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Omni-Directional Rectangular Microstrip Antenna for WLAN

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Abstract— This article highlights the design of Omni-directional rectangular shaped Microstrip patch antenna at 2.4 GHz. Also we have analyzed Microstrip patch antenna with different variations of patch length, width, variations in dimensions of feed line and variations in dimensions of substrate.

Keywords— High Frequency Simulation, WLAN, Communication.

I. INTRODUCTION

Microstrip Patch Antenna in its simplest form consists of a radiating patch on one side of a dielectric substrate and a ground plane on the other side. Conventional microstrip antennas in general have a conducting patch printed on a grounded microwave substrate, and have the attractive features of low profile, light weight, easy fabrication, and conformability to mounting hosts. The radiating patch could be of any arbitrary shape, but it is generally taken as a regular shape for the ease of analysis and understanding of the antenna characteristics.

The main advantages of MSAs are listed as follows: They are lightweight and have a small volume and a low-profile planar configuration. They can be made conformal to the host surface. Their ease of mass production using printed-circuit technology leads to a low fabrication cost. They are easier to integrate with other MICs on the same substrate. They allow both linear polarization and CP. They can be made compact for use in personal mobile communication. They allow for dual- and triple-frequency operations.

In first part of paper we have designed rectangular shaped microstrip patch antenna at 2.4 GHz and simulated with ANSOFT HFSS. In second part, the hardware prototype is designed with photolithographic process and its parameters like VSWR, return loss and smith chart are observed on vector network analyser. In third part, we analysed antenna performance for variations in dimensions of feed line, patch, and substrate.

II. ANTENNA DESIGN

A. Antenna Dimensions

The proposed MS Patch Antenna has following parameters: Patch:-Width:28.8(mm),Length:37.7(mm),Height:0.05(mm) Substrate:- Width:80(mm), Length:75(mm), Height:1.6(mm) Ground:-Width:80(mm)Length:75(mm),Height:0.05(mm)
Air Box:- Width:100(mm),Length:100(mm),Height: 35(mm) Feed line:- Width :3(mm),Length:9(mm),Height:0.05(mm) Port:- Width:3(mm), Length:1.65(mm).
The Microstrip Patch Antenna for above dimensions is simulated using Ansoft HFSS.

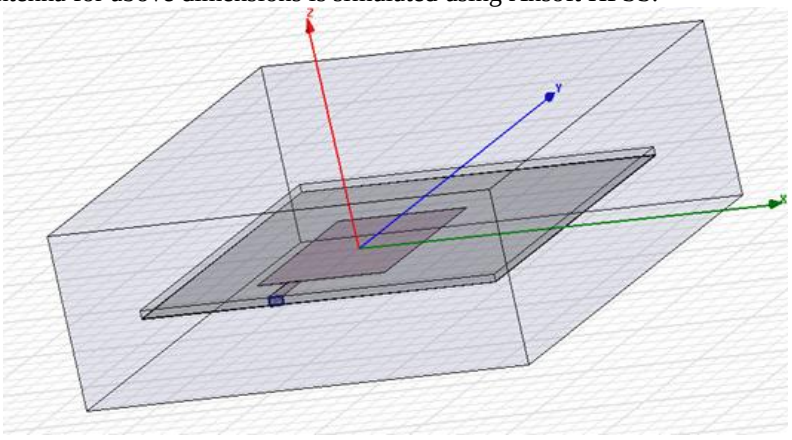

Fig:1 Microstrip Patch Antenna simulated using HFSS.

B. Parametric Analysis of RMSA:

Different dimensions and respective results of antenna using HFSS are given in table-I below:

Table-1: Different dimensions and respective results of MSA using HFSS.

