e-ISSN: 2582-5208
International Research Journal of Modernization in Engineering Technology and Science
(Peer-Reviewed, Open Access, Fully Refereed International Journal)
Volume:06/Issue:05/May-2024 Impact Factor- 7.868 www.irjmets.com

AN E- SHAPED RECTANGULAR MICROSTRIP PATCH ANTENNA WITH DUAL RESONANCE

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DOI : https://www.doi.org/10.56726/IRJMETS55287

ABSTRACT

The rapid growth in the demand for wireless communication and information transfer using handsets and personal communications (PCS) devices has created the need for major advancements of antenna designs as a fundamental part of any wireless system. One of the types of antenna that fulfills most of the wireless systems requirements is the microstrip antenna. These antennas have many advantages like low profile, conformability, low production cost, etc. and it has one major limitations of narrow bandwidth and low efficiency.

In order to increase the band width there are so many techniques. One of the techniques is reactance loading by creating slots. In our project two narrow slots are inserted on patch to form a E shaped patch antenna. This E shaped antenna is a dual resonance antenna designing to resonant at the frequency 2.4 GHz WLAN frequency band and resonate at 1.98 GHz Frequency Band. We are also verifying the effect of slot length, slot width and slot position performance E shaped patch antenna.

Keywords: Microstrip Antenna, E Shaped Patch Antenna, WLAN Frequency Band, Reactance Loading, Narrow Slots.

I. INTRODUCTION

The Wireless communications have progressed very rapidly in recent years, and many mobile units are becoming smaller and smaller. It started with hand gestures, then sounds produced by vocal chords and gradually me moved to wired communication and now wireless communication. In wireless communication we mainly exploit the Electromagnetic Spectrum. To meet the miniaturization requirement, the antennas employed in mobile terminals must have their dimensions reduced accordingly. Planar antennas, such as micro strip and printed antennas have the attractive features of low profile, small size, and conformability to mounting hosts. For this reason, compact, broadband and wideband design technique for planar antennas have been attracted much attention from antenna researchers. Very recently, especially after the year 2000, many novel planar antenna designs to satisfy specific bandwidth specifications of present day mobile cellular communication systems including the global system for mobile communication (GSM; 890 – 960 MHz), the digital communication system (DCS; 1710 – 1880 MHz), the personal communication system (PCS; 1850 – 1990 MHz), and the universal mobile telecommunication system (UMTS; 1920 – 2170 MHz), have been developed. Planar antennas are also very attractive for applications in communication devices for wireless local area network (WLAN) systems in the 2.4 GHz (2400 – 2484 MHz) and 5.2 GHz (5150 – 5350 MHz) bands.

II. METHODOLOGY

The step by step procedure to design the antenna for the given specifications is as follows

Step-1: Specify Input Parameters to design the antenna as follows

- Antenna Geometry- rectangular
- Type of Feeding- probe feeding
- Specify ϵ_r, f_r (in GHz) and h. – frequency is 2.15 GHz, ϵ_r=1 and h=15mm.

Step-2: Theoretical Design of Antenna.

- Design Patch Dimensions
- Design Substrate Dimensions

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- Design Feed
- Find Feed Location

Step-3: Design with EM Simulators (HFSS Software).

Step-4: Insert slots to create E shaped patch antenna

Step-5: Verify Antenna performance in terms of RL (in dB), BW, VSWR, etc.

Step-6: Do parametric analysis to find the effect of slot length, slot width and slotposition.

III. RESULTS AND DISCUSSION

The bellow sub-sections show the performance of E shaped patch antennas in terms of return loss, VSWR, gain, directivity, 3D polar plot, radiation pattern ($\Phi=0^0$ and $\Phi=90^0$) and also the bandwidth of the antenna.

1) E Shaped patch antenna with optimum slot dimensions:

a) Return loss of the Antenna:

The bellow Fig.1 show the return loss characteristic of the E shaped patch antenna with optimum slot dimensions.

