MICROSTRIP PATCH ANTENNA: CAD METHOLOGY

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ABSTRACT

Design and realization of microstrip patch antenna in Ka band at 8.5 GHz is reported in this research paper. It is shown that the design adopted for microstrip patch antenna is quite accurate. By using the conventional microwave integrated circuit fabrication technology the compact, light weight microstrip antenna can be realized. The microstrip antenna are designed and fabricated on the glass epoxy substrate of dielectric constant 4.22 and thickness of 1.6 mm. Simulation is done using the HFSS software to achieve the desired results. From simulated return loss plot, it is seen that antenna offers return loss of -24dB at a frequency of 8.5 GHz. From VSWR plot it is seen that antenna has a minimum VSWR of 1.2 at a frequency of 8.5 GHZ. From radiation pattern it is seen that antenna offers unidirectional radiation pattern. From smith chart it is seen that antenna offers real i.e. resistive impedance as well as capacitive and inductive impedance.

Key words- ***Micro strip patch antenna, VSWR, Return loss, smith chart, and radiation pattern.***

INTRODUCTION

The increasing effort in miniaturization of mobile communication equipments has inspired the development of small, low profile antenna suitable for implementation in portable devices. Whereas in past a single antenna element has been used for mobile transceivers, the desire to combat multipath fading has led to the use of multiple elements arranged in a suitable diversity scheme. When more than one element is used, an important design consideration is the effect of mutual coupling on the antenna-performance. [2]

Early handset treated the antenna as a bolt-on item, but the current trend is to integrate the antenna to within the body of the handset. The handsets are becoming smaller or more functionality is being packed into these units. This leaves little room for the antenna.
This is especially true inside the handsets where sub-assemblies can be held in place using low cost glass reinforced plastics.
The single biggest challenge with designing handset antenna is the time scale. The antenna can only be tuned once the plastic cases, electronics sub-assemblies and substrates became available. That means that the early investigative studies have to use prototype components and this can cause errors.

Micro strip patch antenna structure is planned in configurations and enjoys all the advantages of substrate technology. It is small in size, low weight, easy to manufacture on mass scale with low manufacturing cost. It can also be applied to the metallic surface on an aircraft or missile and does not disturb aerodynamic flow and thus has better aerodynamic properties. Linear and circular polarization are possible with simply changing the feed position [3],[4].

Telemetry and communication antennas on missile are often of microstrip type, small arrays. Small arrays of microstrip radiator are used for radar altimeter antenna applications including satellite and mobile telephone communication.
Microstrip antenna has also been used as communication link between ship and satellites

such as GEOS. Smart weapon system use microstrip antenna because of their thin profile and low cost. One of most important application of microstrip antenna at present is in GPS system and in RFID,TAGs, MOBILES and WIFI applications [4] [6].

II. FEED NETWORK

Feed used for this microstrip patch antenna is Wilkins power divider type. By using formulae for W,L in terms of ϵ_r, ϵ_{reff} and fr feed, dimensions are calculated. Microstrip Willkinson's power divider gives signal amplitude equally to two microstrip patch antenna. Also willkinson's power divider transforms 150Ω impedance present at antenna, into 50Ω impedance. This 50 Ω impedance is known as terminating impedance [5][1].

Width of 50 Ω microstrip line is 3 mm and length is 5 mm. After this matching line has a length of 15 mm and width of 2 mm. Then 100 Ω impedance microstrip line has width of 3mm and length 13 mm. Lastly, there is a matching line whose length is 3 mm and width is 0.5 mm. Impedance present at antenna is 150 Ω that is transformed to 50 Ω impedance which is known as terminating impedance. When terminating impedance matches with probe impedance then power delivered to micro strip antenna is maximum. [7][1].

III. ANTENNA CONFIGURATION

The design of the microstrip patch antenna begins with choice of substrate, selecting feed mechanism, determining patch length L and width W and selecting the feed location. Here micro strip patch antenna of length L= 9 mm and Width W= 6mm and height of substrate 1.6 mm is designed by using standard formulae and then these parameters and dielectric constant of substrate ϵ_r =4.22 and Wilkinson's power divider dimensions mentioned above are simulated in HFSS software. Actual fabricated antenna is shown in Figure 1 & simulated antenna shown in Figure 2 [7].

After simulating microstrip antenna in HFSS

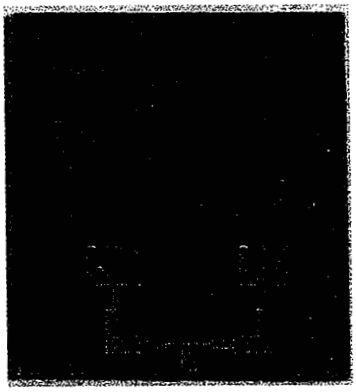

Figure 1. Actual fabricated Antenna.

