Design of X-Band Microstrip Patch Antenna for Doppler Radar Applications

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***Abstract*— In the recent years the development in communication systems requires the development of low cost, minimal weight and low profile antennas that are capable of maintaining high performance over a wide spectrum of frequencies. This technological trend has focused much effort into the design of a microstrip patch antenna. The objective of this paper is to design an microstrip line fed rectangular microstrip patch antenna which operates in C-band at 5GHz. Therefore, method of moments based IE3D software is used to design a Microstrip Patch Antenna with enhanced gain and bandwidth. IE3D is an integrated full-wave electromagnetic simulation and optimization package for the analysis and design of 3D and planar microwave circuits, MMIC, RFIC, RFID, antennas, digital circuits and high speed Printed Circuit Board (PCB). The IE3D has become the most versatile, easy to use, efficient and accurate electromagnetic simulation tool. The length of the antenna is nearly half wavelength in the dielectric it is a very critical parameter, which governs the resonant frequency of the antenna. In view of design, selection of the patch width and length are the major parameters along with the feed line dimensions. Desired patch antenna design was simulated by IE3D simulator program**

***Keywords*— Communication system, Radiation Pattern, Microstrip patch antenna, Doppler RADAR system, Resonant frequency, Return Loss, VSWR, Antenna.**

I. INTRODUCTION

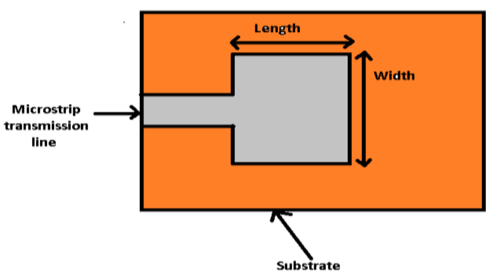
Communication between humans was first by sound through voice.With the desire for slightly more distance communication came,devices such as drums,then visual methods such as signal flags and smoke signals were used.These optical communication devices,of course, utilized the light portion of the electromagnetic spectrum. It has been only very recent in human history that the electromagnetic spectrum, outside the visible region, has been employed for communication, through the use of radio. One of humankind's greatest natural resources is the electromagnetic spectrum and the antenna has been instrumental in harnessing this resource.

Microstrip patch antenna used to send onboard parameters of article to the ground while flight. The aim of the thesis is to Design and fabricate a coaxial fed rectangular Microstrip Antenna and study the effect of antenna dimensions Length (L),Width (W) and substrate parameters relative Dielectric constant(ε_r),substrate thickness on Radiation parameters of Band width and Beam width.

II. EXISTING SYSTEM

Antenna is develop In order to fulfill the problem occur and upgraded the antenna for the advanced technologies. A conventional antenna is very hard to design compared to microstrip antenna.

A conventional antenna is very costly and quite heavy but the microstrip patch antenna has simple structure and quite easy to fabricated. There are many shape of microstrip patch antenna such as rectangular, circular, triangular and other types of geometries. The most popular configuration is rectangular microstrip patch antenna In order to produce antenna Radar application, based on the factor, a rectangular microstrip patch antenna will be designed. This project will used the Flame Retardant 4 (FR4) and Roger4350 as a dielectric substrate in fabrication of the antenna.



Structure of a microstrip patch antenna.

III. PROPOSED SYSTEM

Varied techniques are planned to make multi-band or broadband styles. One ordinarily used approach is using multiple branches to excite many resonant modes. Another well-liked technique is that the coupled feed, that provides a convenient matching standardization mechanism

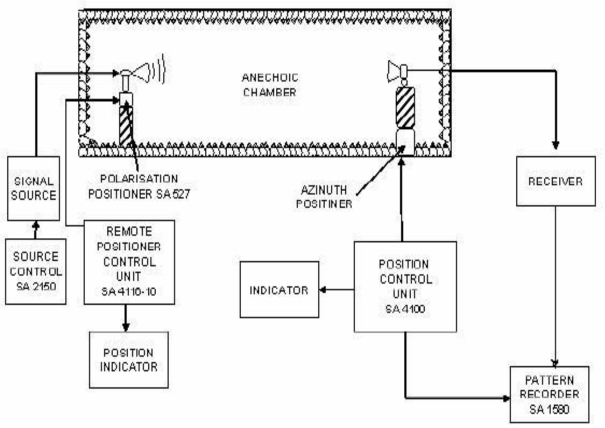


Figure (2.5) . Experimental setup for plotting Radiation Pattern.

