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Comparative Analysis Of Microstrip Rectangular Patch Antenna Using Different Height Substrates

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Abstract: A compact rectangular microstrip patch antenna with minimum return loss having enhanced gain and bandwidth is proposed in this paper. The antenna is analysed for the different height of the dielectric substrate. The resonant frequency of the designed antenna is 2.4 GHz. The dielectric substrate used for antenna designed is FR4-epoxy having a dielectric constant of 4.4. The designed antenna has a bandwidth which covers the frequency band of WLAN applications. It is observed that the gain of the designed antenna using more height substrate is greater than the normal substrate height. The return loss is also greater than the conventional patch antenna. Microstrip line feeding method is used to energize the antenna. VSWR for the designed antenna is less than 2. A comparative analysis of the different characteristics of the antenna such as gain, bandwidth, return loss, directivity and VSWR is carried out using different height substrate .Software High Frequency Structure Simulator (HFSS) is used for the simulation of the designed antenna.

Keywords: VSWR, Microstrip antenna, Bandwidth, High Frequency structure simulator.

I. INTRODUCTION

Microstrip patch antennas are increasing due to use in wireless applications due to their low-profile structure. Therefore they are extremely compatible for embedded antennas in handheld wireless devices such as cellular phones, pagers etc. Microstrip patch antennas radiate mainly due to fringing fields between the ground planes and patch edge. For good antenna performance, dielectric substrate should be thick having a low dielectric constant. It is required because it gives good efficiency, larger bandwidth and better radiation. Microstrip antenna is popular due to their light weight, low volume, low fabrication cost, so can be manufactured in large quantity [1]. These microstrip antennas are mechanically robust when mounted on rigid surfaces.

Microstrip antenna is energized using various feeding techniques such as coaxial feeding, microstrip feeding, aperture coupled feed and proximity coupled feed. From these feeding techniques microstrip feeding technique is easy [1].

II. ANTENNA DESIGN

The antenna is designed at a resonant frequency of 2.4 GHz having the following specifications-

Parameter	Value
Frequency	2.4 GHz
Length of the Patch	27 mm
Width of the Patch	38 mm
Substrate Size	61mm×76 mm
Substrate	Fr4 Epoxy
Dielectric Constant	4.4
Feeding method	Microstrip Line

Here the height of the substrate is taken as 1.6 mm.In this paper designed antenna is analysed for the different height of the dielectric substrate. Designed antenna is analysed for the different characteristics of the antenna such as return loss, gain, radiation pattern, voltage standing wave ratio, and directivity. The designed antenna is analysed for the substrate height of 1.6mm, 3.2mm, 4.8mm, and 6.4mm. According to the outputs observed it is seen that various antenna characteristics changes significantly with respect to change in height of the substrate. The return loss of the antenna is minimized significantly. Besides this the gain and bandwidth of the antenna also increased. The voltage standing wave ratio of the designed antenna is less than 2.

The designed antenna is simulated using high frequency structure simulator.

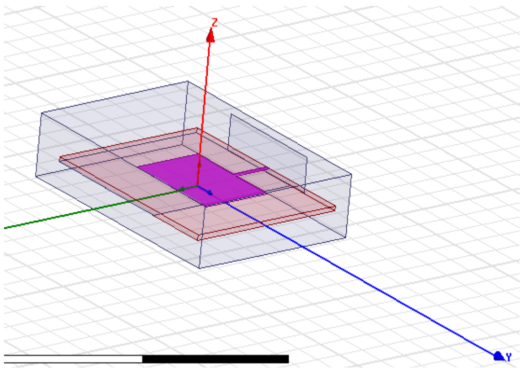

Fig.1 HFSS Design of antenna

III. RESULTS AND DISCUSSION

The simulation results for the designed antenna using software high frequency structure simulator such as return loss, gain, radiation pattern, directivity is observed for the different height of the substrate such as 1.6mm, 3.2mm, 4.8mm,6.4mm.

