Microstrip Patch Antennas for Dual Band WLAN Applications using Rectangular, Triangular and Pentagonal Shapes of Patch

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ABSTRACT

This paper presents an efficient design procedure for designing Dual band (2.45GHz and 5.2GHz) microstrip antennas for WLAN applications using three different shapes of patch viz. rectangular, triangular and pentagonal. Computation used in designing is the transmission line method as it offers good physical insight. The designs are simulated using "CST Microwave studio V9". The paper presents simulated results for return loss, bandwidth, smith chart presentations. The analysis of the simulated results confirms successful designs of Coaxial fed microstrip antennas for WLAN applications.

Keywords

Coaxial fed microstrip antenna, rectangular, triangular, pentagonal patch, transmission line method.

1. INTRODUCTION

In this era of next generation networks we require high data rate and size of devices are getting smaller day by day. In this evolution two important standards are Wi-Fi (WLAN) and Wi-MAX. For success of all these wireless applications we need efficient and small antenna as wireless is getting more and more important in our life. This being the case, portable antenna technology has grown along with mobile and cellular technologies. Microstrip antennas (MSA) have characteristics like low cost and low profile which proves Microstrip antennas (MSA) to be well suited for WLAN/Wi-MAX application systems.

A microstrip antenna has a dielectric substrate having a radiating patch on one side and a ground plane on the other side. The EM waves firing off the top patch into the substrate and are radiated out into the air after reflecting off the ground plane. The feed of microstrip antenna can have many configurations like microstrip line, coaxial, aperture coupling and proximity coupling. But microstrip line and the coaxial feeds are relatively easier to fabricate. However, the microstrip line limits the bandwidth to 2 to 5% as spurious radiations increase with the increase in the substrate thickness. Therefore, we are using coaxial feed[2].

The design of the microstrip antenna is carried out using transmission line model (TLM) as it gives the adequate results for most engineering purposes and requires fewer computations. The simulations are carried out using CST Microwave studio V9 which is a high performance full-wave electromagnetic (EM) field simulator for arbitrary 3D volumetric passive device modeling [2].

2. GEOMETRY OF THE DESIGNED ANTENNAS

The dimensions of the designed antennas are shown below with the substrate thickness of 3.048 mm.

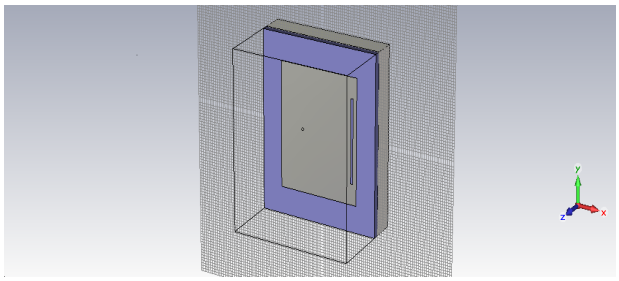

Fig 1 Structural view of the rectangular patch antenna [3].

Dimensions of Rectangular patch antenna

Ground size	55.78×64.4 mm
Substrate size	55.78×64.4 mm
Patch size	37.6×45 mm
Slot size	1×30 mm
Feed point location	19.89,32.2
Dielectric constant	2.2

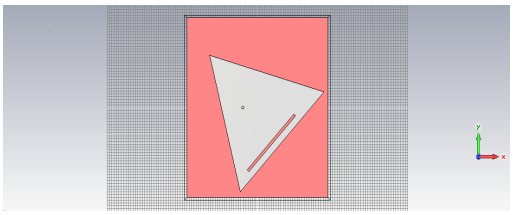

Fig 2 Structural view of the triangular patch antenna [4]

Dimensions of Triangular patch antenna

Ground size	60×64 mm
Substrate size	60×64 mm
Patch size	50.22 mm(each side)
Slot size	28×1 mm
Feed point location	23.8,32
Dielectric constant	2.2

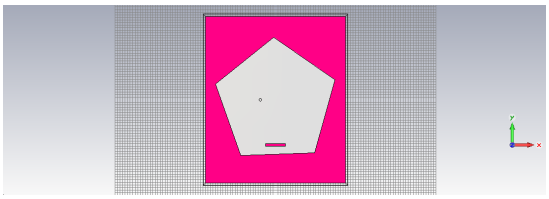

Fig 3 Structural view of the pentagonal patch antenna [5]

Dimensions of Pentagonal patch antenna

Ground size	55.78×64.4 mm
Substrate size	55.78×64.4 mm
Patch size	29.389mm(each side)
Slot size	8×1 mm
Feedpoint location	21.89,32.2
Dielectric constant	2.2

3. SIMULATION RESULTS

The designed antenna resonates at two different frequencies 2.45GHz and 5.2GHz can be used for WLAN applications.

The simulated return loss and smith chart presentation of the dual band rectangular patch microstrip antenna is shown in fig 4 and fig 5 respectively. Fig.6 shows the radiation pattern of rectangular patch antenna.

