IJEAST

INTERNATIONAL JOURNAL
OF ENGINEERING APPLIED SCIENCE
AND TECHNOLOGY

VOLUME : 2 ISSUE : 2 Print / Issue Publication Date: 27-Jan-2017

ISSN : 2455-2143

Indexed In

Google SCHOLAR OPEN ACCESS doi Crossref

WWW.IJEAST.COM

editor@ijeast.com

International Journal of Engineering Applied Sciences and Technology, 2016
Vol. 2, Issue 2, ISSN No. 2455-2143, Pages 81-84
Published Online December-January 2016 in IJEAST (http://www.ijeast.com)

SIZE REDUCTION OF A RECTANGULAR MICROSTRIP PATCH ANTENNA USING SLOTS FOR GSM APPLICATIONS

Prashant Gola
Research Scholar
Department of Electronics & Communication
ITM University, Gwalior, India

Anshul Agarwal
Assistant Professor
Department of Electronics & Communication
ITM University, Gwalior, India

Abstract- As an important design perspective, the demand of size reduction of low frequency antennas is the main development of communication engineering with integration technology. In this work, with the help of rectangular micro strip patch antenna and slots, the size reduction is proposed. In the absence of slots, the structure found to be resonant at 3.11GHz. When the slots are introduced, then frequency shift of 3.11GHz to 1.808GHz is observed. Miniaturization of 72.3% is the main contribution of this paper.. Our present paper deals with the size reduction of microstrip patch antenna on 1.808GHz which is applicable for GSM applications.

Keywords: Rectangular microstrip antenna (RMPA), slots, Miniaturization, GSM

I. INTRODUCTION

Rectangular Micro strip patch antenna has been very popular due to their many advantages, like lightweight, low profile, easy to fabricate, small size and conformable for the planar and non planar surfaces. Ground plane is the plane which consists of plane rectangular sheet or **patch** made up of metal which, mounted over the large sheet of metal[1]. The frequency is inversely proportional to the size of the microstrip patch antenna and due to their lower frequency than microwave and therefore the size which we required does not make sense for microstrip patches [2] [4]. However, it suffers from the narrow impedance bandwidth. Microstrip antenna is being extensively used in hand held because of their small and light enough to be operated while you hold it in your hands and mobile communications devices [3] [5]. To miniaturize the rectangular microstrip antenna paper slots are used [6]. The present work deals with the design and analysis of a rectangular microstrip antenna for GSM communication and application. Initially the antenna is designed for a resonant frequency of 3.11GHz and while using of slots, the resonant frequency is brought down to 1.808GHz. So, a size reduction of 72.3% is achieved.

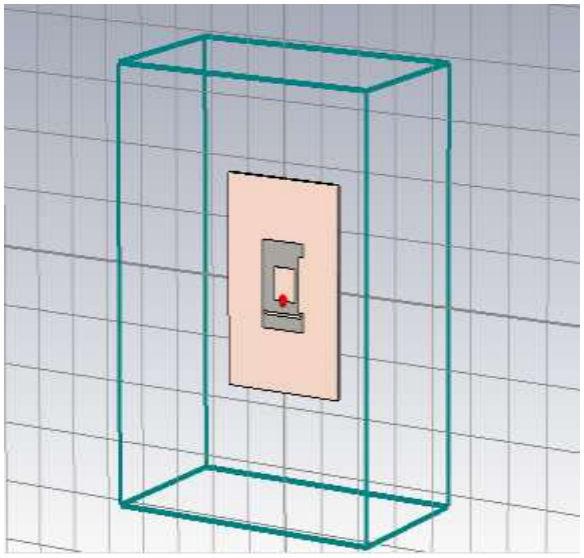

Figure 1: A Rectangular Microstrip Patch Antenna with slots

II. DESIGN PROCEDURE, FORMULATION & SIMULATION

A. Desired Parametric Analysis[4]:

a) Calculation of Width(W)

$$W = \frac{1}{2fr\sqrt{\mu\varepsilon}}\sqrt{\frac{2}{\varepsilon r + 1}} = \frac{c}{2fr}\sqrt{\frac{2}{\varepsilon r + 1}} \quad \text{--- (1)}$$

b) Effective dielectric constant is calculated from:

International Journal of Engineering Applied Sciences and Technology, 2016
Vol. 2, Issue 2, ISSN No. 2455-2143, Pages 81-84
Published Online December-January 2016 in IJEAST (http://www.ijeast.com)

$$\varepsilon eff = \frac{\varepsilon r + 1}{2} + \frac{\varepsilon r - 1}{2}\left(\frac{1}{\sqrt{1 + \frac{12h}{w}}}\right) \quad \text{--- (2)}$$

c) The actual length of the Patch (L)

$$L = Leff - 2\Delta L \quad \text{--- (3)}$$

Where,

$$Leff = \frac{c}{2fr\sqrt{\varepsilon eff}} \quad \text{--- (4)}$$

d) Calculation of Length Extension

$$\frac{\Delta L}{h} = 0.412\frac{(\varepsilon eff + 0.3)\left(\frac{w}{h} + 0.264\right)}{(\varepsilon eff - 0.258)\left(\frac{w}{h} + 0.8\right)} \quad \text{--- (5)}$$

Where,
c = free space velocity of light,
εr = Dielectric constant of substrate
h = height of dielectric substrate
ΔL= Effective length
Fr= Resonating frequency
L= Length of patch
W= Width of patch
Eeff= Effective dielectric constant

III. ANTENNA SPECIFICATION

The antenna is designed and simulated with Computer simulation Technology (CST-MSW) 2010 software [7]. CST microwave studio is ultimate software to simulate the design, as this software is desirable for 1D, 2D and 3D platform in simulating a full wave simulation and other specifications [5].

Length of ground= 30mm
Width of ground= 35mm
Length of dielectric substrate= 30mm
Width of dielectric substrate= 35mm
Length of rectangular patch= 22.779mm
Width of rectangular patch= 29.53
Dielectric constant of substrate= 4.3
Height of dielectric substrate= 1.6mm
Free space velocity of light= $2.99*10^8$
Resonating frequency= 3.118GHz

IV. RESULTS

Return Loss of the rectangular patch with slots and without slots is given in figure 3 and 5. It is observed from figure 3 that returns loss at 3.11 GHz is -27dB in absence of slots. From figure 4 , It is seen that return los at 1.808GHz is -26dB in presence of slots as shown in figure respectively.

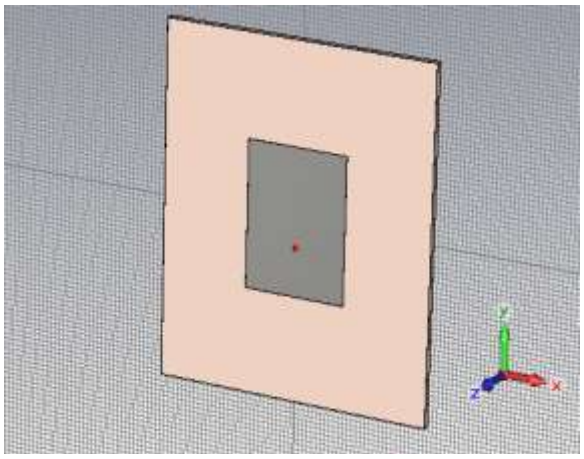

Figure 2: A rectangular Microstrip patch antenna without slots

The dimension of the slots of the rectangular Microstrip patch antenna is as follows-

S.no.	Xmin	Xmax	Ymin	Ymax
SLOT 1	6.75	-4.75	-5	6
SLOT 2	-8	8	-10	-11
SLOT 3	7.8	11	10	-8