A micro strip antenna in its simplest configurations consists of a radiating patch on one side of the dielectric substrate and a ground plane on the other side. The patch conductor, normally of copper or gold, can be of any shape like rectangle, circle, triangle etc. This work considers rectangular and circular patches only. Radiation from a patch antenna depends upon the substrate parameters such as dielectric thickness, relative dielectric constant and loss tangent etc.

IV. PHASES IN THE PROPOSED SYSTEM

(i)Input impedance: The input impedance or admittance of a micro strip radiator is an essential parameter and it should be accurately known so as to provide a good match between the element and the feed.

(ii)Q-factor and Losses: The Q-factor of the antenna is primarily affected by the substrate thickness, dielectric constant and loss tangent. The main losses are through
radiation, surface wave generation, dielectric losses and conductor losses. The associated Q-factors are: Q_r, Q_s, Q_d and Q_c respectively. The overall Q is given by

$$\frac{1}{Q_T} = \frac{1}{Q_r} + \frac{1}{Q_s} + \frac{1}{Q_d} + \frac{1}{Q_c} \quad (2.1)$$

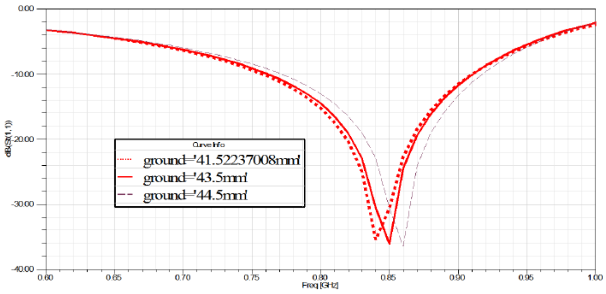
For optimal bandwidth the overall Q (i.e., Q_T) must be minimized i.e., the losses should remain small.

(iii)Bandwidth: The bandwidth (B) of a micro strip antenna for a feed line VSWR < S can be shown to be

$$BW = \frac{S-1}{Q_T\sqrt{S}} \quad (2.2)$$

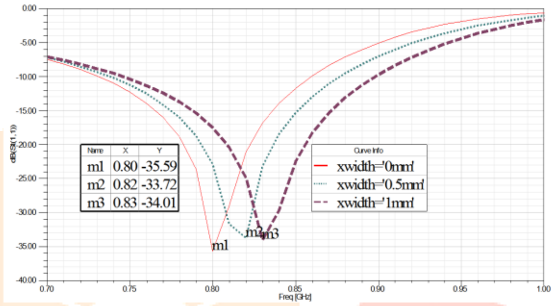
Where Q_T is the total quality factor. A typical plot of BW for a micro strip element of VSWR < 2 is shown in Fig 2.3. For a given frequency, larger bandwidth is possible by choosing a thicker substrate. The curves also indicate that a lower of ε_r also results in a larger bandwidth.

Step 1:- Change the height of the ground from 40 mm to 50 mm with step 0.5m and fix the other parameters. The simulation result of return loss S11 is shown in Figure 3



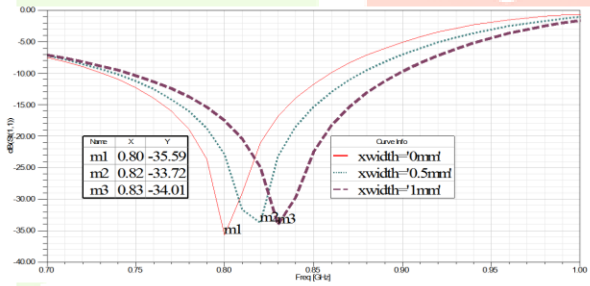
Return loss

Fig. 3 shows that the resonant frequency is increasing when the height of the ground is increased. The best result is obtained when the ground height is 41.5 mm, where it has the bandwidth of 155 MHz. In the next step we study the effect of the other parameters.



