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Design and Implementation of E-shaped Antenna for GSM/3GApplications

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Abstract: **The proposed E-shaped Microstrip patch antenna is designed for GSM and 3G applications. For this E Shaped antenna simulated results for main parameters such as return loss, bandwidth, radiation patterns and gains are also discussed here. In the simulation we achieved fr=1.2 GHz, Gain=5.68, Directivity=6.74 and Return losses = -23.62 dB. By changing feeding points fr=1.5GHz, Return Loss= - 29 dB was achieved for GSM Band and fr=1.9 GHz, Return loss =-32dB for 3 G band after fabrication. The Designing & simulation of this antenna is done in ADS Software and fabricated antenna was tested by network analyzer.**

Keywords: **GSM, 3G, Microstrip Antenna, GPS, ADS**

I. INTRODUCTION

Global System for Mobile communications (GSM) is most widely used for three digital wireless telephony technologies. It is used for transmitting mobile, voice and data services. GSM is operated in the frequency range of 900MHz or 1800MHz. 3G networks are wide area cellular telephone networks which are used in voice and video telephony and mobile internet access at high speed. It offers large capacity and broadband capabilities and achieves and improves spectrum efficiency through wireless network.This work is focused on designing an Microstrip antenna for GSM applications

The Microstrip patch antennas consist of a metallic patch on a ground plane. The metallic patch can take many different configurations, such as horn, cone, rectangle, circular etc. The most popular are rectangular and circular patches because of the ease of analysis and fabrication, and their attractive radiation characteristics, especially low cross polarization.

The microstrip antennas are low profile, simple and in expensive to fabricate using modern circuit technology. They are very versatile in terms of resonant frequency, polarization, pattern and impedance. Microstrip antennas are also known as “Printed antennas”. These are mostly used at microwave frequencies, because the size of the antenna is directly tied to the wavelength at the resonant frequency. These antennas can be mounted on the surface of high performance aircraft, spacecraft, satellites, missiles, cars and even handheld mobile phones.

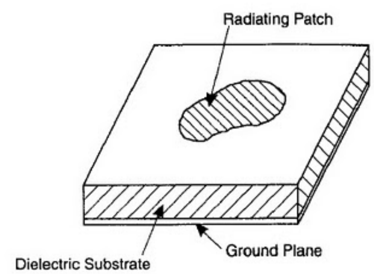

Fig.1 Microstrip Patch Antenna

The antenna patch can be made either of copper or gold. Here in this ADS software copper has been taken by default as the patch material. Patch material is in the form of E shape. The pattern seems to be of particular English alphabet 'E'. The rectangular patch, with dimensions of 60 mm ×72mm is supported by allow dielectric substrate with dielectric permittivity with material FR4. The material FR4 is a dielectric component that is already defined in the ADS library. It is having the dielectric constant as 4.4 the substrate height is of much importance for the perfect matching of antenna impedance with the line feed impedance. If a mismatch occurs then the return loss occurs and return loss is to be expected as much as less possible for better performance of antenna.[1][2]

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II.PROPOSED ANTENNA DESIGN

The antenna with optimized dimensions is simulated using the ADS software. It is modeled on a FR4 substrate of dielectric constant ϵ_r= 4.4 and thickness h= 1mm with tangent loss of 0. The resulting antenna resonates at 1.2GHz. From simulation and experimental studies, it is found that the dimensions of the rectangular patch optimized to resonate at 1.2GHz [2][7].Thus the proposed antenna is effectively operated at this resonating frequency with optimum gain(value is 5.68db).

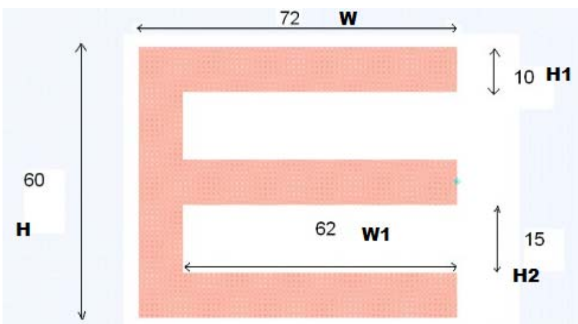

Fig.2 Proposed Antenna Dimensions

Table.1 Dimension of Proposed Antenna

W	H	W1	H1	H2
72	60	62	10	15

For fr =1.2GHz, Length &Width are calculated by

$$W = \frac{c}{2f_0}\sqrt{\frac{2}{\epsilon_r+1}} = 75.4\text{.... } 3.1$$

$$\epsilon_{reff} = \frac{\epsilon_r+1}{2} + \frac{\epsilon_r-1}{2}\left[1+12\frac{h}{W}\right]^{-1/2} = 4.27\text{....}3.2$$

