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Compact Micro-Strip Patch Antenna Having Three Rectangular Slots For WLAN Application

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Abstract: A compact, MPA for WLAN (5.2GHz) application is proposed. The antenna system is a simple micro-strip structure with three rectangular slots and a common ground plane. FR4 Epoxy substrate is preferred for proposed antenna having height of substrate 1.6mm.

The dimension of the proposed antenna system is 13.19 X 17.54 X 1.64 mm^3. This antenna provides S11 value -19.42 dB with VSWR of about 1.86 and gain 5.21 dBi at frequency 5.2 GHz this antenna system provides 338 MHz Bandwidth at center frequency 5.2GHz, so this Microstrip patch antenna is suitable for WLAN application. For this antenna we have selected Microstrip line feed method to excite the antenna and for simulation HFSS software is used.

Keywords: Micro strip Patch Antenna, FR4 Bandwidth, Return loss, Ultra wide band, High Frequency Structure Simulator (HFSS), WLAN**.**

I. INTRODUCTION

In 1950 Microstrip antenna was first introduced. After 20 Years printed circuit board was introduced. Light weight, low cost are the main advantages of MPA. MPA's are widely used in wireless applications for example radar system, remote sensing, missile guidance and so on[1]

MPA's are easy for fabrication, compact in size and compatible to any structure for mounting [2]

In this paper Sanjay Singh, and et.al. designed a simple Micro-strip Patch Antenna for WLAN applications operating in a single band of frequency 2.4GHZ. Design and simulation processes are carried out with the help of the HFSS(High Frequency Structural Stimulator). Rogers TMM 4 substrate is used. -27.50db return loss achieved with gain 4.96dB.[3]

In this paper Houda Werfelli and et.al. designed a simple Microstrip Patch Antenna having resonant frequency of 4.1GHz. FR4 substrate was used for designed antenna. The center frequency is 4.1 GHz with achieved -30dB S11 value, achieved gain is 3.48. Within the frequency range from 3GHz to 5GHz achieved VSWR value was 1.6. [4]

In this paper Dheeraj Mungur and et.al. explained an Antenna for 5G Applications having frequency range of 28 GHz. The designed antenna has 27.91 GHz frequency with achieved S11 value of -12.59dB and achieved 582 MHz of Bandwidth and 6.69 dBi gain. Rogers RT Duroid 5880 substrate was used with insert feed method and attained VSWR value is 1.77. [5]

In this paper Shera Prabjyot Singh and et.al. designed an Antenna for frequency 2.4 GHz for WLAN. That designed antenna provided -12.05 dB S11 value.[6]

In this design, length of patch can be represented by L and width of Patch can be represented by W. The proposed antenna works on the frequency 5.2GHz,which is nothing but wireless local area network(WLAN)frequency. The substrate preferred for this design is FR-4Epoxy

II. ANTENNA DESIGN

A. *Antenna configuration*

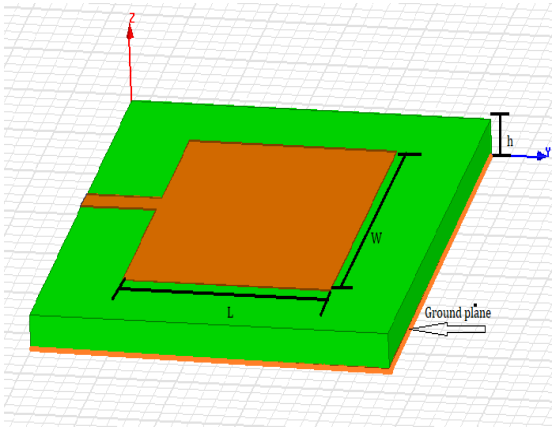

Figure 1: Antenna Geometry

Figure 1 shows the structure of proposed antenna consisting of microstrip feed line, ground plane, Patch as well as substrate. Table 1 includes the respective calculated parameter values of the antenna.

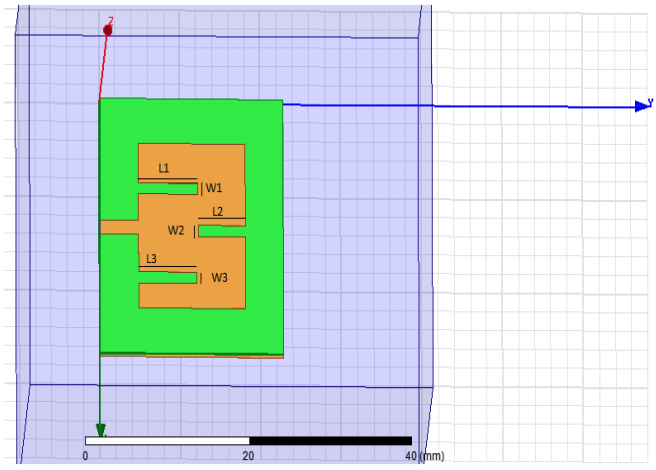

Figure 2: Design of Proposed antenna

III. DESIGN STEPS OF ANTENNA

The proposed antenna is expected to work at a frequency of 5.2 GHz which is frequency of wireless applications. For this antenna FR4 substrate is preferred, which is easily available having dielectric constant 4.4.