A. When substrate height is 1.6 mm:

When the substrate height is taken as 1.6 mm, the simulation results for the different antenna characteristics are shown below:

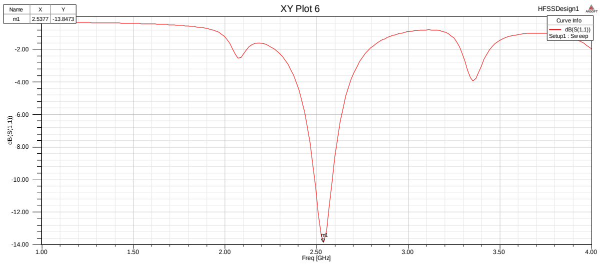

Fig.2 Return loss of the antenna

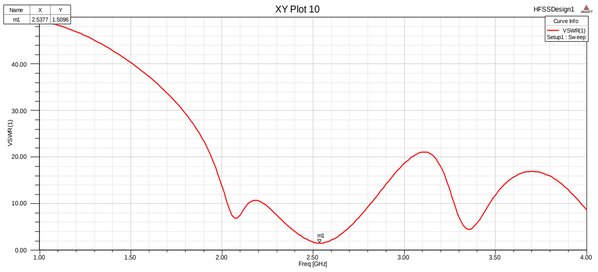

Fig.3 VSWR of the antenna

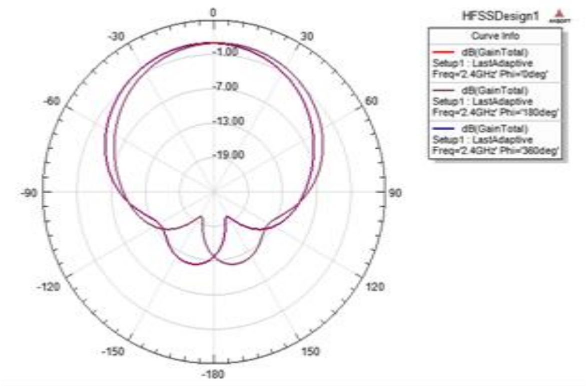

Fig.4 Radiation Pattern of the antenna

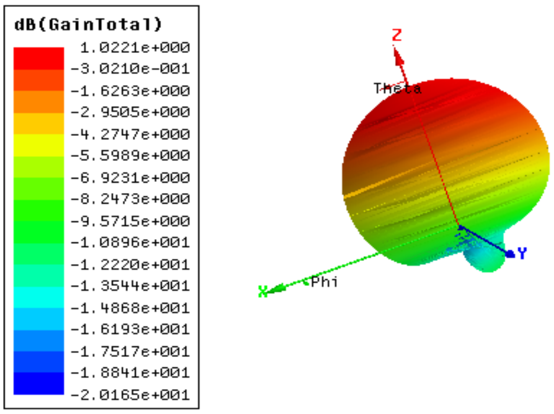