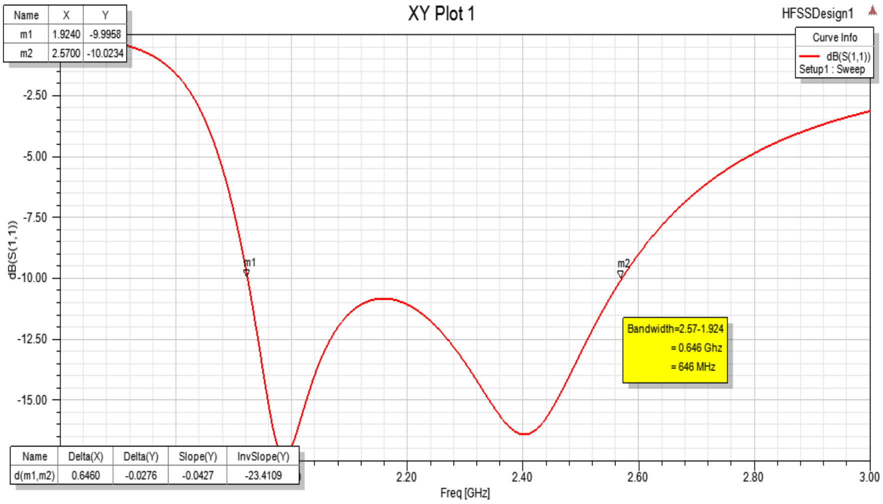

Figure 1: Return loss VS Frequency plot

b) VSWR Vs Frequency Plot:

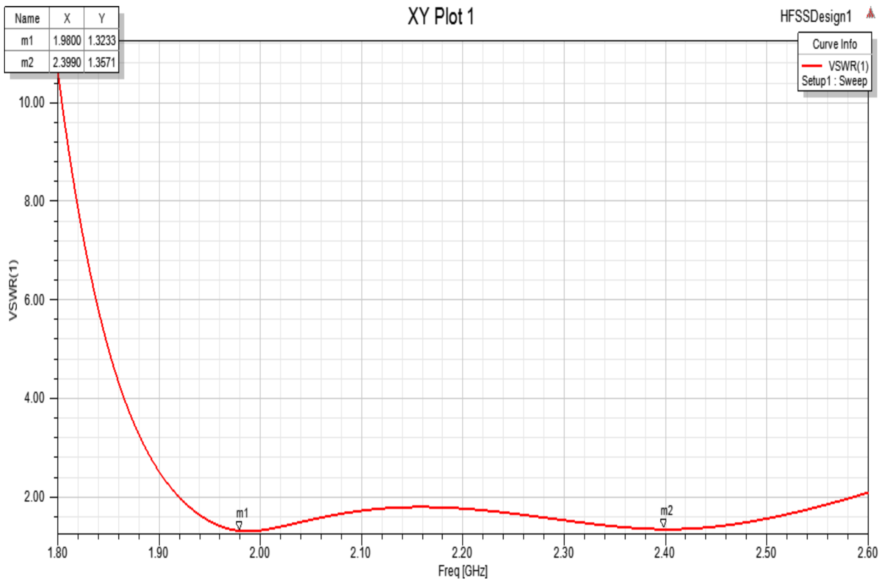

Figure 2: VSWR Vs Frequency Plot

c) 3D Polar Plot:

The Fig.3 shows the 3D polar plot of the antenna. This plot show the totalgain of the antenna is 8.93 dB.

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Figure 3: 3D Polar Plot

d) Radiation Pattern:

The 2-D radiation pattern in Fig.4 shows the total directivity of the antenna in Φ=0 degrees direction. The directivity of the antenna is 8.19 dB.