The basic steps for the calculations of W, L of patch as well as ground & substrate are [6]:

1. The width is calculated by

$$\frac{c}{2fr\sqrt{\frac{\varepsilon r+1}{2}}}$$

2. The effective dielectric ε_{eff} is given by;

$$\epsilon_{eff}=\frac{\varepsilon_r+1}{2}+\frac{\varepsilon_{r-1}}{2}\left[1+\frac{12h}{w}\right]^{\frac{-1}{2}}$$

3. The Dielectric constant L_{eff} is given by;

$$L_{eff}=\frac{c}{2_{fr\sqrt{\delta_{eff}}}}$$

4. $$\Delta L = 0.412h\frac{(\varepsilon_{eff}+0.3)\left(\frac{w}{h}+0.264\right)}{(\varepsilon_{eff}-0.258)\left(\frac{w}{h}+0.8\right)}$$

5. $$L = L_{eff}-2\Delta L$$

6. The Length of Substrate is given as;

$$(L_g) = 6h + L$$

7. The width of Substrate is given as;

$$(W_g) = 6h + W$$

8. VSWR:

$$VSWR = \frac{V_{max}}{V_{min}} = \frac{1+|\Gamma|}{1-|\Gamma|}$$

IV. SIMULATED RESULTS IN HFSS

After completion of design part, we have simulated that antenna for number of parameters e.g. S11 parameter, VSWR, as well as total gain using HFSS.

fig.3 shows S11 value graph. Graph shows that the designed antenna is providing S11 value of -19.42dB And fig.4 shows VSWR graph. Graph shows that the designed antenna is providing VSWR with minimum value of 1.86 at Frequency 5.025 to 5.369GHz

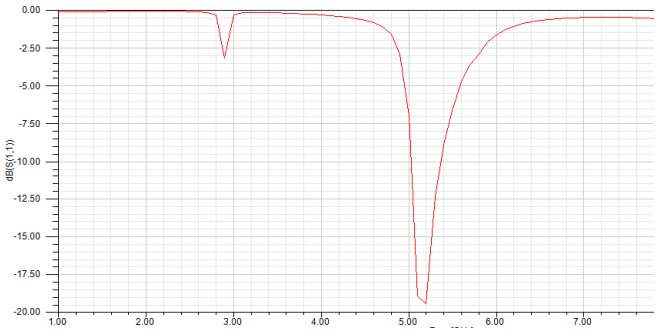

Figure 3: S11 parameter

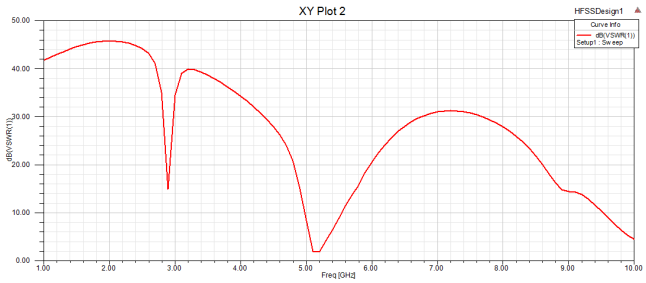

Figure 4: VSWR

VSWR means the maximum to minimum voltages ratio. The p (reflection coefficient) is given as:

$$\rho = |r| = \frac{VSWR - 1}{VSWR + 1}$$

Table 1: Calculated Values of proposed antenna

Parameters	Values(mm)
W_g	27.14
L_g	22.79
W_s	27.14
L_s	22.79
H	1.6
W	17.54
L	13.19
L1	9
W1	1.2
L2	7
W2	1.2
L3	8
W3	1.2

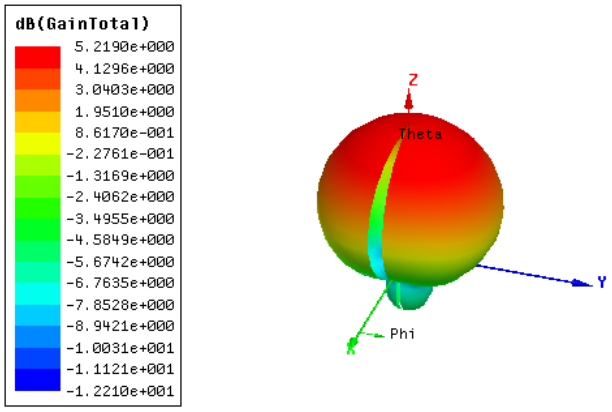

Figure 5: 3D Radiation pattern

Figure 5. shows the graph of simulated gain value. At frequency 5.2GHz the proposed antenna provides the gain 5.21 dBi.

V. SUMMARY OF RESULTS

Antenna parameters At 5.2GHz	S11 Parameter	VSWR	Gain
Specification Detail	-19.42	1.86	5.21dB

VI. CONCLUSION

The designed antenna center frequency is 5.2GHz, which provides the return loss of -19.42dB. HFSS software is used for the simulation. The designed antenna provides VSWR value of 1.86 for Bandwidth of 338 MHz. Total gain provided by the antenna is 5.21 dBi. To achieve expected frequency of WLAN(5.2 GHz) the micro strip feed line is used.

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