Fig.5 Gain of the antenna

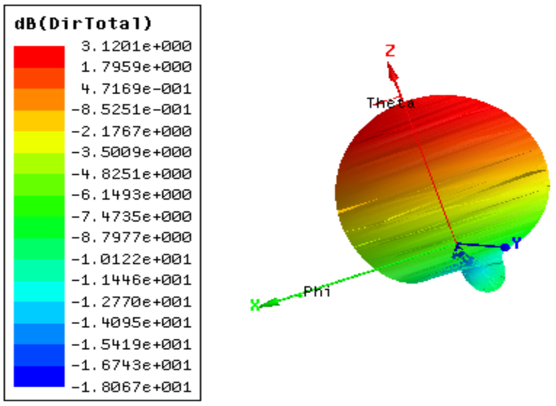

Fig.6 Directivity of the antenna

B. When substrate height is 3.2 mm:

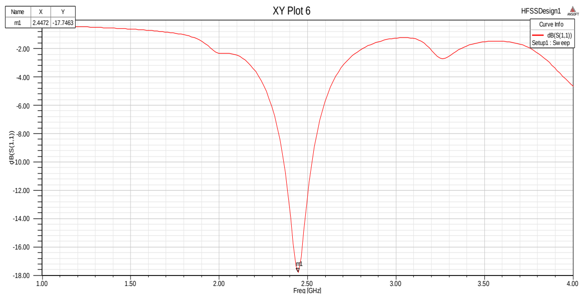

Fig.7 Return loss of the antenna

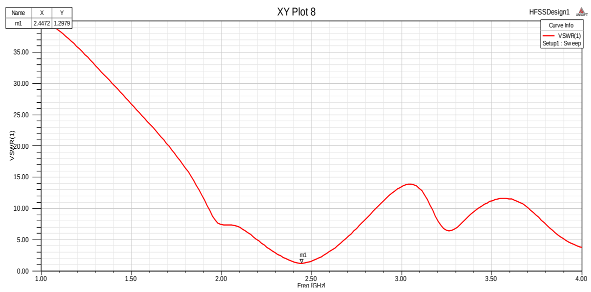

Fig.8 VSWR of the antenna

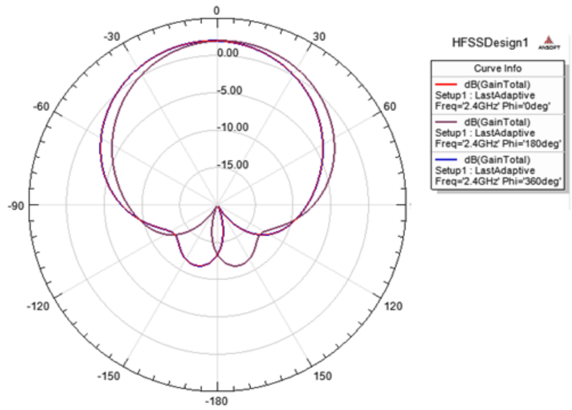

Fig.9 Radiation Pattern of the antenna

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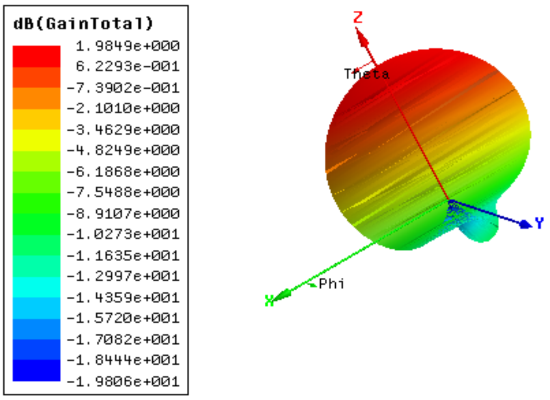