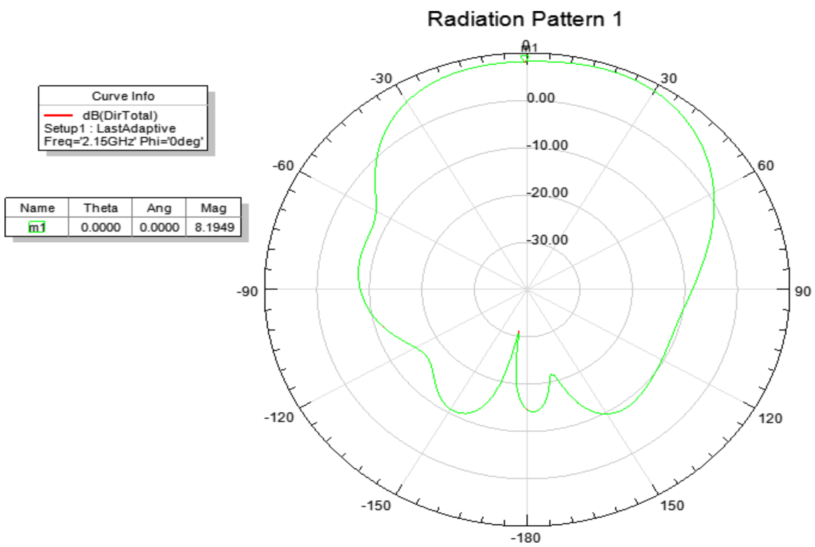

Figure 4: Directivity of the antenna for $\Phi=0^0$

The 2-D radiation pattern in Fig.5 shows the total gain of the antennain Φ=0 degrees direction. The directivity of the antenna is 8.25 dB.

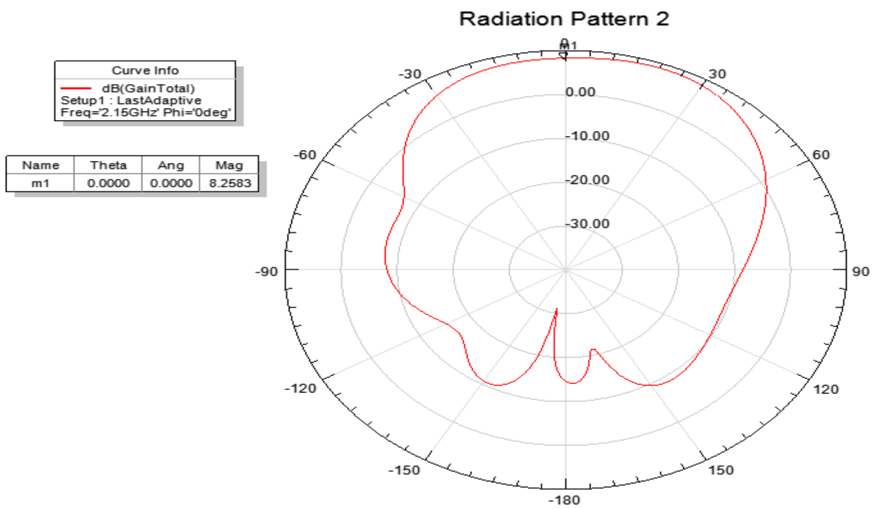

Figure 5: Gain of the antenna for $\Phi=0^0$

The 2-D radiation pattern in Fig.6 shows the total gain of the antenna inΦ=90 degrees direction. The gain of the antenna is 8.25 dB.

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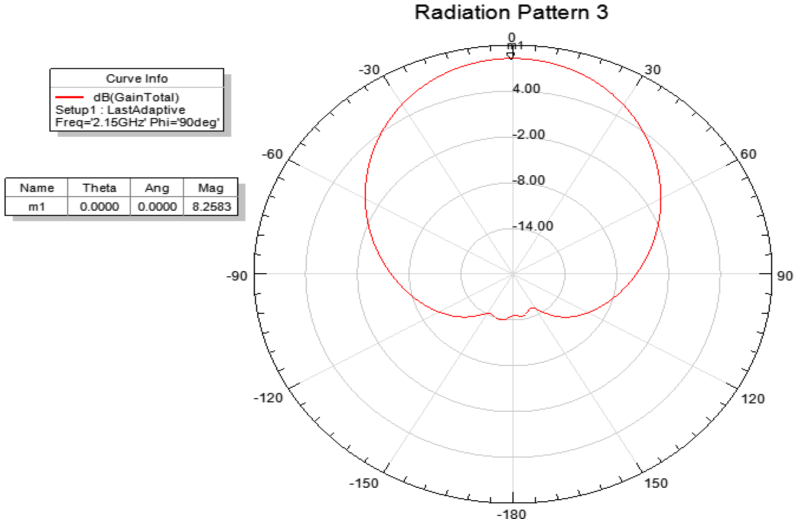

Figure 6: Gain of the antenna for $\Phi=90^0$

The 2-D radiation pattern in Fig.7 shows the total directivity of the antenna in $\Phi=90$ degrees direction. The directivity of the antenna is 8.19 dB.

