Multi-Band Microstrip Patch Antennas for Wireless Mobile Applications

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***Abstract* ---Microstrip antennas have becoming a rapidly booming area of research. It has got limitless and broad applications, due to their minimum weight, small size, and easy for manufacturing. One limitation is their inherently narrow bandwidth. Recent research has found ways of overcoming this obstacle. In this paper, we have designed a methods for multi-band terminal antennas using a single microstrip patch for UHF band is presented. The multi-band microstrip patch antenna have been designed with the three-band central frequencies. . Therefore, the antennas proposed in this paper can be used for various kinds of a mobile communication applications This design has three working bands centered around 1.3GHz, 2.5 GHz and 2.9GHz with S-shaped patch. Design results aresimulated for VSWR and return loss S_{11} in this paper. Simulation results are obtained by a Advanced Design System (ADS),the world's leading electronic design automation software for RF, microwave,and high speed digital applications. The innovative and commercially successful technologies to calculate S parameters and 3D EM simulators,**

Key words —Microstrip, Multiband, S-Shaped Advanced Design System

I INTRODUCTION

Recently, Microstrip patch antennas are largely used because of their excellence, such as the low profile, less Weight and conformity. But the drawback is narrow band width is in patch antenna. Researchers have made many efforts to overcome this problem and many layouts have been presented to extend the bandwidth [1][2]. In recent, radio communication domain is largely used by mobile telecommunication terminals. The minimization, efficiency, and accuracy of the mobile phone's antennas will create demanded a new design technologies progress in future. The expected application area regarding the mobile telecommunication terminal antenna with development of RF communication is expanding quickly. In that, the size reduction and an application characteristic of the antenna and the research regarding the multi-band performance in a simple patch antenna are being studies actively [3][4]. This multi band antenna system will be able to communicate for differenent frequencies simultaneously But the narrow band width is drawback in patch antenna. Multiband antennas control an input and output signal at multiple and above duplication.

It is like that it will be able to improve the ability which the single band radio system of existing has a lot. Also this contributes to the minimization of terminal size. Instead of using many antennas for multi signals, it is better to use single multiband antenna. As the use of this production, the cost of the terminal is expected to be reduced as well.

II. DESIGN AND MODELING

The design method adapted for our antenna. Initially conventional patch length and width is designed. After designing the patch, we made two slits in the patch to make it S-shape patch. Basic length and width is designed with the use of following equations.

$$W = \frac{c}{2f\sqrt{\frac{\varepsilon_r + 1}{2}}} \qquad (1)$$

Width of the patch is designed using the equation (1), here f_0 is the center frequency, ε_r is relative permittivity and c is speed of light.

$$L_{eff} = \frac{c}{2f\sqrt{\varepsilon_{reff}}} \qquad (2)$$

$$\varepsilon_{reff} = \frac{\varepsilon_r+1}{2} + \frac{\varepsilon_r-1}{2}\left[1 + 12\frac{h}{W}\right]^{-\frac{1}{2}} \qquad (3)$$

$$\Delta L = 0.412h\frac{(\varepsilon_{reff}+0.3)\left(\frac{W}{h}+0.264\right)}{(\varepsilon_{reff}-0.258)\left(\frac{W}{h}+0.8\right)} \qquad (4)$$

$$L = L_{eff} - 2\Delta L \qquad (5)$$

Here equations (1-5) are used to design the Length of the patch where h is the thickness of substrate. Using these equations we have designed length and width of conventional patch here. A square patch so length and width are same and it is 50 mm, so a square patch is 50×50 mm^2 is designed shown in Figure 1. We have made out two slits from the patch to make it S-shape and to improve the results as shown in figure. The dimension of the slits is 30×10mm^2

The top view and side view of the design is shown in Figure 1(a) and 1(b) respectively.

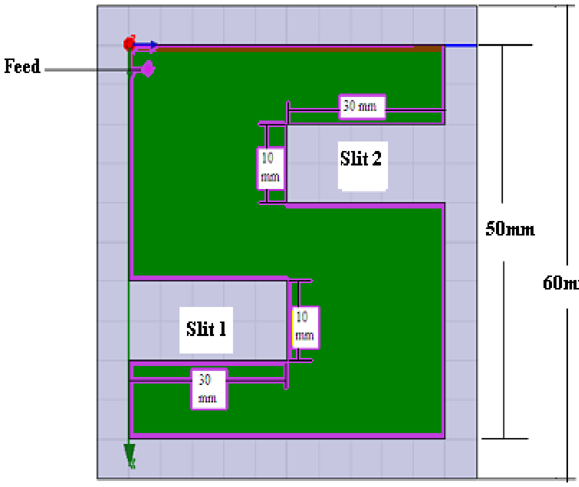

Figure 1a. Top view of the design of the patch

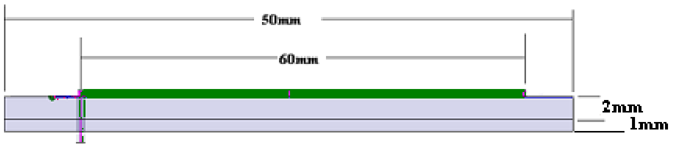

Figure 1b. Side view of the design of the patch

Table: I Material of patch antenna

Material	
Copper	Patch
FR4 epoxy with ε=	Substrate

Material details shown in Table I. Patch is of copper material. Substrate is of FR4 epoxy material with ε=4.4. The base material is also of copper.