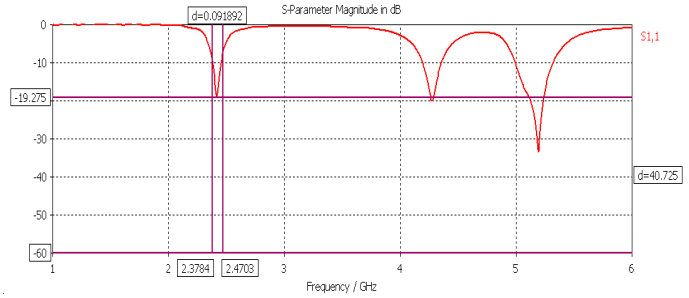

Fig 4(a) Simulated Return Loss[s_{11}] of the Dual Band Rectangular patch antenna

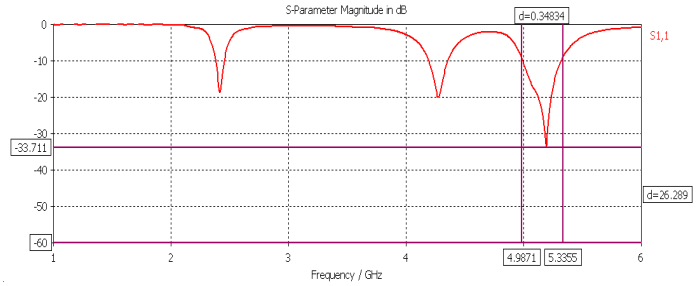

Fig 4(b)Simulated Return Loss[s_{11}] of the Dual Band Rectangular patch antenna

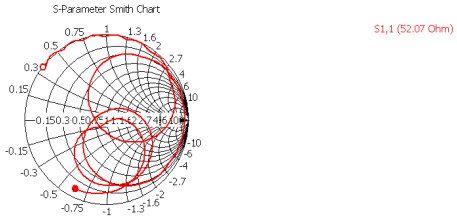

Fig 5: Smith chart presentation of the rectangular patch antenna.

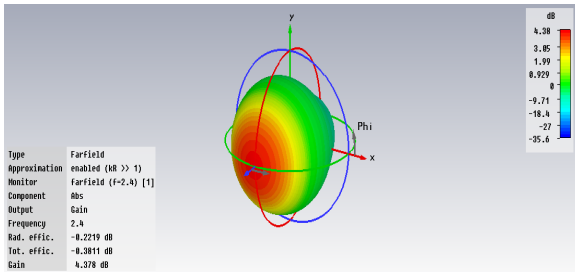

Fig. 6(a) Radiation pattern of rectangular patch antenna at 2.4 GHz

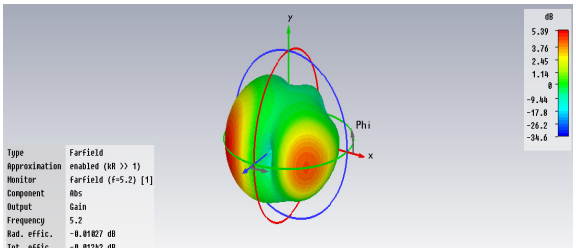

Fig 6(b) Radiation pattern of rectangular patch antenna at 5.2 GHz

The simulated return loss and smith chart presentation of the dual band triangular patch microstrip antenna is shown in fig 7 and fig 8 respectively. Fig.9 shows the radiation pattern of triangular patch antenna.