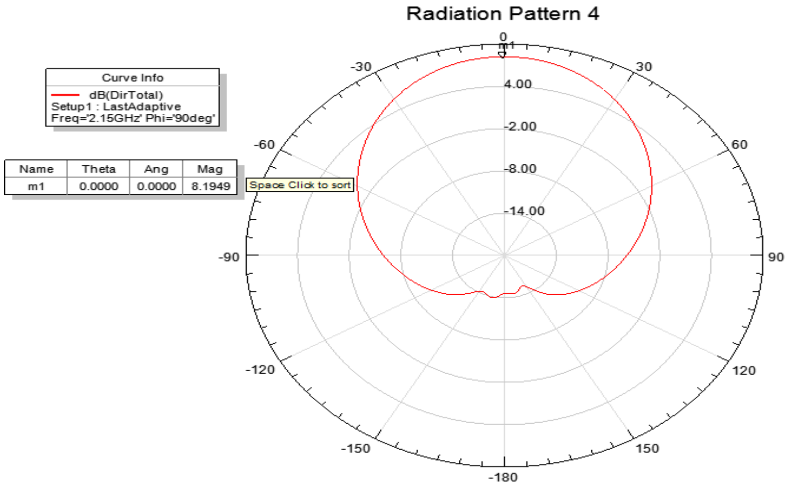

Figure 7: Directivity of the antenna for $\Phi=90^0$

2) Effect of slot length on antenna performance:

The Fig.8 show the effect of different slot lengths like ln=40mm, 42mm, 44mm and 46mm on antenna performance in terms of its return loss.

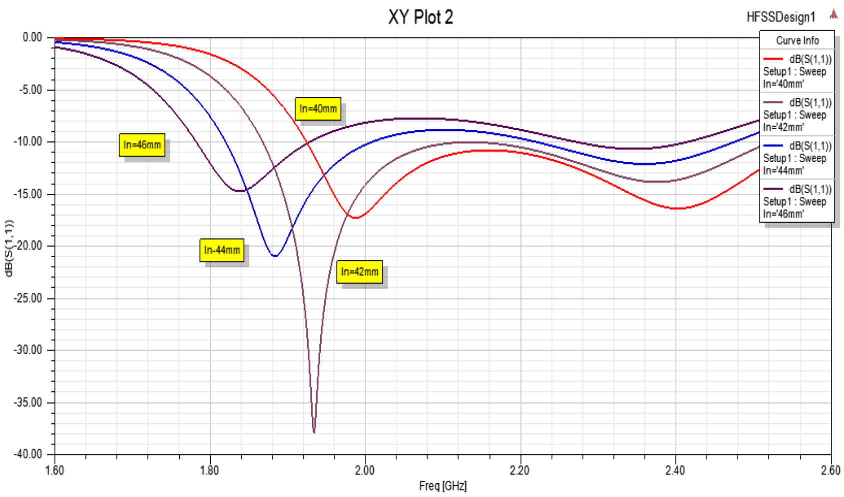

Figure 8: Variation of return loss with frequency for different slot length at pn=10mm and s=6mm

From the fig.8 it is observed that the length of the slot increases and the lower resonant frequency decreases.

3) Effect of slot width on antenna performance:

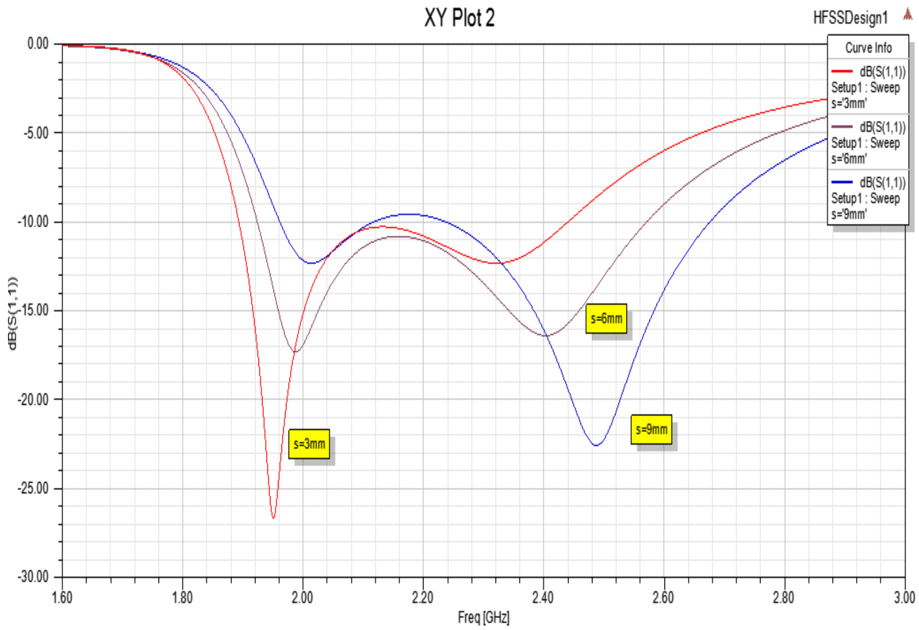

Figure 9: Variation of return loss with frequency for different slot widths at ln=40mm and pn=10mm.

From this figure it is observed that:

- At all the three slot widths two resonant frequencies exist
- At lower slot width matching at lower resonant frequency improves and at higher slot width matching at higher resonant frequency improves
- The best matching at both resonant frequencies is obtained at slot width *s = 6mm.*

4) Effect of slot position on antenna performance:

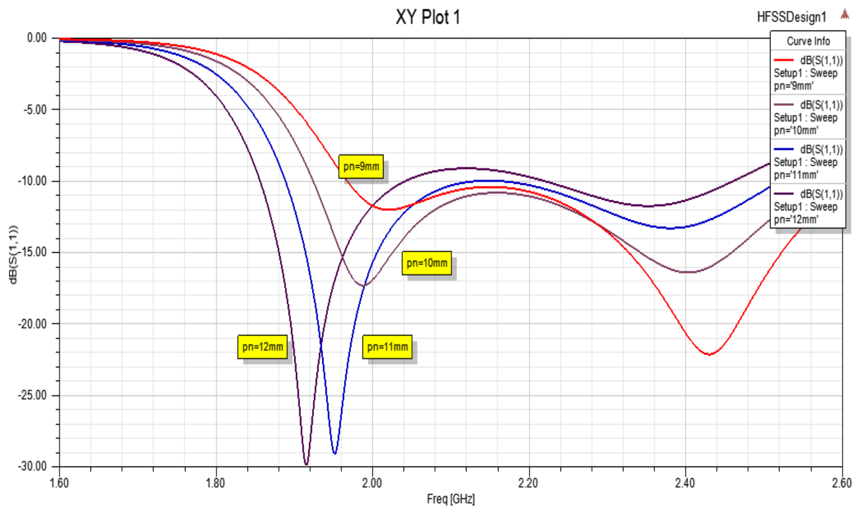

Figure 10: Variation of return loss with frequency for different slot positions at ln=40mm and s=6mm

From this figure it is observed that:

- At the lower position (pn) it behaves as dual/wide band antenna.
- At the highest slot position (pn) it lost wideband nature and it behaves as dual band antenna.

IV. CONCLUSION

In this project we have designed E shaped patch antenna with optimum dimensions operating from 1.982 GHz to 2.57 GHz with a bandwidth of 646 MHz and verified its parameters like Return loss, Gain of the antenna as 8.9 and radiation pattern of the antenna in Φ=0 & Φ=90 deg. We have also verified the effect of slot length, slotwidth and slot position as

- Length of the slot increases the lower resonant frequency decreases.
- At all the three slot widths two resonant frequencies exist
- At lower slot width matching at lower resonant frequency improves and at higher slot width matching at higher resonant frequency improves
- The best matching at both resonant frequencies is obtained at slot width *s = 6mm.*
- At the lower slot position (pn) it behaves as dual/wideband antenna.
- At the higher slot position (pn) it lost wideband nature and it behaves as dual band antenna.

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