Modelling and Simulation of Rectangular Micro-Strip Patch Antenna for L Band Applications

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***Abstract*—This Paper presents design and simulation of rectangular micro strip patch antenna in L band for its attractive usage and applications the design is performed by taking thickness of 1.59mm and FR4 substrate with dielectric constant of 4.3, and frequency 1.66GHz. In the recent years due to huge development in communication systems requires the development of low cost, minimal weight, low profile antennas that are capable of maintaining high performance over a wide spectrum of frequency. This technological trend has focused much effort into the design of a Microstrip patch antenna. The proposed antenna design on different dielectric substrate and analyse the result of all operating frequency between 1GHz to 2GHz, this proposed design antenna at 1.66GHz operating frequency. At this frequency the performance obtained is good and efficient.**

***Keywords*— Antenna, CST, VSWR, Return loss, Directivity.**

I. INTRODUCTION

In this paper the design consideration for the rectangular micro-strip antenna has been presented. In modern wireless communication systems, the micro-strip patch antennas are commonly used in the wireless devices. Therefore, the miniaturization of the antenna has become an important issue in reducing the volume of entire communication system. The various parameters of rectangular micro-strip antenna, input impedance, VSWR, return loss, radiation pattern have been investigated as a function of frequency for proper matching and radiations. The proposed antenna is designed having parameters, height of 1.59mm from the ground plane and this design for operating frequency of 1.66GHz. The entire simulation work is done on CST software. In the recent years the development in communication systems requires the development of low cost, minimal weight, low profile antennas that are capable of maintaining high performance over a wide spectrum of frequencies the performance of the antenna was measured and compared with two type of substrate material (FR4, Roger and Arnol).

II. MICRO-STRIP PATCH ANTENNA

In telecommunication, there are several types of micro strip antennas (also known as printed antennas) the most common of which is the micro-strip patch antenna or patch antenna. The micro strip antenna was first proposed by G.A. Deschamps in 1953, but didn't become practical until the 1970s when it was developed by researchers such as Robert E. Munson and others using low-loss soft substrate materials that were just becoming available. A micro-strip or patch antenna is a low profile antenna that has a number of advantages over other antennas it is light weighted, inexpensive, and easy to integrate with accompanying electronics. In its most basic form, a Micro strip patch antenna consists of a radiating patch on one side of a dielectric substrate which has a ground plane on the other side as shown in Figure 1. The patch is generally made of conducting material such as copper or gold and can take any possible shape. The radiating patch and the feed are usually photo etched on the dielectric substrate.

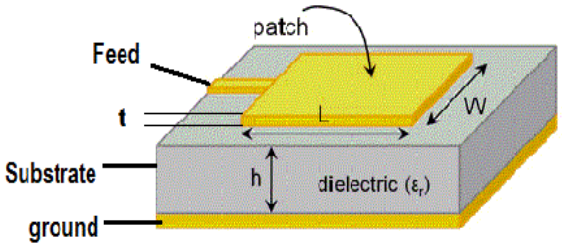

Fig. 1. Micro Strip Patch Antenna

III. L-BAND (1-2 GHZ)

Being a relatively low frequency, L-band is easier to process, requiring less sophisticated and less expensive RF equipment, and due to a wider beam width, the pointing accuracy of the antenna does not have to be as accurate as the higher bands. Only a small portion (1.3-1.7Ghz) of L-Band is allocated to satellite communications. L-Band is also used for low earth orbit satellites, military satellites, and terrestrial wireless connections like GSM mobile phones. It is also used as an intermediate frequency for satellite TV where the Ku or Ka band signals are down-converted to L-Band at the antenna LNB, to make it easier to transport from the antenna to the below deck, or indoor equipment.

IV. FEED TECHNIQUES

Micro-strip patch antennas can be fed by a variety of methods. These methods can be classified into two categories-contacting and non-contacting. In the contacting method, the RF power is 34 fed directly to the radiating patch using a connecting element such as a micro-strip line. In the non-contacting scheme, electromagnetic field coupling is done to transfer power between the micro-strip line and the radiating

patch [4]. The four most popular feed techniques used are the micro-strip line, coaxial probe (both contacting schemes), aperture coupling and proximity coupling (both non-contacting schemes).

Table 1. Characteristics of the different feed techniques

Characteristics	***Micro strip Line Feed***	***Coaxial Feed***	***Aperture coupled Feed***	***Proximity Coupled Feed***
Spurious Feed Radiation	More	More	Less	Minimum
Reliability	Better	Poor due to soldering	Good	Good
Ease of Fabrication	Easy	Soldering and De-soldering needed	Alignment Required	Alignment Required
Impedance Matching	Easy	Easy	Easy	Easy
Bandwidth	2-5%	2-5%	2-5%	13%

V. DESIGN AND SIMULATION FOR L-BAND RECTANGULAR MICRO-STRIP PATCH ANTENNA

The proposed antenna is designed at the height of 1.59mm from the ground plane and this design is operated at 1.66GHz. The entire simulation work is done on CST software. CST MWS allows us to choose the best technique for each application. The transient solver could be best for wideband or planar antenna. Computer simulation can allow you to see how a system might respond before you design or modify it.