Sr. No.	Antenna size			Feed		Return loss	VSWR	Frequency Shift
	L(mm)	W(mm)	H(mm)	L(mm)	W(mm)			
1.	60	60	0.05	15.6	6	-18.9356	1.2811	2.4369
2.	55	55	0.05	14.6	5	-20.8145	1.2358	2.5888
3.	45	45	0.05	14.6	5	-9.4208	2.0362	3.0248
4.	30	30	0.05	13	1	-14.9007	1.6143	2.984
5.	32	32	0.05	13.6	2	-11.5282	2.71	3.0381
6.	35	37	0.04	13.6	3.5	-10.5882	2.0362	2.6850
7.	30	30	0.04	13.6	3.5	-23.9913	2.3756	3.3812
8.	32.4	30	0.04	13.6	3	-19.2308	1.2217	2.2011
9.	30	30	0.05	16.6	3	-3.7285	4.6968	2.3714
10.	30	30	0.05	15.6	3	-10.1041	1.8100	3.3508
11.	32.4	30	0.05	15.6	3	-10.8019	2.2624	2.1623
12.	32.4	30	0.05	15.6	3.6	-9.5701	2.0362	2.1531
13.	32.4	30	0.05	15.6	2.9	-12.5113	1.8100	2.1502
14.	39.4421	38.03	0.05	15.6	3	-11.3122	2.434	2.5777
15.	35	30	0.05	15.6	3	-11.6743	1.7056	2.0303
16.	31	30	0.05	15.6	3.5	-4.1437	4.2489	2.2383
17.	34	30	0.05	15.6	3	-10.4011	1.8652	2.0909
18.	28.8	37.7	0.04	10	3	-14.1516	1.448	2.2542
19.	28.8	37.7	0.05	9	3	-12.0011	1.6708	2.3747

C. Simulation Results of MSA:

From simulation the return loss and VSWR are observed as below:

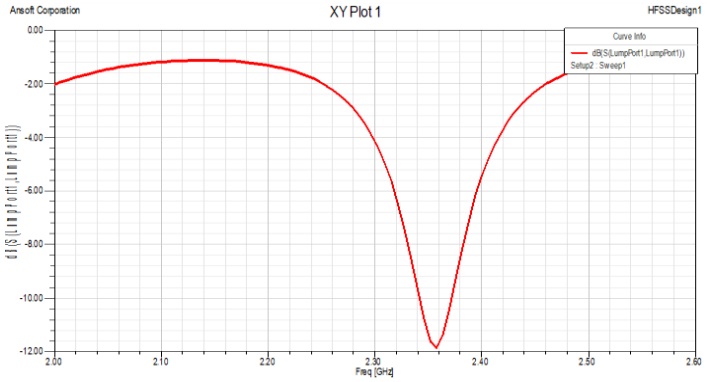

Fig:2 Return Loss(S11 Parameter)

