iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 8 **Issue:** V **Month of publication:** May 2020

DOI: http://doi.org/10.22214/ijraset.2020.5278

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 8 Issue V May 2020- Available at www.ijraset.com

Design of Metamaterial Antenna for Dual Band Operation

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Abstract: ***A compact dual band antenna is proposed for various wireless applications. The antenna consists of a rectangular patch with metamaterial inspired ELC ground plane. The antenna is printed on a FR-4 substrate which has a dielectric constant of 4.4.The size of the proposed antenna is 23x12.7x1.6 mm^3.The antenna is fed by a 50 ohm microstrip line feed. The antenna resonates at 3.5 GHz and 5.4 GHz which is suitable for WiMAX and WLAN applications.***
Keywords: Dualband ;ELC; metamaterial; WiMAX; WLAN.

I. INTRODUCTION

In recent scenarios, metamaterial element emerges for improving the performance of antenna. Veselago made the first theoretical prediction on the existence of metamaterials which could show
negative permeability and negative permittivity
characteristics [1]. Metamaterials produces artificial electromagnetic properties that can be used to enhance the new era in microwave devices [2]. ELC based metamaterial element is used to improve the performance of the antenna such as dual band antenna design [3]. Since multiband antennas are in compact size and cost efficient, they are commonly used in wireless devices [4]. Many design techniques for multiband antenna design have been developed.
By using metamaterial structure, dualband and antenna miniaturization have been achieved [4]. In order to improve the performance of the antenna metamaterial embedded antenna were used due to their unprecedented electromagnetic properties [5].In this paper, metamaterial element ELC based antenna is proposed for obtaining multiband and 84% of antenna miniaturization.

II. ANTENNA DESIGN

The configuration 1 is a typical rectangular radiating patch. FR4 substrate is used for antenna design, having dielectric constant of 4.4.In the configuration 2 the new metamaterial element known as Electric Field Coupled Resonator (ELC) has been introduced in the ground plane. This alters the traditional ground plane resonance characteristics and provides better impedance matching and dual band resonance characteristics.

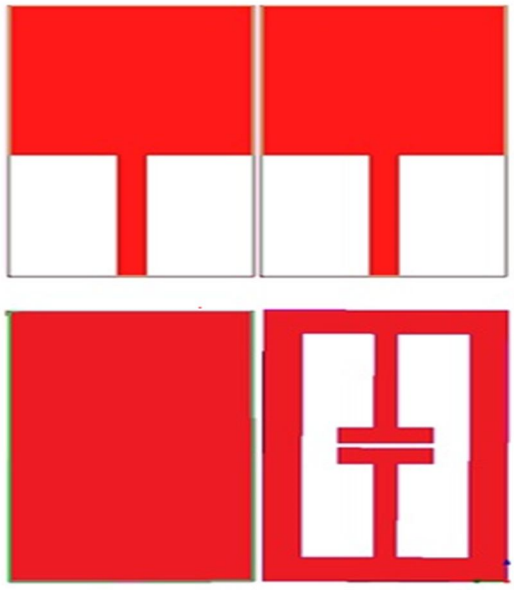

Fig 1: Design steps of the proposed antenna

ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 8 Issue V May 2020- Available at www.ijraset.com

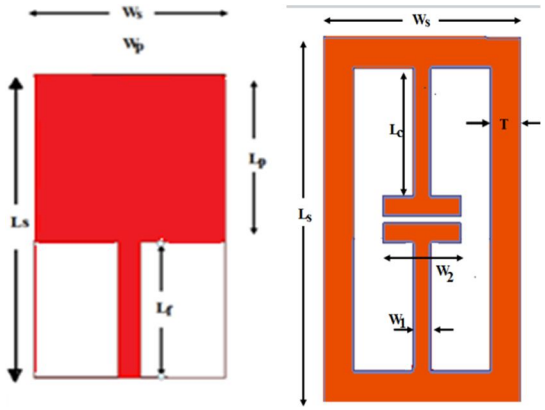

Fig 2: Top view and bottom view of proposed antenna.

Table 1: Dimensions of the proposed antenna

PARAMETERS	DIMENSIONS(mm)
L_s	23
L_c	8
L_f	10.3
L_p	12.7
Wp,W_s	12.8
W_1	1.5
W_2	5
T	2

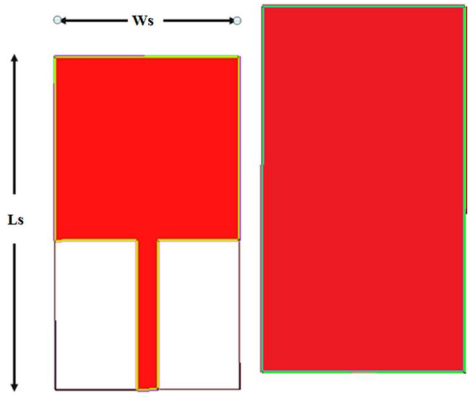

Fig 3: Configuration 1.