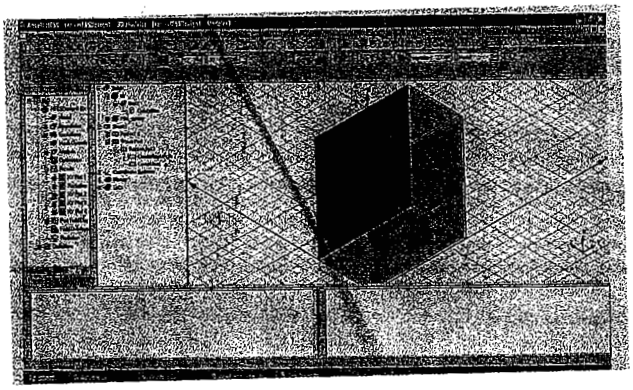

Figure 2. Actual fabricated Antenna.

IV. RESULTS AND MEARSUEMENTS:-

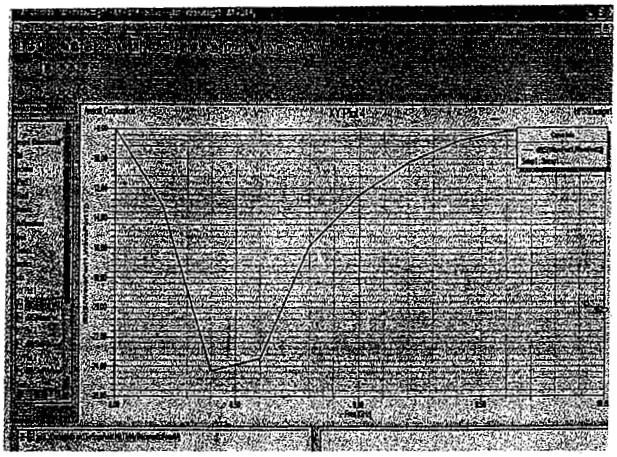

Figure 3. Return loss vs frequency Plot.

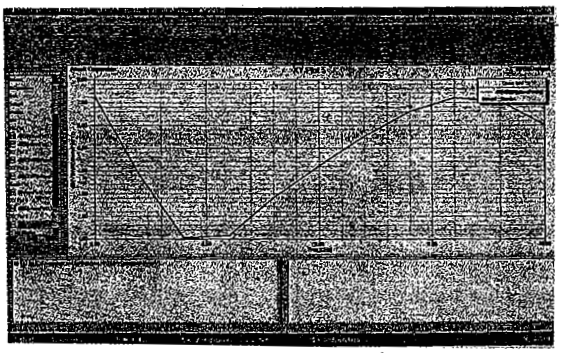

Figure 4. Return loss vs frequency Plot.

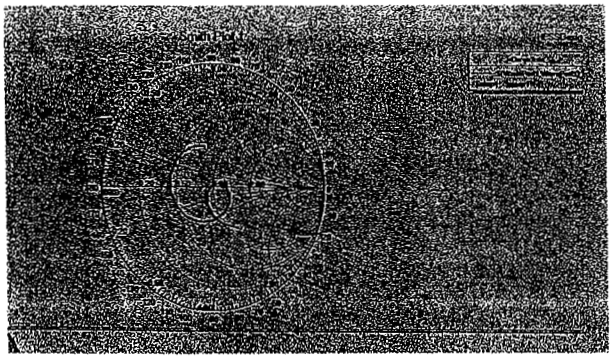

Figure 5. Smith Chart

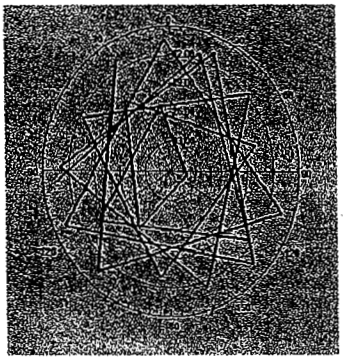

Figure 6. Radiation Pattern.

software, following parameters are presented.
From Figure. 3 it is seen that return loss is -24 dB at a frequency of 8.5 GHz. From this result it is seen that antenna radiates satisfactorily since return loss is -24 dB.
From Figure.4 it is seen that antenna offers VSWR to be 1.2 at a frequency of 8.5 GHz.
From smith chart it is seen that antenna offers impedance to be resistive, capacitive and inductive also. From radiation pattern it is seen that antenna offers unidirectional radiation pattern. Unidirectional radiation pattern plays important role in mobile communication. [7].

V. CONCLUSION

The purpose of this paper was to present some of the challenges of designing antennas integrated into modern handset.

It can be seen that the design adopted for the antenna in this research paper are accurate. This antenna can be used at 8.5 GHz for radar and military applications.
For the antenna to radiate sufficient power the VSWR must be less than two and return loss must be less than +10 dB, only then the antenna radiates or receives power with minimum reflection. As the designed antenna has a return loss of -24 dB and VSWR 1.2 with slight shift in Frequency. So this antenna is best with sufficient band width.
The shift is that the actually designed frequency and actual measured frequency could be attributed due to low quality substrate used.

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