Fig.10 Gain of the antenna

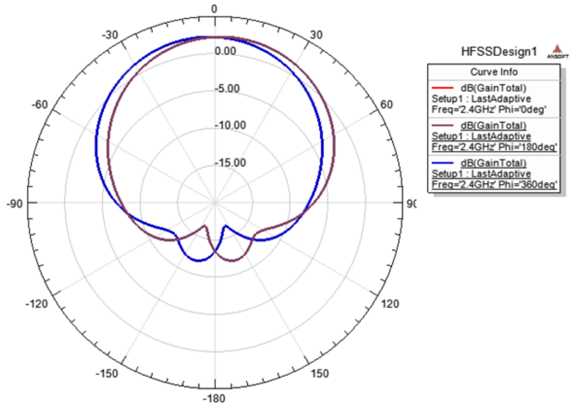

Fig.14 Radiation Pattern of the antenna

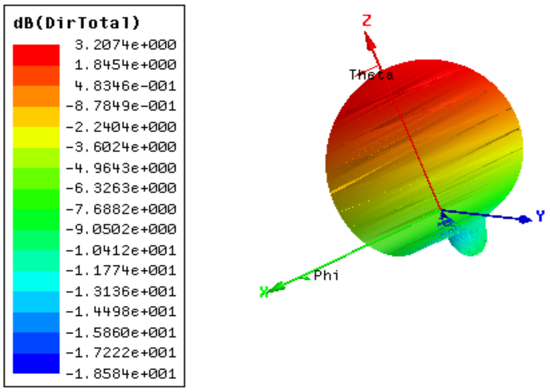

Fig.11 Directivity of the antenna

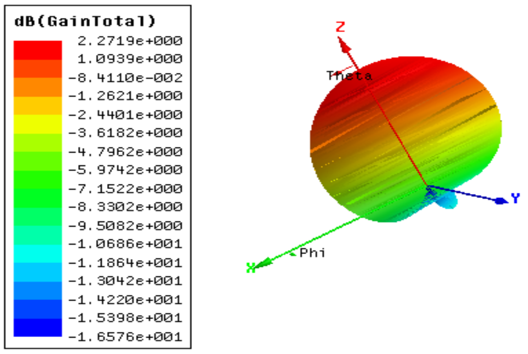

Fig.15 Gain of the antenna

C. When substrate height is 4.8 mm:

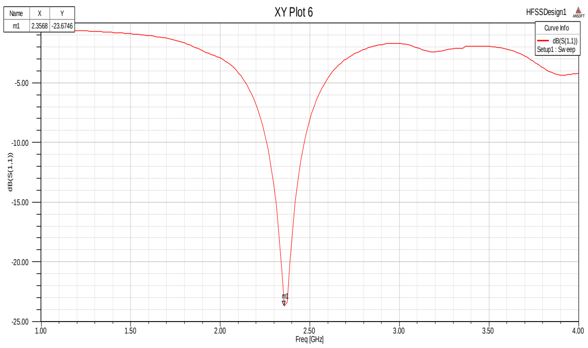

Fig.12 Return loss of the antenna

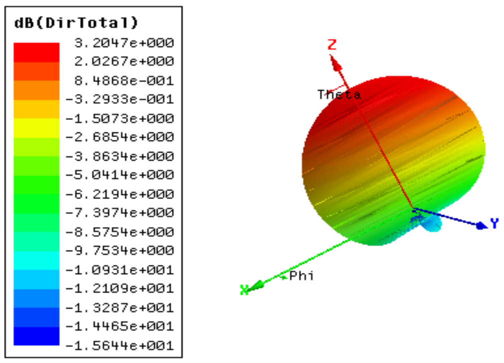

Fig.16 Directivity of the antenna

C. When substrate height is 6.4 mm:

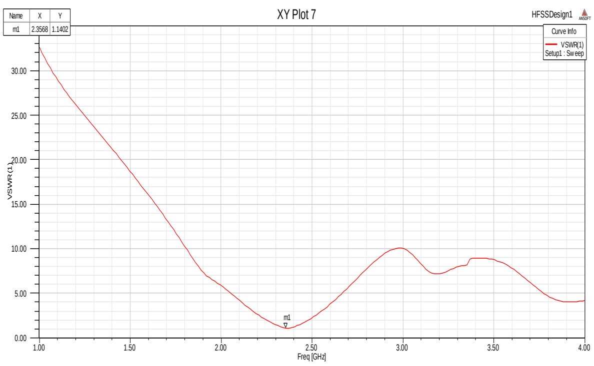

Fig.13 VSWR of the antenna

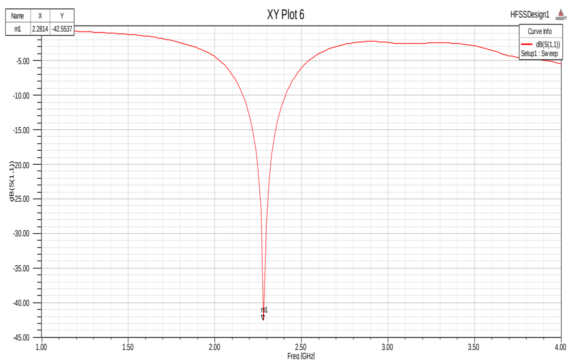

Fig.17 Return loss of the antenna

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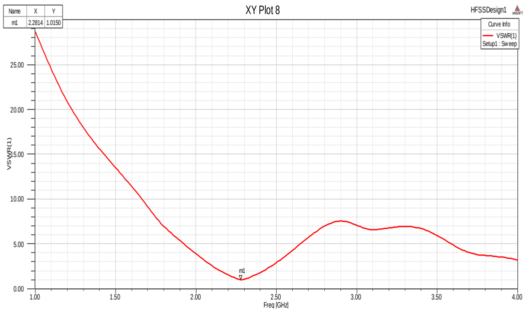

Fig.18 VSWR of the antenna

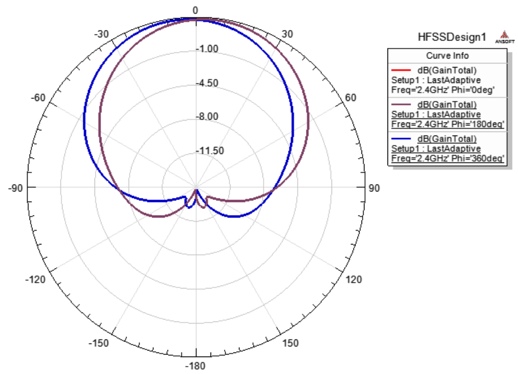

Fig.19 Radiation Pattern of the antenna