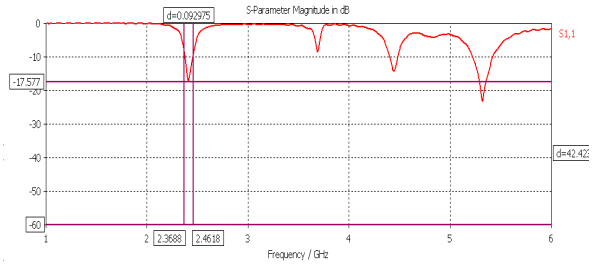

Fig 7(a)Simulated Return Loss[s_{11}] of the Dual Band Triangular patch antenna

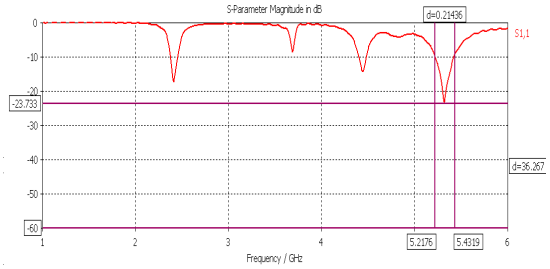

Fig 7(b)Simulated Return Loss[s_{11}] of the Dual Band Triangular patch antenna

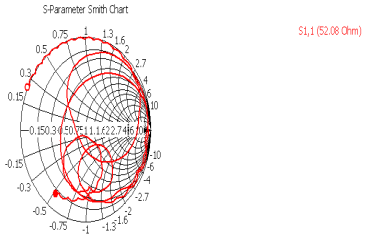

Fig 8 Smith chart presentation of the Triangular patch antenna

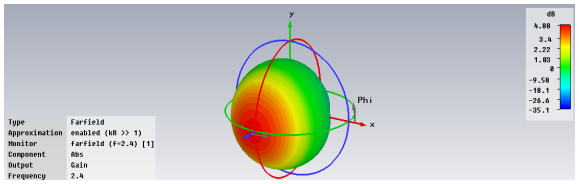

Fig 9(a) Radiation pattern of Triangular patch antenna at 2.4 GHz

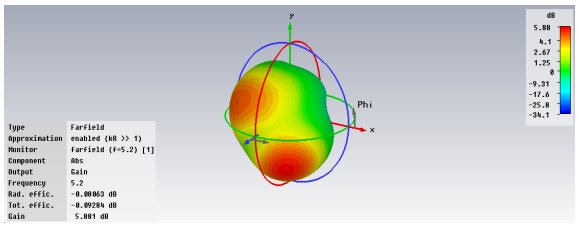

Fig 9(b) Radiation pattern of Triangular patch antenna at 5.2 GHz

The simulated return loss and smith chart presentation of the dual band pentagonal patch microstrip antenna is shown in fig 10 and fig 11 respectively. Fig.12 shows the radiation pattern of pentagonal patch antenna.

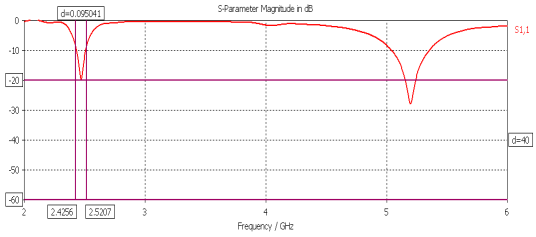

Fig 10(a)Simulated Return Loss[s_{11}] of the Dual Band Pentagonal patch antenna

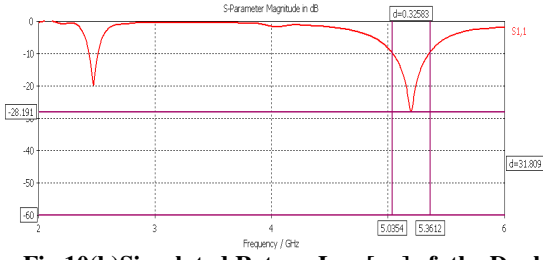

Fig 10(b)Simulated Return Loss[s_{11}] of the Dual Band Pentagonal patch antenna

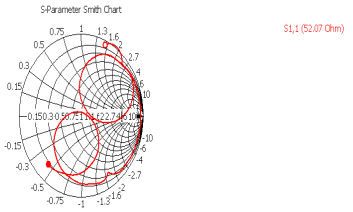

Fig11 Smith chart presentation of the Pentagonal patch antenna

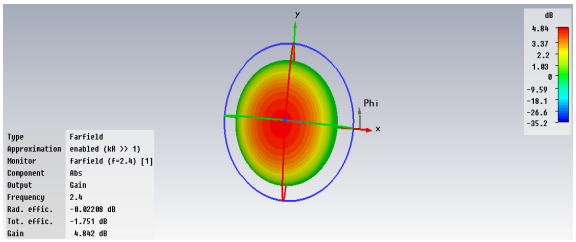

Fig 12(a) Radiation pattern of pentagonal patch antenna at 2.4 GHz

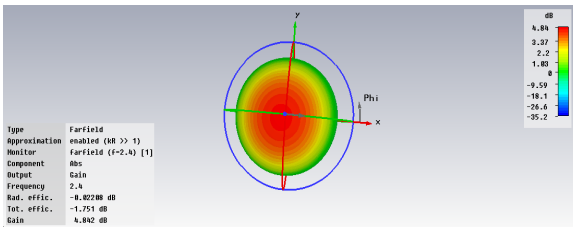

Fig 12(b) Radiation pattern of pentagonal patch antenna at 5.2 GHz

4. COMPARISON OF DESIGNED ANTENNAS

SHAPE OF PATCH	FREQUENCY	RETURN LOSS	BANDWIDH
Rectangle	2.4GHz	-19.275dB	91.89MHz
	5.2GHz	-33.711dB	348.34MHz
Triangle	2.4GHz	-17.577dB	92.975MHz
	5.2GHz	-23.733dB	214.36MHz
Pentagon	2.4GHz	-20dB	95.04MHz
	5.2GHz	-28.191dB	325.83MHz

5. CONCLUSION

The results are successfully simulated and thedesigned antennas fulfill the bandwidth requirements for WLAN applications.

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