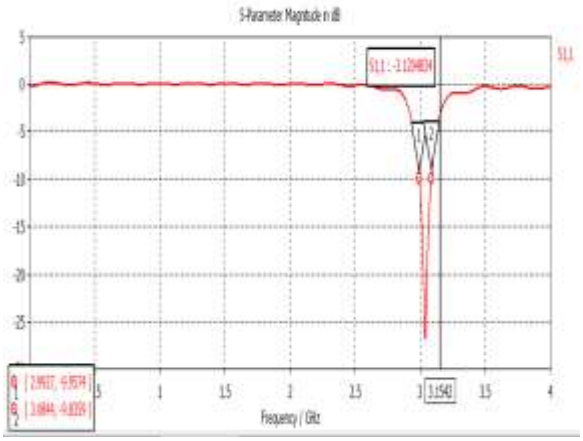

Figure 3: Return Loss without slots

International Journal of Engineering Applied Sciences and Technology, 2016
Vol. 2, Issue 2, ISSN No. 2455-2143, Pages 81-84
Published Online December-January 2016 in IJEAST (http://www.ijeast.com)

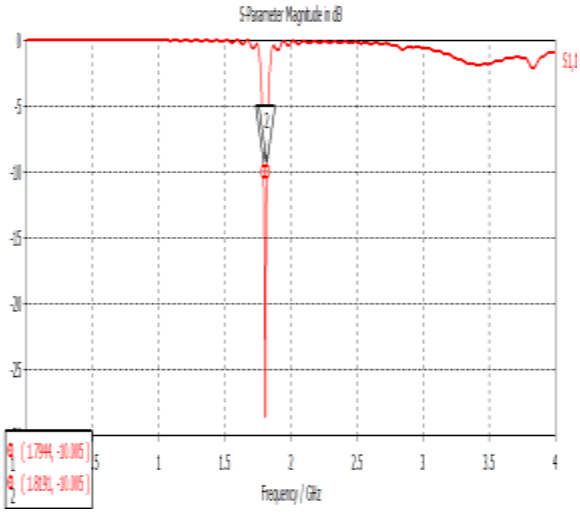

Figure 4: Return Loss with slots

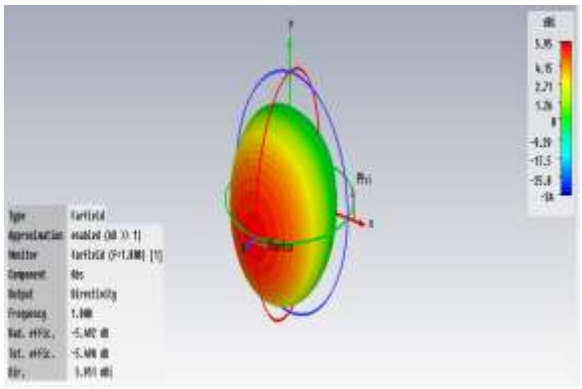

Figure 5: Directivity of Microstrip Patch antenna at 1.808GHz

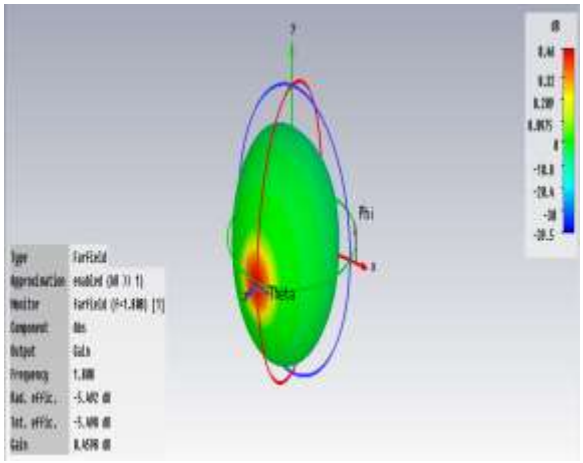

Figure 6: Gain of Microstrip Patch antenna at 1.808GHz

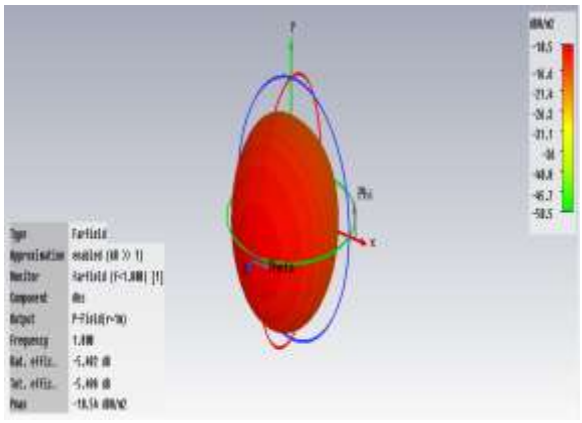

Figure 7: Radiation pattern of a Microstrip Patch antenna

The Directivity of the rectangular microstrip patch antenna at 1.808 GHz is shown in figure 5, the gain of the microstrip patch antenna 1.808GHz is shown in figure 6, Radiation pattern of micro strip patch antenna 1.808GHz is shown in figure 7. The radiation efficiency is 72.3%and VSWR of microstrip patch antenna is 1.077

V. CONCLUSION

In this paper design of rectangular microstrip patch antenna with slots is carried out. A size reduction of about 72.3% and the shifting of resonant frequency from 3.11GHz to 1.808 GHz with -26dB return loss fascinating the antenna to be used for GSM application.

VI. REFERENCES

[1] J.S. Wong, Kuo, "A compact microstrip antennas with meandering slots in the ground plane", Microwave opt technol Lett 29, 2001, .pp.95-97.
[2] D. Sarkar, S. Sarkar, S, Biswas, A.D. Mondal, S. Majumdar , " Miniaturization of rectangular Microstrip patch antennasusing optimized single slotted ground plane ". Microwave and optical technology Letters, 53, 2011:pp.111-115.
