Simulation and Analysis of Circular Microstrip Patch Antenna for WiMAX Application Using C-Band

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Abstract- Micro strip antenna are preferred for majority of their applications This is because of the inherent advantages such as size miniaturization, power consumption, simplicity, compatibility with printed circuit technology, low profile, light weight, lower return loss, good radiation properties , small size, planar structure and ease of fabrication. C band are used in satellite communication, WiMAX, WLAN, Wi-Fi applications. This paper provides a comprehensive review of the research work done in the recent past by various authors on the design and optimization of the circular micro strip patch antenna with different slots operating in C band.

Keywords- Microstrip Patch Antenna, Circular Shape Patch Antenna, HFSS, VSWR, Return Loss, Radiation Pattern.

I. INTRODUCTION

The designed antenna consists of infinite Ground upon which an FR4 substrate is fabricated whose dielectric constant is 4.4 and a finally a circular patch has been fabricated on the top to produce radiation. There is a micro-strip feed to give excitation to the designed structure. Micro strip antenna are preferred for majority of their applications This is because of the inherent advantages such as size miniaturization, power consumption, simplicity, compatibility with printed circuit technology, low profile, light weight, lower return loss, good radiation properties , small size, planar structure and ease of fabrication. The Micro-strip patch antennas, as shown in Figure, the inner conductor of the coaxial connector extends through the ground plane.

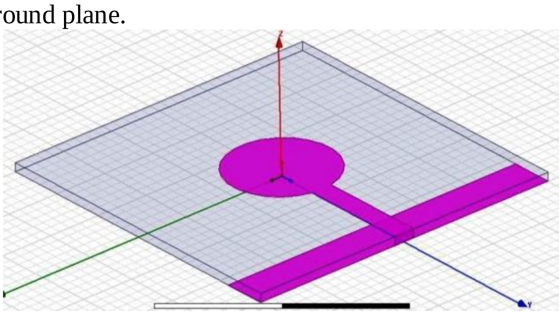


Fig 1: Circular Micro Strip Patch Antenna

II. ANTENNA GEOMETRY

There are some standard formulae which have to be followed to calculate the antenna design with Radius and Effective Radius of the Circular Micro strip Patch Antenna. They are as follows

The Actual Radius of the Patch is given by

$$a=\frac{F}{\left\{1+\frac{2h}{\pi\varepsilon r F}\left[\ln\left(\frac{\pi F}{2h}\right)+1.7726\right]\right|1/2\}}$$

Where

$$F=\frac{8.791\times10^{9}}{fr\sqrt{\varepsilon r}}$$

The Effective Radius of Patch is used given by

$$a_e=\left\{1+\frac{2h}{\pi\varepsilon r a}\left[\ln\left(\frac{\pi a}{2h}\right)+1.7726\right]\right|1/2\}$$

Hence, the Resonant Frequency for the Dominant Mode is given by

$$Fr=1.8412V_0/2\pi ae\sqrt{\varepsilon r}$$

h = height of the substrate

εr = dielectric constant (4.4)

C = speed of light ($3*10^{8} m/sec$)

The Conductance due to the Radiated Power of the Circular Micro Strip Patch Antenna can be Computed based on the Radiated Power.

The Conductance across the gap between the patch and Ground Plane $\varphi = 0\ Deg$.

III. DESIGN OF CIRCULAR MICROSTRIP PATCH ANTENNA

The circular patch is etched on the top substrate and the dual orthogonal apertures and feed lines are etched on the bottom substrate. Rohacell foam is sandwiched between the top (patch) and bottom (feed) layers for bandwidth enhancement. For the same objective, the height of the foam and the lengths and positions of the coupling apertures are optimized such that both the radiating circular patch and the coupling slots resonate at close frequencies. To increase the isolation between the two ports, the separation along the x direction between the apertures is optimized.

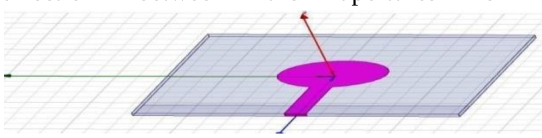


Fig2: Design of Circular Micro Strip Patch Antenna

IV.SIMULATION AND RESULTS

It is a parameter which indicates the amount of power that is “lost” to the load and does not return as a reflection.For optimum working such a graph must show a dip at the operating frequency and have a minimum dB value at this frequency. This parameter was found to be of crucial importance to our project as we sought to adjust the antenna dimensions for a fixed operating

