandwidth achieved.

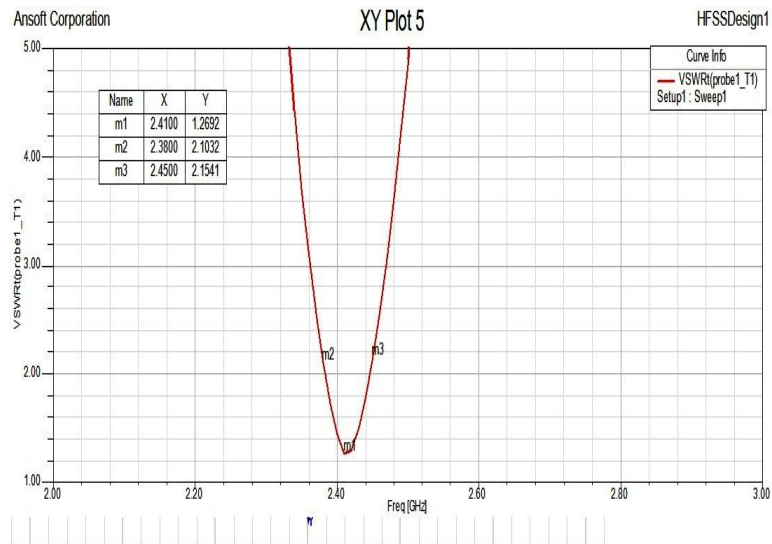


Figure 2: Bandwidth of Hexagonal antenna.

This design of hexagonal antenna tunes only at 2.4GHz. To make it dual band a notch is added in this design.

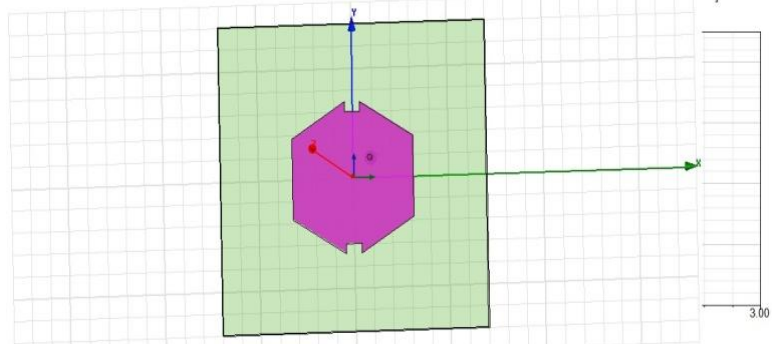


Figure 3: Hexagonal antenna with corner notch

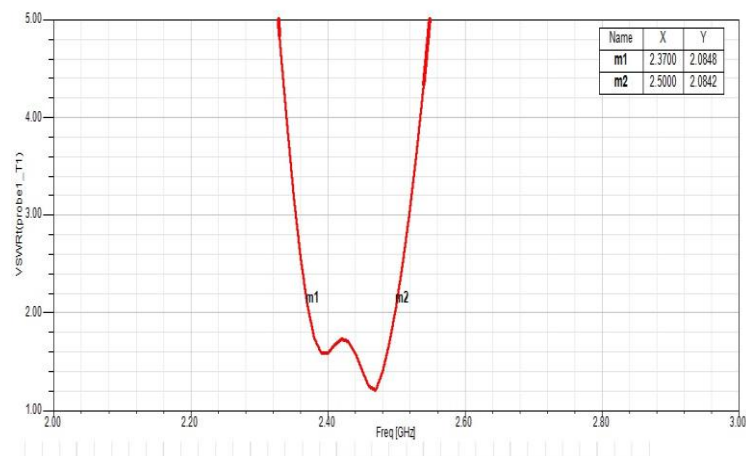


Figure 4: Hexagonal antenna with corner notch Bandwidth

By adding corner notches in hexagonal patch achieved only one band. So if notches are added in edge of the antenna two bands at 2.4GHz and 1.9GHz achieved.