A. Design Parameters

The resonant frequency is 1.66GHz. The dimensions taken to design the rectangular micro-strip patch antenna are shown in table 2

Table 2. Design Parameters for rectangular micro-strip patch antenna

Design Parameters	**Length**	**Width**	**Height**	**Material Used**
Ground	40	20	0.03	PEC
Substrate	40	20	1.53	FR-4 (lossy).
Patch Ring	15	16	0.03	PEC
Patch Loop	11	12	0.03	PEC
Inset Feed	28	1	0.03	PEC

B. Stimulated results

The simulation results of the L band Micro strip patch antenna using CST are shown in following Figures. FR4 lossy material is used as a substrate. Its relative permittivity is 4.3. The designed antenna giving resonates at the desired frequency which is 1.66 GHz. At the resonant frequency the input reflection coefficient has the minimum magnitude which is about -15.370 dB.

1) VSWR

The value of VSWR should be between 1 and 2 for efficient performance of an antenna VSWR 1.4107984.

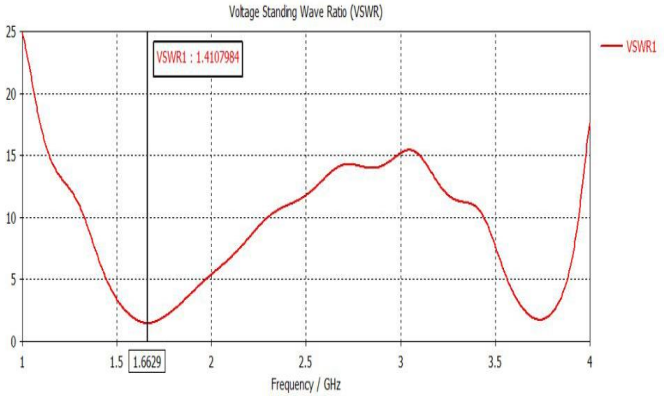

Fig.2: VSWR plot for the substrate FR-4

2) Return Loss and Antenna Band Width

For an antenna to radiate effectively, the return loss should be less than−10Db. Figure shows the S11 parameters (return loss) for the proposed antenna resonates at 1.66GHz having value of -15.370dB.

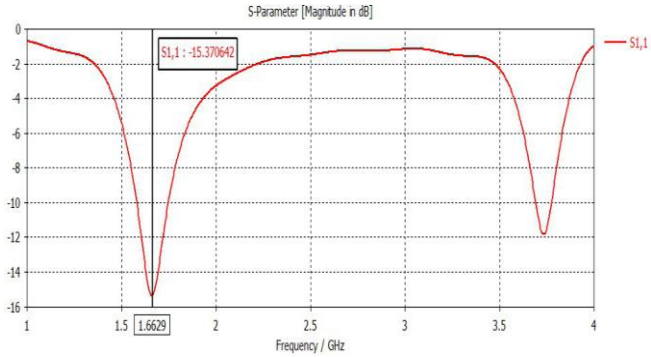

Fig.3: Return loss Vs Frequency graph for FR-4

3) Compare all three Substrate's output Freuency Responce:

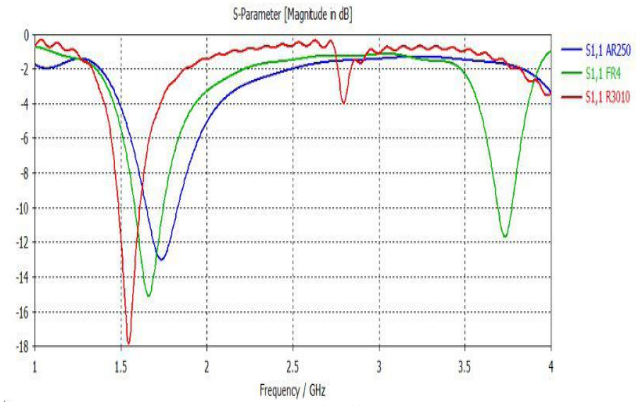

Fig.3: Comparison of different substrates

VI. CONCLUSION

In this work the design of L Band (1-2 GHz) micro-strip antenna has been carried out and a compact L-band Micro strip patch antenna for telecommunication and GPS applications is being presented. Compared to many antennas proposed earlier, this antenna is designed based on a simple structure and suitable for L frequency bands of Satellite Phones and GPS applications simultaneously. The measured

results show that At resonant frequencies of 1.66GHz the return loss(S- Parameter) is -15.370dB, VSWR is 1.4107984, radiation efficiency is - .3011db directivity is 2.269dBi respectively, good enough for L-Band application. As the designed antenna meeting the requirements of GSM application, it could be highly useful for mobile application. By changing substrate material we can see that the resonant frequency of designed antenna also changed and as dielectric constant of substrate increases the resonant frequency decreases.

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