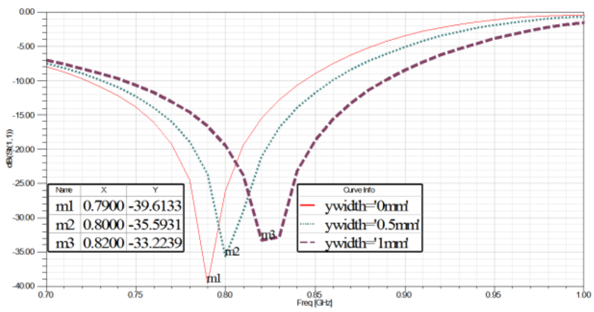
Return loss for the different values for The Width w1

Step 2:- Choosing the optimum result of S11 from step 1 (height of the ground is 41.5 mm), and varying the width w1by a step of 0.5 mm from 0.0 mm to 2.5 mm and fixing the other parameters. The return loss is shown in Figure 3.5. It can be seen that when the width w1 is increasing, the resonant frequency is also increasing. In this case, increasing width w1 could affect the resonant frequency and bandwidth as shown in Figure 3.5, where the best value is obtained when increasing w1 is 0.0 mm. The resonant frequency is 0.8 GHz, the bandwidth is 130 MHz and the maximum gain for the entire phi and theta is shown in Figure 4.0 and 4.1. Now in the next step we study the effect of the other parameters.



Return loss for the different values for the width w1

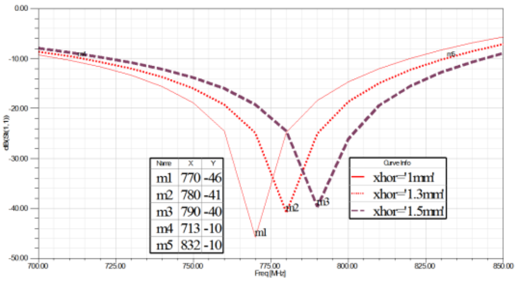
Step 3:- Choosing the optimum result of S11 from step 1 (height of the ground is 41.5 mm and w1=0.0 mm), and vary width w2 by step 0.5 mm from 0.0 mm to 2.5 mm and fix all other parameters.The characteristic of the return loss is shown in Figure 3.8. It is shown that, when the width w2 is increasing, the resonant frequency increases. In this case, increasing width w2 could affect the resonant frequency and bandwidth, where the best value is found when increasing w2 equal 0.0 mm too, where the resonant frequency is 0.79 GHz, the bandwidth is 130 MHz and the maximum gain at the resonant frequency for entire phi and theta is shown in Figure 3.6 and 3.7. Now in the next step we will parameterize the width w3.



Return loss for varying the width

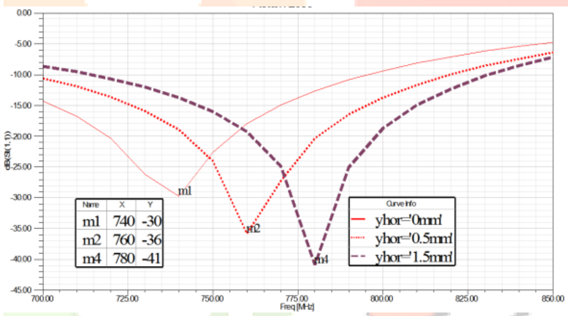
Step 4:- Choosing the optimum result of S11 from step 3 (height of the ground is 41.5, w1=0.0 and w2 =0.0 mm), and vary width w3 by step up 0.5 mm from 0.0 mm to 2.5 mm and fix all other parameters.

- The characteristic of return loss is shown in Figure 3.7. It is shown also that, when the width w3 is increasing, the resonant frequency increases. In this case, increasing width w3 could affect the resonant frequency and bandwidth, where the best value is found when w3 equal 1.3 mm, where the resonant frequency is 0.78 GHz, the bandwidth is 120 MHz and the maximum gain at the resonant frequency for entire phi and theta is shown in Figure 3.12 and 3.13. Now in the next step we will parameterize the width w4.

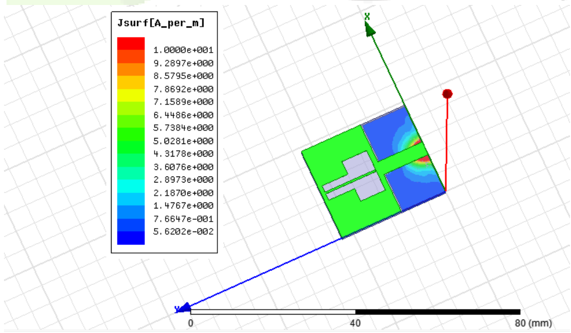


Return loss for the different width of 'w'

