The purpose of the inset cut in the patch is to match the impedance of the feed line to the patch without the need for any additional matching element.
This is achieved by properly controlling the inset position. Hence this is an easy feeding scheme, since it provides ease of Substrate Ground Plane.

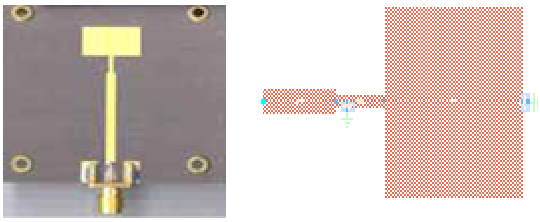

Fig:2 Top View of Antenna and generated Layout of schematic design of Microstrip Antenna

2.2 Method of Analysis (micro strip Patch antenna)

The rectangular patch antenna is approximately one-half wavelength long section of rectangular micro strip transmission line. When air is the antenna substrate. As the antenna is loaded with a dielectric as its substrate, the length of the antenna decreases as the relative dielectric constant of the substrate increases. The resonant length of the antenna is slightly shorter because of the extended electric "fringing fields" which increase the electrical length of the antenna slightly.
The simple analytical modeling techniques are transmission model and cavity model.

In order to operate in the fundamental TM_{10} mode, the length of the patch must be slightly less than $\lambda/2$ where λ in the dielectric medium and is equal to $\lambda 0/\sqrt{\varepsilon_{reff}}$ where $\lambda 0$ is the free space wavelength.

Line Calculation

Line calculation for Patch in terms of length L, Width W, Height H, and characteristics impedance Z_0 at centre frequency 5.4GHz can be calculated by following calculation.

The initial design was done by hand to create a rough model in which to begin simulations. The equations are as listed below and sourced by:

$$\varepsilon_{eff} = (\varepsilon r+1)/2 + (\varepsilon r-1)/2[1+12(h/W))^{-1/2} \quad (1)$$

$$L=0.814\, h\, (\varepsilon_{eff} + 0.3)(\, W/h + 0.264) / \{ (\varepsilon_{eff} - 0.258)(W/h + 0.8)\} \quad (2)$$

$$W= 0.5\lambda 0/ \sqrt{(\varepsilon_{reff}+1)/2} \quad (3)$$

Characteristics impedance Z_0 are as:

When W/H ≥ 1

$$Z_0= 120\pi/\sqrt{(\varepsilon_{reff}[(W/H)+1.393+2/3\ln\{(W/H)+1.444\}]}$$

Due to fringing fields, the change in dimensions of length is given by:

$$\Delta L = \frac{0.412h\, [(\varepsilon_{reff}+0.3)*\{(W/H)+ 0.264\}]}{[(\varepsilon_{reff}-0.258)*\{(W/H)+ 0.8\}]} \quad (4)$$

Effective length $L_{eff} = L + 2\Delta L$

3.0 Design Specifications

The three essential parameters for the design of a rectangular Microstrip Patch Antenna are:

- Frequency of operation (f_0): The resonant frequency of the antenna must be selected appropriately. Hence the antenna designed must be able to operate in this frequency range. The resonant frequency selected for design is 5.4 GHz.
- Dielectric constant of the substrate ($\square_r$): The dielectric material selected for design are ($\square_r$ =*2.22, 4.84,9.6, 10.5*). A substrate with a high dielectric constant has been selected since it reduces the dimensions of the antenna.
- Height of dielectric substrate (*h*): For the micro strip patch antenna to be used in cellular phones also, it is essential that the antenna is not bulky. Hence, the height of the dielectric substrate is selected as 2 mm.

Hence, the essential parameters for the design are:

- f_0 = 5.4 GHz
- ε_r = 2.22, 4.84, 9.6, 10.5 • h = 2 mm

3.1 Schematic of patch antenna

Equivalent circuit or schematic of micro strip edge feed Patch antenna of 5.4 GHz. Micro strip patch antenna in ADS platform is shown in screen snapshot, Figure3.

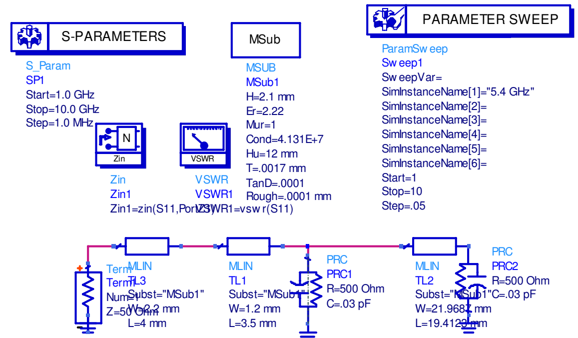

Fig:3 Overall Patch antenna schematics or equivalent circuit on ADS schematic window

Creating Layouts of the design for the microstrip patch antenna shown in fig.2 which is included all the necessary routes has transmission lines so the layout should be automatic and can be achieved by selecting layout-> generate.

4.0 Simulation and Results Analysis

Principle of operation of ADS momentum based on Finite Difference Time Domain (FDTD).
After performing the simulation, the results window open, choose the Rectangular Plot and smith chart plot, select the respective parameter for frequency 5.4 GHz .

Summary of parametric study results for four Substrate ($\square_r$ *=2.23,4.84, 9.6,10.5)* with Length , width and height at centre frequency 5.4 GHz in terms return losses S_{11} ,VSWR and Smith chart for impedance matching Z. Where $Z= Z_l/Z_0$, should be unity.