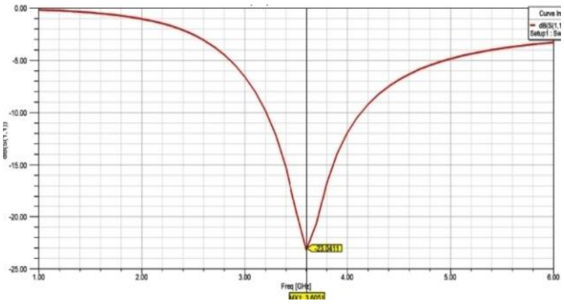


Fig 3: Graph for VSWR

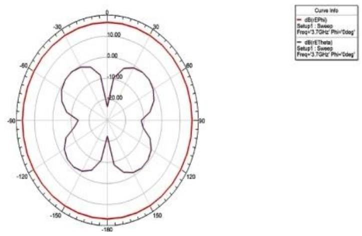
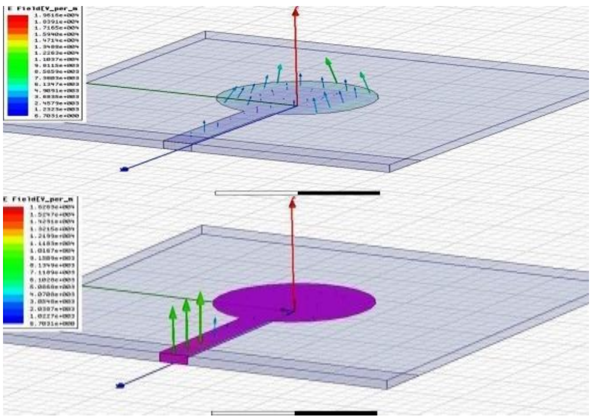


Fig 4: Radiation pattern

The radiation pattern of an antenna is a plot of the far-field by the elevation angle (θ) and the azimuth angle (φ).More specifically it is a plot of the power radiated from an antenna per unit solid angle which is nothing but the radiation intensity. Cartesian slice of this 3D graph. It is an extremely parameter as it shows the antenna's directivity as well as gain at various points in space. It serves as the signature of an antenna and one look at it is often enough to realize the antenna that produced it.



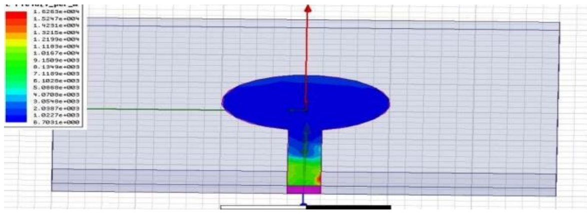


Fig 5: Electric & Magnetic Field Distribution

The current distribution plot gives the relationship between the co-polarization (desired) and cross-polarization (undesired) components. Moreover, it gives a clear picture as to the nature of polarization of the fields propagating through the patch antenna.

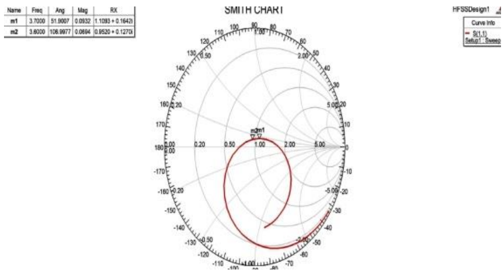


Fig 6: Graph of Smith Chart

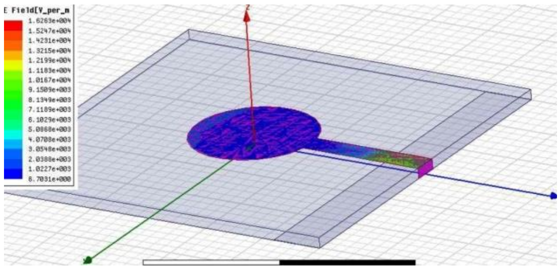


Fig 7: Polarization

Most antennas show a pattern of "lobes" or maxima of radiation. In a directive antenna, shown here, the largest lobe, in the desired direction of propagation, is called the "main lobe". The other lobes are called "side lobes" and usually represent radiation in unwanted directions. Once an answer is obtained through the graphical constructions described below, it is straightforward to convert between normalised impedance (or normalised admittance) and the corresponding un normalized value by multiplying by the characteristic impedance (admittance).

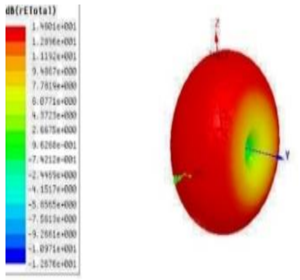


Fig 8: Gain 3D polar Plot

Gain is a measure of the ability of the antenna to direct the input power into radiation in a particular direction and is measured at the peak radiation intensity. Directivity and gain differ only by the efficiency, but directivity is easily estimated from patterns. Gain directivity times efficiency must be measured.

V. CONCLUSION

The Micro Strip patch antennas are most preferable antennas due to its inherent advantages like small size and weight, low cost, printed directly on the circuit board, low profile and easy to fabrication. The slotted antennas are used in C Band applications like satellite communication, WLAN, WiMAX, Wi-Fi etc. This paper describes about the introduction of different slots on the antenna have resulted in improvement of various performance parameters of the antenna like gain, bandwidth, return loss etc.

VI. REFERENCES

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