

Design and Simulation of Microstrip Patch Antenna for Wireless Communication

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Abstract

This paper presents the design and simulation of broadband microstrip patch antenna using High Frequency Structure Simulator (HFSS). The two different configuration of broadband microstrip patch antenna, simple rectangular patch antenna & E shaped patch antenna are analyzed. The performance of designed antennas is analyzed in terms of return loss, bandwidth and gain. The substrate used in these two configurations is FR-4 having dielectric constant 4.4. After analyzing, the return losses and gain of two different antennas are calculated. The calculated result for return loss of rectangular patch & E shape patch are -21.93 db & -25.714 db and gain of rectangular patch & E shape patch are 6.787 db & 8.284db respectively

Keywords –

Patch antenna, High Frequency Structured Simulator, Rectangular Patch, E –Shape patch

Due to evaluation of wireless communication, many high performance mobile devices are developed which require efficient mean of communication i.e. it should have low return loss & high bandwidth.

I. Introduction

Microstrip antenna is an ideal choice for wireless communication due to low profile, light weight, conformal shaping, low cost, simplicity of manufacturing and easy integration to circuit [1]. However, conventional microstrip patch antenna suffers from very narrow bandwidth, typically about 5% bandwidth with respect to central frequency.

In recent years, there is a need for more compact antennas due to rapid decrease in size of personal communication devices. As communication devices become smaller due to greater integration of electronics, the antenna becomes a significantly larger part of the overall package volume. This results in a demand for similar reductions in antenna size. In addition to this, low profile antenna designs are also important for fixed wireless application. The microstrip antennas used in a wide range of applications from communication systems to satellite and biomedical applications.

There are numerous and well known method to increase the bandwidth of antennas, including increase of substrate thickness, the use of low dielectric substrate [2]

II. Antenna Design

In this section, structure of patch antennas are discussed, rectangular patch, E shape patch configuration are simulated by HFSS software in order to decrease return loss and increase bandwidth

A. Rectangular Patch Antenna

A Rectangular patch antenna is designed and simulated here. Dimension is given in fig. 1. Dimensions of patch are calculated using [3] and optimized dimensions are $L=52.8\text{mm}$, $W=47\text{mm}$. Substrate with dielectric constant 4.4 and height 14.3 mm, $x=23.2\text{mm}$. Patch is designed for operating frequency 6.895 GHz. Dimension of ground plate is calculated using following equation

$$W_g = 6h + w$$

$$L_g = 6h + L$$

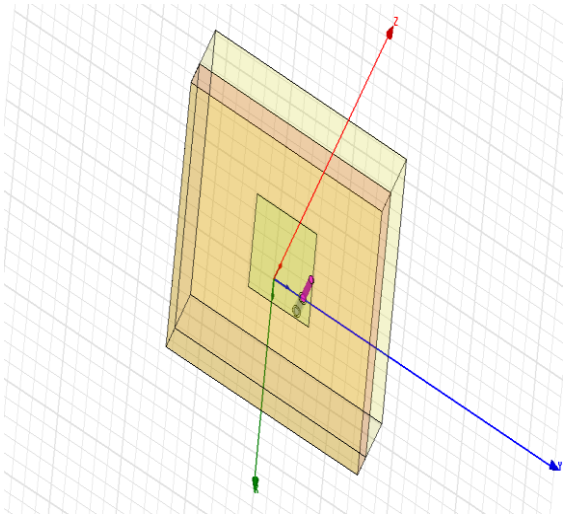


Fig 1.

Top and Side view of rectangular patch antenna

After Simulation return loss is obtained -21.93 db with gain 6.787 db and bandwidth 7.13%. Frequency vs Return Loss plot & radiation pattern is shown in fig 2. & fig 3 respectively

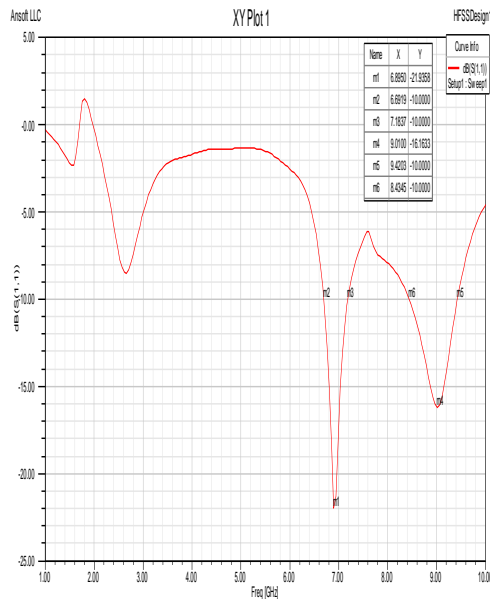


Fig 2.

Frequency Vs return loss plot for rectangular patch antenna

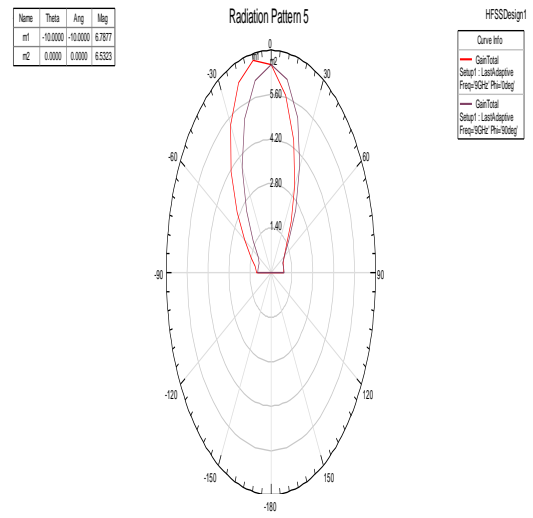


Fig 3.