III. SIMULATION RESULTS

For simulation we used Advanced Design System ,the world's leading electronic design automation software for RF, and microwave applications. ADS provides full, standards-based design and verification with Wireless Libraries and circuit-system-EM co-simulation in an integrated platform.After simulating the design he result we got is as follows. Figure 2 is the Return Loss (S_{11}) shown for different bands with their frequency in dB .Table II shows values of. The minimum return loss which we are getting for this design is -19 dB for the second band centered around 2.5GHz

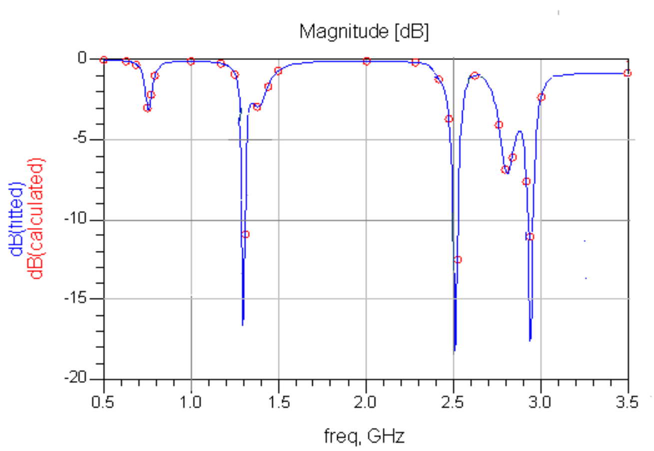

Figure 2 Return Losses (S_{11})

Table II (S_{11}) Values- Return Loss

Frequency	Band	(S_{11})-Minimum Return Loss in db(-ve) Values
1.3 GHz	I	-17
2.5 GHz	II	-19
2.9 GHz	III	-18

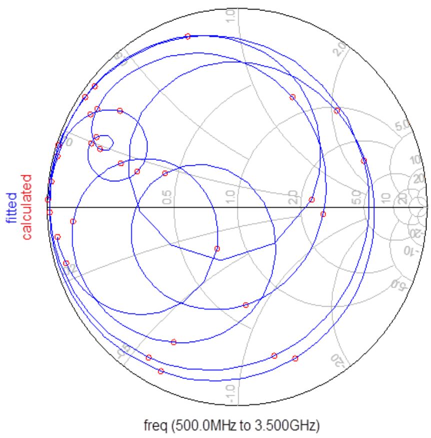

Figure 3 Smith Chart for VSWR)

Table III shows the voltage standing wave ratio (VSWR)
for different band with frequencies. For full range of band VSWR is less than 2 and lowest VSWR for the design is 1.253 for the second band centered around 2.5 GHz.

Table III VSWR Values

Frequency in GHz	Band	VSWR
1.3 GHZ	I	1.329
2.5 GHz	II	1.253
2.9 GHz	III	1.288

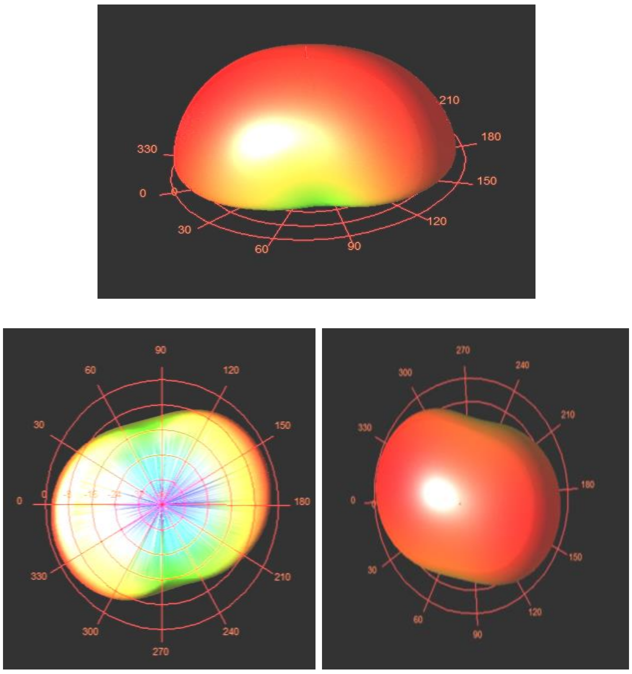

Fig 4 Simulated Radiation Patterns

IV. CONCLUSION

In this paper, the small three-band microstrip patch antennas are presented. The antenna is designed to be used in multi-band system, covering the RF and the mobile communication band. The modeling and repeated simulations are carried out at center frequency of 2.5 GHz. The result indicates the three bands so the antenna can used for L Band and S Band Applications. In future the design modification can be done for other multiband applications in C Band, X Band and other bands. The results are in very good agreement with the standard published antenna-requirements with respect to ease of fabrication, compactness and volume miniaturization compared to other antennas so far designed for similar applications.

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