Antenna	**$\square_r$**	**L /W in mm**	**H in mm**	**S_{11}in db**	**VSWR**
1	**2.23**	**19.12/21.88**	**2**	**22.329**	**1.191**
2	4.84	13.62/16.25	2	14.581	1.635
3	9.6	9.17/11.94	2	12.76	2.113
4	10.5	8.57/11.58	2	8.99	1.774

Table:1

Simulated parameter S_{11} ,VSWR ,Smith chart or impedance matching Z_l/Z_0 and phase plot for ε_r =2.22 on Display window shown in figure 4.

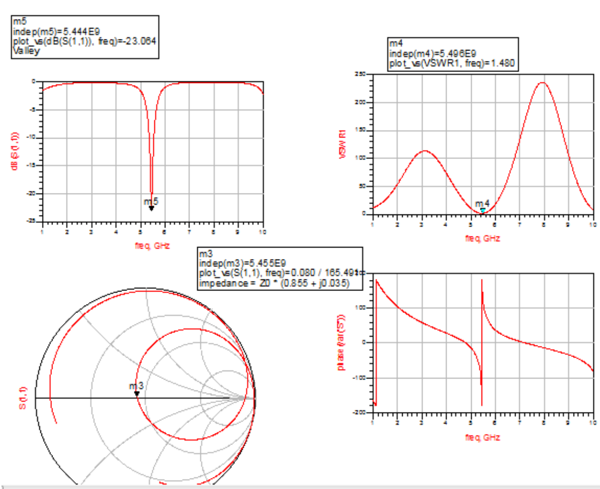

Figure: 4

In the fig. 4, $S_{11}$is -23db ,VSWR is 1.4 and Z is (.865 + 0.035) ohm at the frequency 5.44 GHz

Effect of changing height from 1.9mm to 5mm for the substrate material RT/Duriod 5870 with ε_r= 2.23 shown in table 2:

SN	H in mm	freq. *obtained-GHz*	S_{11} in- db	VSWR	$Z= Z_l/Z_0$
1	1.9	5.411	-15.623	1.4510	0.717-j.008
2	2.22	5.427	-23.046	1.210	0.895-j.109
3	**2.78**	**5.418**	**-35.682**	**1.079**	**1.000-j.012**
4	**2.88**	**5.425**	**-64.314**	**1.164**	**1.017-j.062**
5	3	5.463	-27.375	1.251	1.121-j.093
6	4	5.477	-17.501	1.467	1.364-j.067
7	5	5.485	-13.961	1.723	1.652-j.101

Table:2

Simulated parameter S_{11} ,VSWR ,Smith chart or impedance matching Z_l/Z_0 and phase plot for ε_r = 2.23 with height H= 2.78mm shown below in fig.5 .

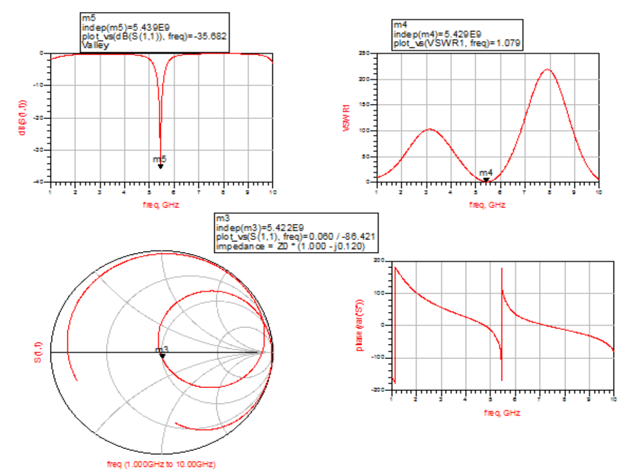

Figure: 5

Figure 5 shows , S_{11} is -35.682 db at center frequency 5.43GHz ,VSWR is 1.079 and impedance matching Z is (1.000-j0.120) ohm has been observed at frequency centered around 5.4GHz, which is used for WLAN application.

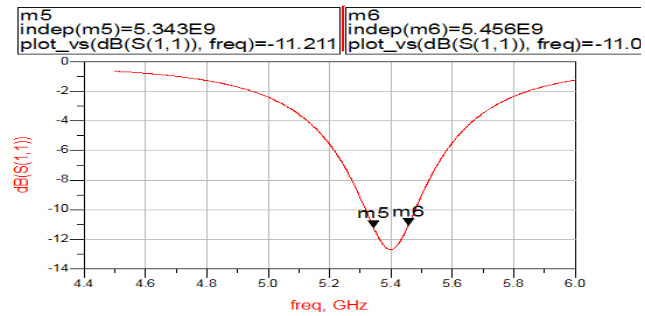

Fig: 6 Return lose ε_r= 4.84

The return loses S_{11} is -13db with frequency band 5.343GHz-5.5456GHz and bandwidth of 120 MHz has been achieved with ε_r =4.84 .

Conclusions

In this paper by using basic design methodology, compared four different Substrate materials for designing of the microstrip patch antenna. The materials which has been taken with dielectric constant ε_r =*2.23, 4.84, 9.6, 10.5).* It has been found from the above simulation results that the as Rogers RT/Duriod 5870 ε_r =2.23 for H=2.78mm gave good results in terms of different simulated parameter are given in table 1&2 and In the figure 4&5 **with S_{11} is -35.6db, VSWR is 1.079, Z is 1.00Ω.** This proposed design of micro strip antenna functioning for the WLL systems at 5.4 GHz has been obtained and analyzed.

Future aspect of this effective design of micro strip antenna (1) has to increase beam width and develop a microstrip patch array for the conformal antenna which is used for military application.

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