Radiation Pattern for rectangular patch antenna

B. E – Shaped Patch Antenna

E- Shaped patch antenna is designed and simulated here. Dimension is given in fig. 3.

Dimension of E shape patch is same as rectangular patch antenna with specific dimension $w_s=16.3$, $p=6.3$ and $y=22.5$. Patch is designed for operating frequency 6.895.

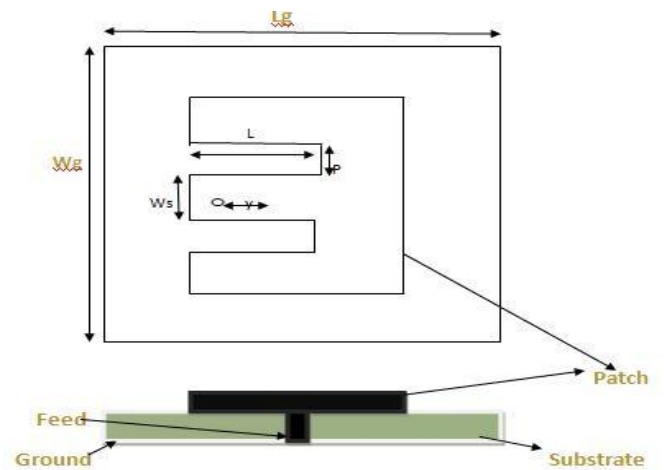


Fig 4.

Top and Side view of E- Shape patch antenna

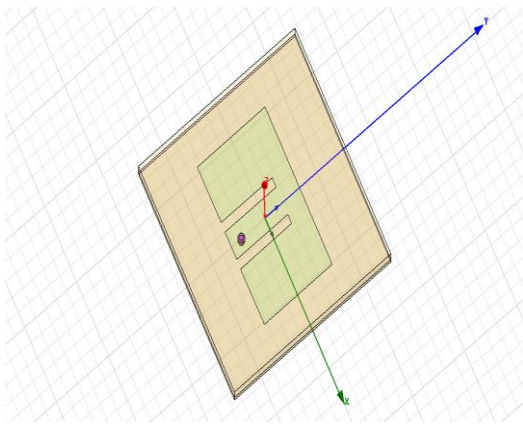


Fig 5.

Top and Side view of E- Shape patch antenna in HFSS

After Simulation return loss is obtained -25.7143 db with gain 8.284 db and bandwidth 8.69 %.

Frequency vs Return Loss plot & radiation pattern is shown in fig 6 and fig 7. Respectively

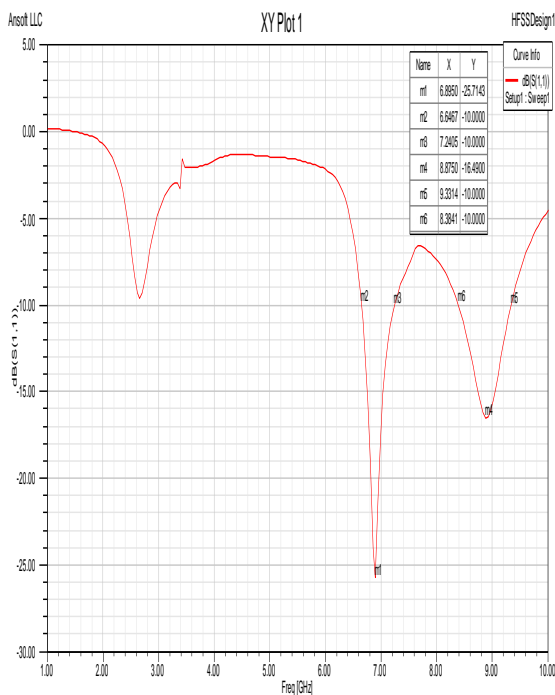


Fig 6.

Frequency Vs return loss plot for rectangular patch antenna

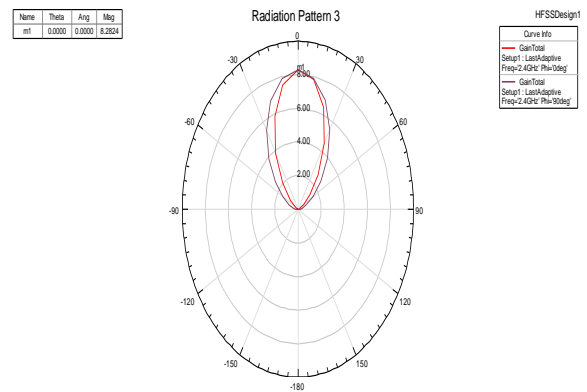


Fig 7.

Radiation Pattern for rectangular patch antenna

III. Comparative Analysis

In this section, comparative of two configurations is shown in tabular form. Return loss and bandwidth is compared in table 1.

Sr. No.	Parameters	Rectangular Patch Antenna	E-Shape Patch Antenna
1.	FL(GHz)	6.6919	6.646
2.	FH(GHz)	7.1837	7.2404
3	F0(GHz)	6.895	6.895
4.	Bandwidth (%)	7.13	8.69
5.	Return Loss(db)	-21.935	-25.714
6.	Gain	6.787	8.284

Table 1.

Comparative analysis of two configurations of Antenna

IV. Conclusion

After Simulation, it is found that E –shaped patch antenna has low return loss with high gain and bandwidth. Simulated return loss is -25.714 with gain 8.284 db and bandwidth 8.9% is obtained from E shaped patch antenna

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