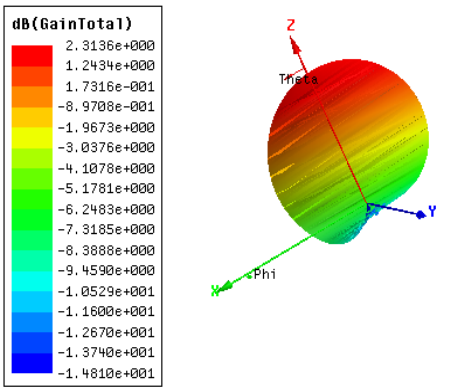

Fig.20 Gain of the antenna

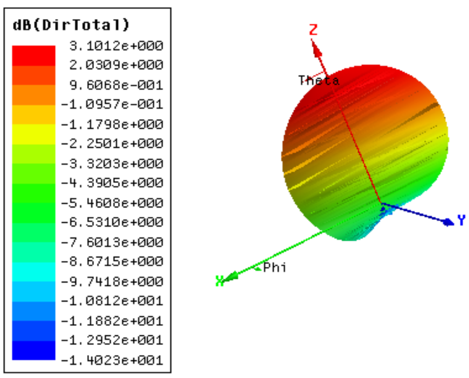

Fig.21 Directivity of the antenna

TABLE I COMPARISON CHART USING DIFFERENT HEIGHT SUBSTRATE

Height of substrate (mm)	Return loss (dB)	Gain (dB)	Directivity (dB)	Bandwidth (MHz)
1.6	-13.84	1.02	3.12	100
3.2	-17.74	1.98	3.20	160
4.8	-23.67	2.27	3.20	210
6.4	-42.55	2.31	3.10	240

So from the above table it is clear that return loss of the antenna is minimized significantly when the substrate height is increased. A return loss of -42.55 dB is achieved for a substrate height of 6.4 mm. The gain of the antenna is also increased and it is 2.31 dB and bandwidth of the designed antenna is 240MHz for the substrate height of 6.4 mm. The voltage standing wave ratio of the designed antenna is less than 2.

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