Step 5:- Choosing the optimum result of S11 from step 3 (height of the ground is 41.5 mm, w1=0.0, w2= 0.0 mm and w3=1.3 mm), and vary width w4 by step up 0.5 mm from 0.0 mm to 2.5 mm and fix all other parameters. Finally, the characteristic of return loss is shown in Figure 3.14. It is shown that, when the width w4 is increasing, the resonant frequency is increasing. In this case, increasing width w4 could affect the resonant frequency and bandwidth as shown in Figure 3.15, where the best value is found when w4 equal 1.5 mm, where the resonant frequency is 0.78 GHz, the bandwidth is 120 MHz and the maximum gain at the resonant frequency for entire phi and theta is shown in Figure 3.16 and 3.17. The final design of the MLA is shown in Figure 3.17 where the return loss and the gain are shown in Figure 3.18 and Figure 3.19 respectively. But



Return loss for the different width and height



The final design for the MMP using parametric study

Patch design: A rectangular patch for the aperture coupled mictrostrip patch phased array was designed as shown in [4]

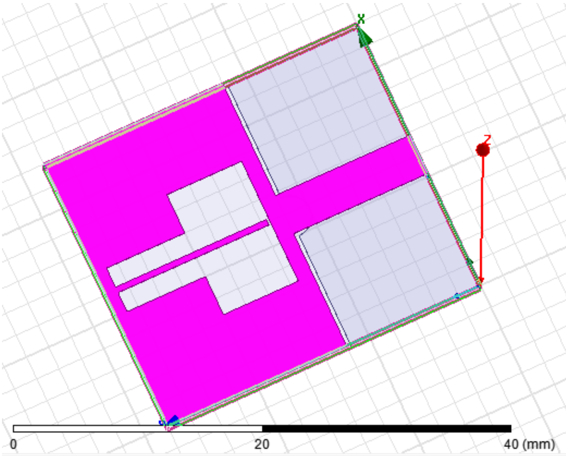


Fig.1 Multiband Micro strip Patch Antenna for LTE

Parametric analysis: Parametric studies were conducted to verify assumed antenna operation mechanisms and to derive antenna tuning guidelines.

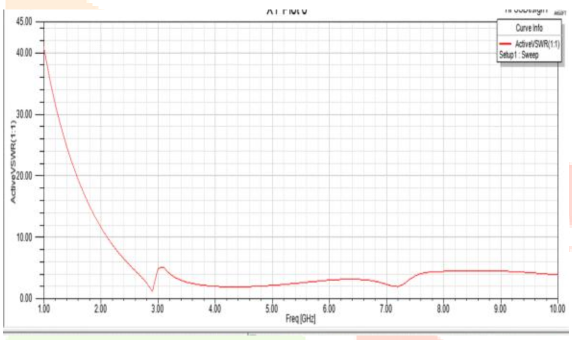


Fig.2 VSWR plot

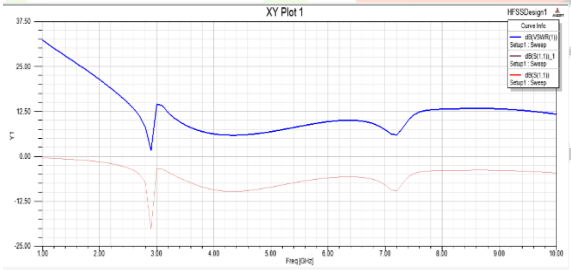


Fig.3 The return loss for the final design for the

V.CONCLUSION

In this Project work, a printed antenna is designed using meander line technique to demonstrated lager impedance bandwidth for considerably small dimensions. Two types of Multiband Microstrip Patch antennas have been studied in this report. The first type is the design of MMP for LTE mobile application in 0.78 GHz band and the second is the design of T-shape MMP for LTE mobile application in 2.9 GHz band. The first contribution of this Project work, we analysis and design MMP for LTE mobile application in 0.78 GHz band that has a correct selection of MMP dimensions that deal with it. And we show that as tabulated in the conclusion section of chapter 3, The MLA in this research has better gain comparing with MLA was used for it.The second contribution of this research work is to analysis and design T-shape MLA for LTE mobile handsets in 2.5 GHz band, where is the new shape antenna developed from the original MMP. We used in this thesis two techniques: the first technique is parametric study where study each variable in the antenna then study the effect each of them on the antenna, after that go to other type and make the work until finish all the variables. We show the results from this technique is a good method for enhancement the gain an the bandwidth and gives optimal solution.

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