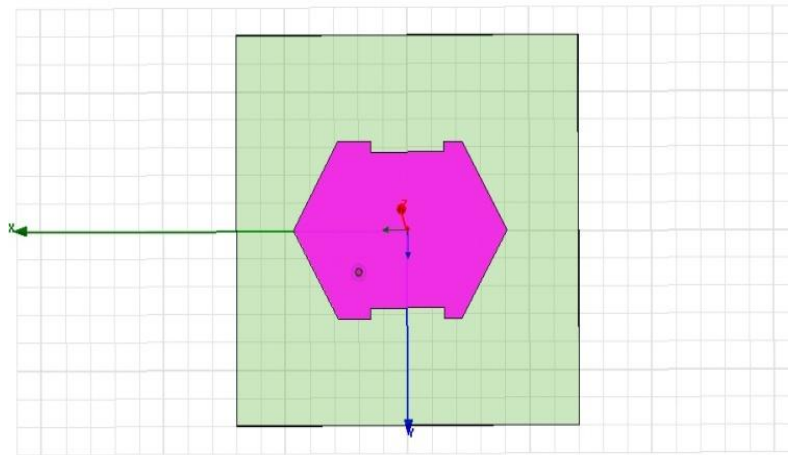


Figure 5: Hexagonal antenna with edge notch

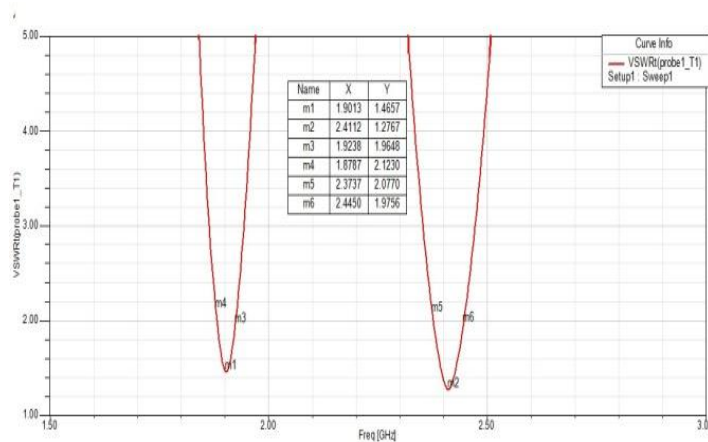


Figure 6: Hexagonal antenna with edge notch Bandwidth

From this design bandwidth achieved is up to 45MHz and 71.3 MHz for 1.9GHz and 2.4 GHz respectively but that is not sufficient.

For bandwidth improvement proposed antenna is selected a hexagonal micro strip suspended antenna.

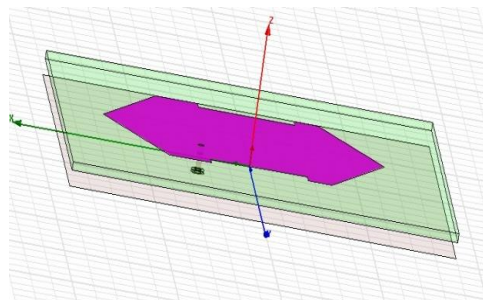


Figure 7: Suspended Hexagonal Antenna

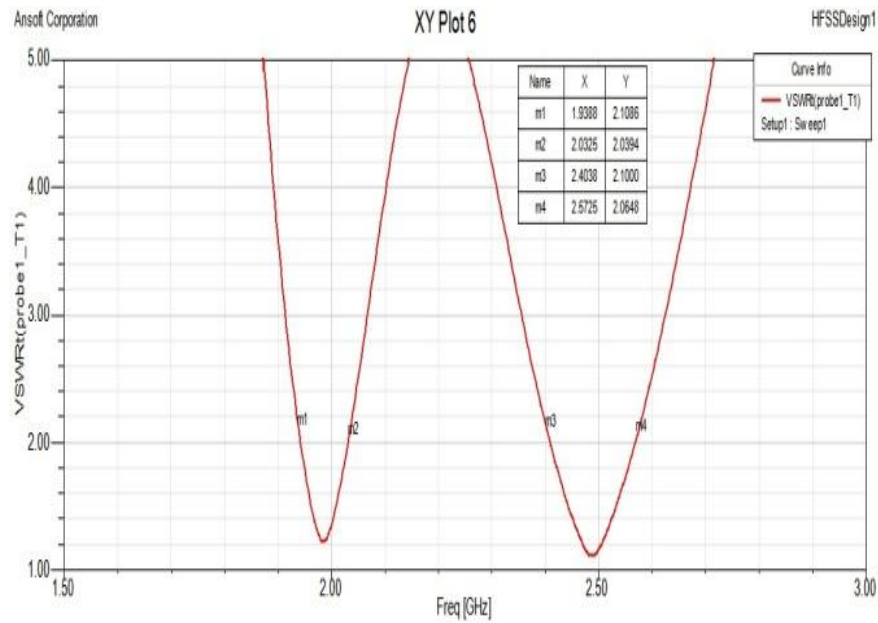


Figure 8: Bandwidth of Suspended Hexagonal Antenna

The proposed antenna is tuning for a two different frequencies 2.4GHz & 1.9GHz frequencies with an improved bandwidth.

Following comparison table shows simulated results of different shapes of antenna.

Table 1: Comparisons table

Sr. No.	Shape of MSA	Freq.(GHz)	B.W.(MHz)
1.	Simple Hexagonal MSA	2.4	70
2.	Hexagonal with corner notch	2.4	130
3.	Hexagonal with edge notch MSA	1.9	45
		2.4	71.3
4.	Suspended Hexagonal with edge notch MSA	1.9	93.7
		2.4	168.7

IV. CONCLUSION

The proposed antenna is a dual band circular polarized suspended hexagonal micro strip antenna is applicable for 1.9 GHZ (Personal mobile communication) and 2.4 GHZ (Bluetooth) applications with bandwidth of 93.7MHz and 168.7MHz. In this design improvement in bandwidth achieved by edge slits and suspended structure.

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