$$L_{eff} = \frac{c}{2f_0\sqrt{\epsilon_{reff}}} = 60.001\text{..... } 3.3$$

$$\mathrm{L} = \mathrm{L_{eff}} - 2\Delta\mathrm{L} = \ 59.0694 \quad \text{... } 3.4$$

$$\Delta L = 0.412h\left[\frac{(\epsilon_{reff}+0.3)\left(\frac{W}{h}+0.264\right)}{(\epsilon_{reff}-0.258)\left(\frac{W}{h}+0.8\right)}\right] = 0.4658\text{.. } 3.5$$

$$W_g = 6h + W = 81.4 \qquad \text{..... } 3.6$$

$$L_g = 6h + L = 66.01 \qquad \text{... } 3.7$$

III. SIMULATED RESULTS

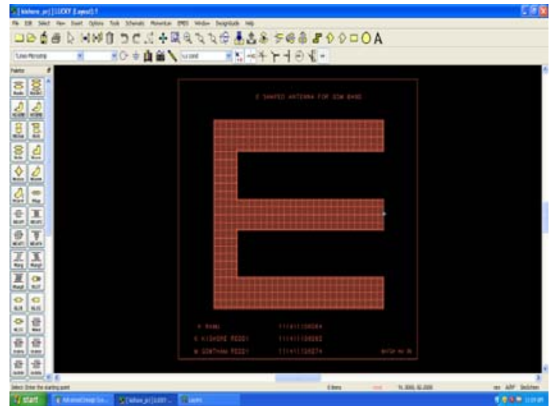

Fig.3 Configuration of Proposed Antenna.

It can be noted that the return loss of the antenna at the resonance frequency of 1.2GHz (GSM application) is -23.62dB.

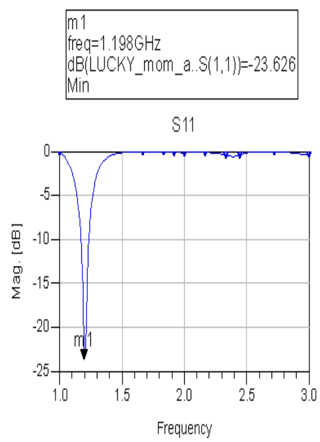

Fig.4 Simulation Results of Magnitude ofS_{11}.