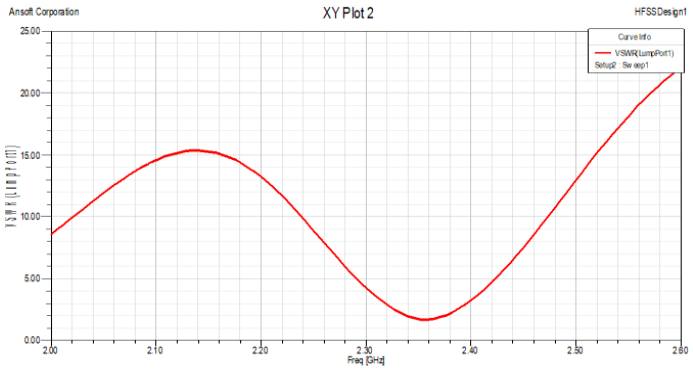

Fig: 3 VSWR

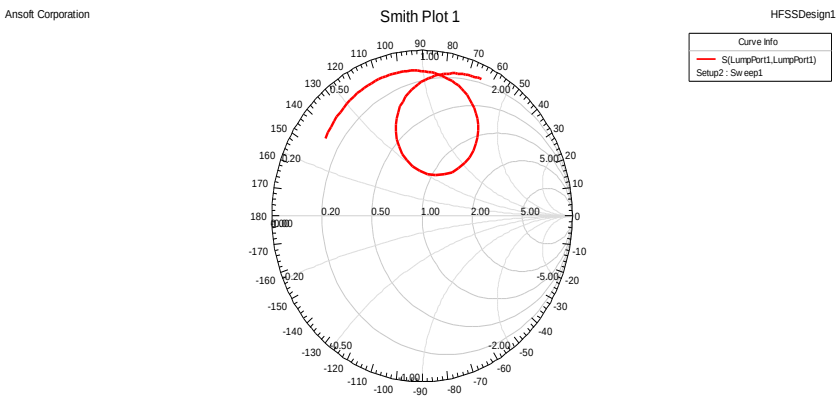

Fig 4: Smith Chart

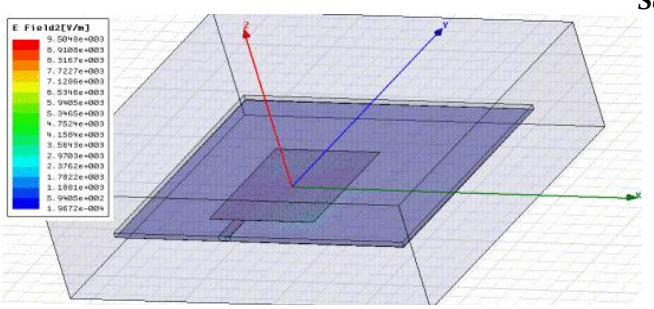

Fig 5: E-Vector Distribution.

The Omni-Directional radiation pattern is observed as below:

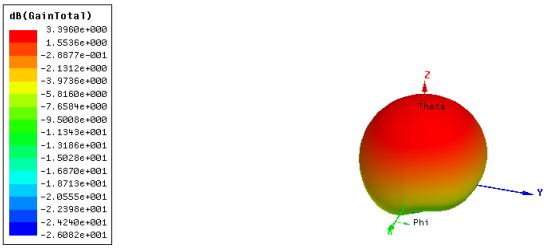

Fig 6 : Polar radiation plot

D. Hard Ware Results:

The RMSA is designed with Photolithographic process shown in figure 7.

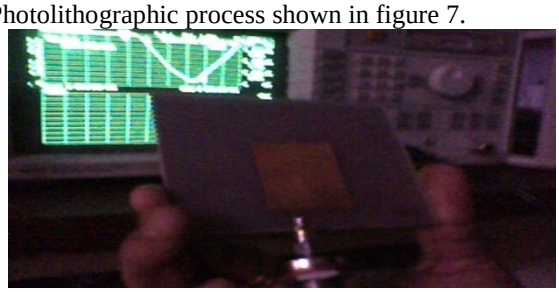

Fig 7 : Hardware Prototype

The RMSA is analyzed using Agilant Technologies Network Analyzer (Serial Number-8714ET) the practical values such as return loss, SWR etc are observed.

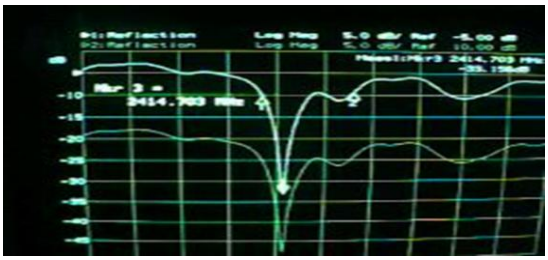

Fig 8**:** S11 parameter with Network Analyzer

At mark m1, the frequency is equal to 2.256 GHz and mark m2,the frequency is 2.441 GHz. Therefore the impedance bandwidth is

B.W.= (2.441-2.256) GHz
= 0.185 GHz
= 185 MHz

Here the S11 Parameter is -33.15dB at mark m3 i.e. Center Frequency Fc=2.414703 GHz

Fig 9: Measured Smith Chart

The smith chart is as shown above.