[3] K.L. wong and T.W. chiou, "Design of compact microstrip antennas with slotted ground plane", In:proceeding of the IEEE antenna and propagation society international symposium, Vol.2, Boston, MA, 2001, pp.732-735
[4] H.D. Chen, "compact circularly polarized microstrip antenna with slotted ground plate ", electron let 34, 2002, pp.616-617
[5] Ping Jack Soh, Guy A. E Vandenbosch, Soo Liam Ooi, "Design of a Broadband All-Textile Slotted

PIFA by CST", IEEE Transactions on Antennas and Propagation, Vol.60, Issue: 1, January 2012, pp. 379-384.
[6] A.K. Skivernilk, J.R. Mosig and Zurcher O. staub, "PCS Antenna Design: The challenges of Miniatururization", IEEE Antenna Propagation Magazine, 43(4), pp. 12-27, August 2011M, 1989
[7] https://www.cst.com/Products/CSTS2

IJEAST

INTERNATIONAL JOURNAL
OF ENGINEERING APPLIED SCIENCE
AND TECHNOLOGY

ABOUT IJEAST

International Journal of Engineering Applied Science and Technology (IJEAST) is a peer-reviewed, open access journal that publishes high-quality research papers in the field of Engineering, Applied Science and Technology.

IJEAST aims to provide a platform for researchers, academicians, and professionals to share their innovative ideas, research findings, and practical experiences with the global scientific community.

FOCUS AREAS

- Engineering
- Applied Science
- Technology
- Innovation & Development
- Interdisciplinary Studies

PEER REVIEWED
All submissions are rigorously peer reviewed to ensure quality.

OPEN ACCESS
Free and unrestricted access to research for all.

GLOBAL REACH
Connecting researchers and professionals worldwide.

TIMELY PUBLICATION
We ensure a swift and efficient publication process.

For more information, visit our website
www.ijeast.com

INTERNATIONAL JOURNAL
OF ENGINEERING APPLIED SCIENCE
AND TECHNOLOGY

editor@ijeast.com
www.ijeast.com
India

2455-2143