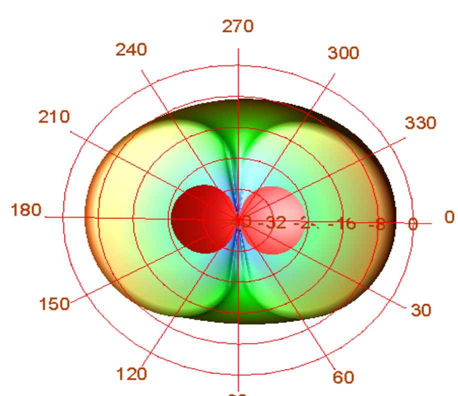

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Fig.5 Radiation Pattern

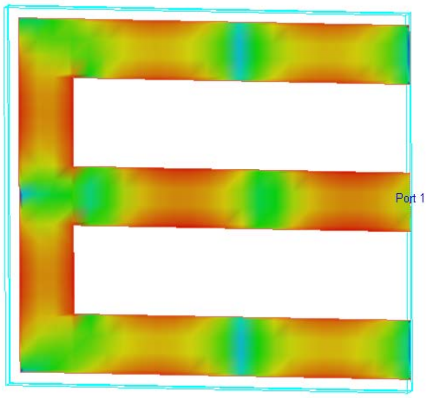

Fig.6 Current Distribution of Proposed Antenna

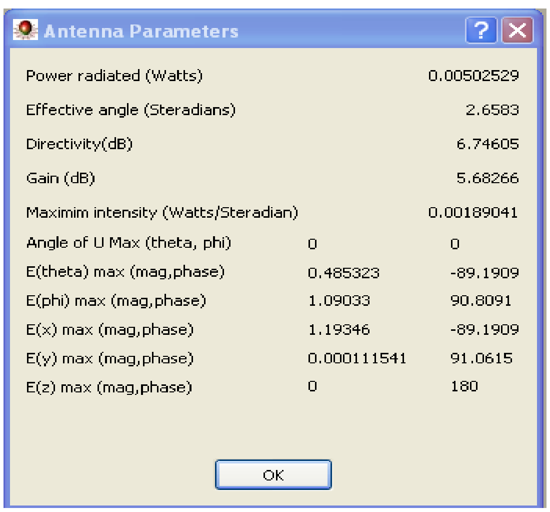

Fig.7 Antenna Parameters.

IV MEASURED RESULTS

The fabricated Microstrip patch antenna was tested using Agilents Network analyzer, and the return loss of the antenna was observed. The simulated results for E-shaped antenna in ADS software are applicable only for GSM. But in the fabricated microstrip antenna, by adjusting the position of the port, it resonates in frequencies of GSM, GPS and 3G applications also. WherinFrequency ranges for GSM,GPS and 3G applicationsare 1.9GHz,1.57GHz and 0.9-1.2GHz respectively.

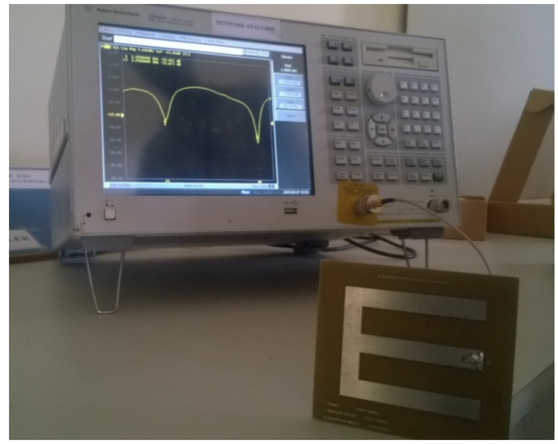

Fig.8 Characteristics of Antenna Using Network Analyzer

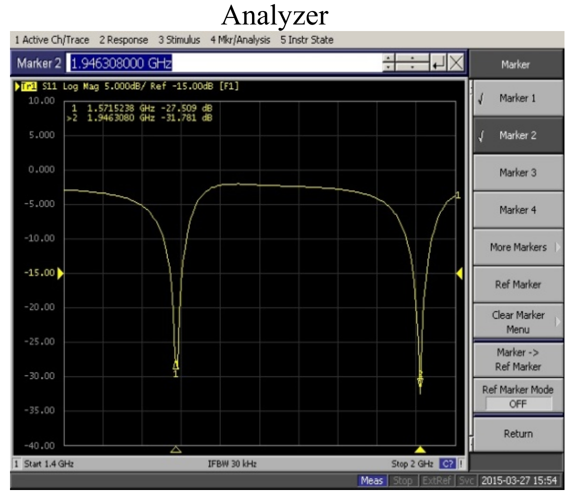

Fig.9 Return Loss of Fabricated Antenna

The return loss of the fabricated antenna is observed to be -27dB for 1.5GHz (GPS) and -31dB for 1.9GHz (3G) which is good enough for the focused applications.

V. CONCLUSION

The simulated results forthe lowprofileE-shaped antenna in ADS software are applicable only for GSM. But in the fabricated antenna, by adjusting the position of the port, it is useful for GSM, GPS and 3G applications.Frequency ranges for GSM,GPS and 3G applications are 1.5GHz,1.17GHz and 1.9GHz.Thereturn loss is below−20dB.Atthesametime,theantennaisthinand compact withthe use oflow dielectric constant substrate material.

VI. ACKNOWLEDGMENT

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VII. REFERENCES

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