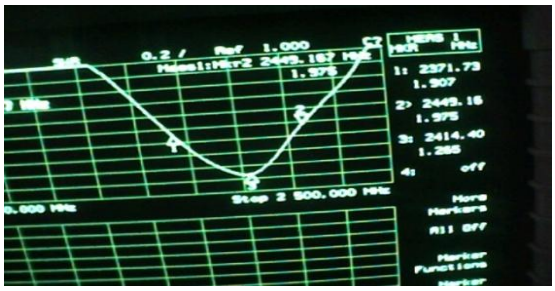

Fig 10: Measured VSWR

The parametric analysis of Microstrip patch antenna shown below. The variation of feed line, L=10mm, W = 3 mm and with L =9 mm, W = 5 mm, along with variations in patch length & width, for VSWR shown in figure 11.

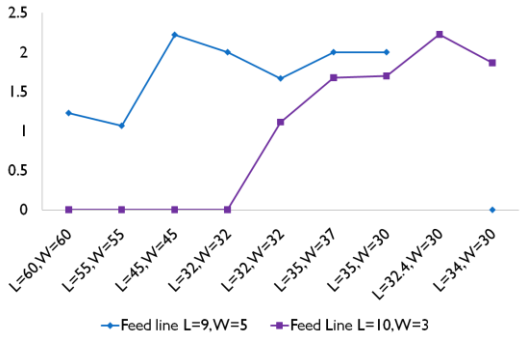

Fig 11**:** Parametric Analysis of proposed MSA.

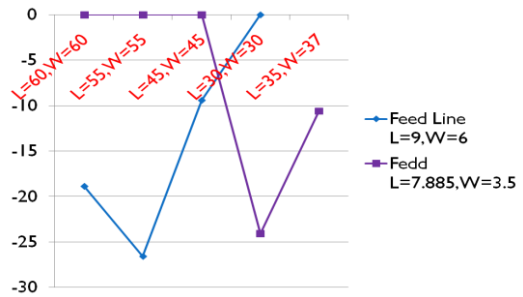

Fig 12**:** S11 vs Patch Length for various Dimensions Feed Line.

The return losss is analyzed at different lengths & width of feed line and patch shown in figure12.

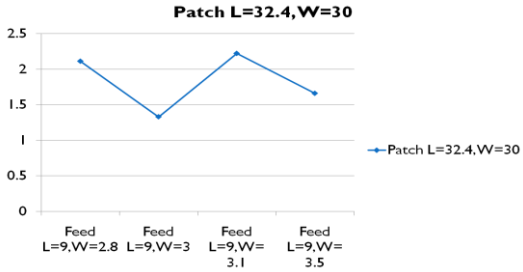

Fig 13: Parametric Analysis VSWR vs Feed Line Size Variations:

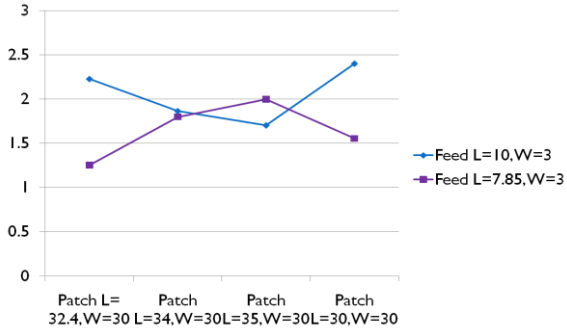

Fig 14**:** VSWR vs Patch size/ Feed Line Size

III. CONCLUSIONS

Thus the proposed Omni-directional rectangular microstrip patch antenna at 2.4 GHz is simulated, designed and also tested for various parameters like SWR, S11, etc using network analyzer. The observed and simulated results are compared also parametric analysis of antenna is carried out. With measured results, we achieved 185 MHz bandwidth with centre frequency at 2.414 GHZ.

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