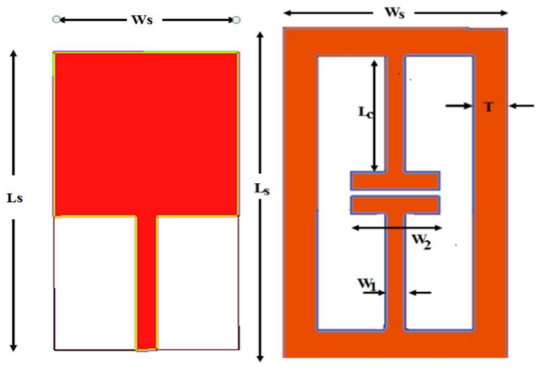

Fig 4: Configuration 2.

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III. SIMULATION AND RESULT

The simulated reflection co-efficient (S_{11}) dB of the configuration 1 is shown in fig 5. It shows that the conventional rectangular patch antenna does not offer good impedance matching.

The introduction of ELC in the ground plane (fig 6) offers a dual resonant frequencies of 3.5 GHz and 5.40 GHz.

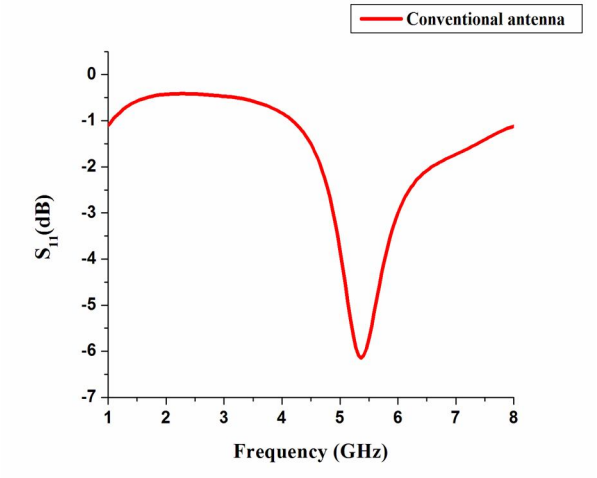


Fig 5:Simulated S_{11}(dB) of config 1.

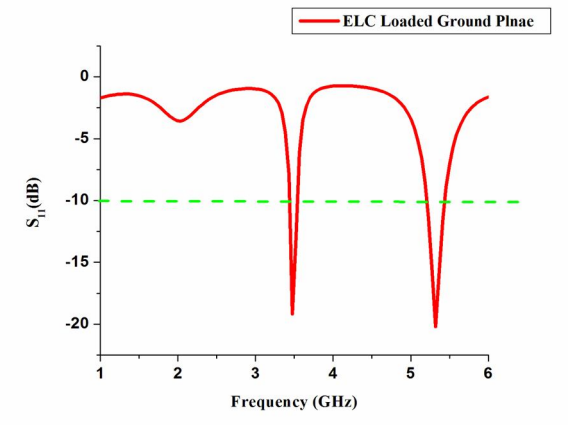


Fig 6:Simulated S_{11}(dB) of config 2.

IV. RADIATION PATTERN

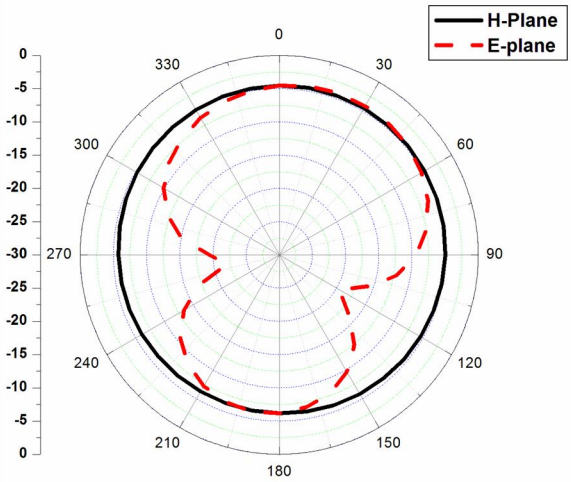


Fig 7(a):Radiation pattern of config 1.

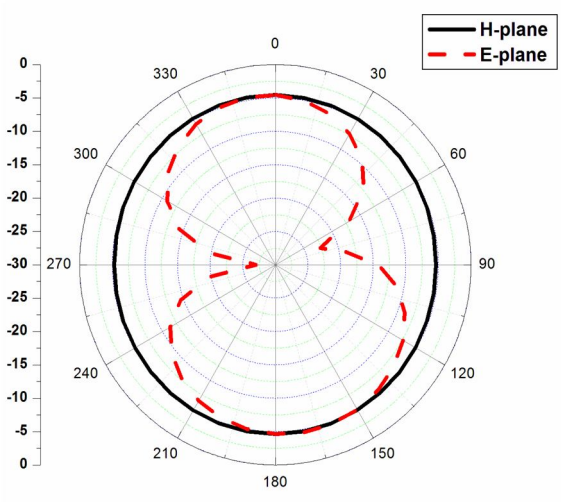


Fig 7(b):Radiation pattern of config 2.

Figures 7(a) and 7(b) depicts the E-plane and H-plane radiation patterns of the proposed antenna at 2.1 GHz, 3.51 GHz respectively. The proposed antenna covers the desired directions.

REFERENCES

[1] Md. Moinul Islam 1, Mohammad Tariqul Islam , Md. Samsuzzaman , Mohammad Rashed Iqbal Faruque , Norbahiah Misran and Mohd Fais Mansor ," A Miniaturized Antenna with Negative Index Metamaterial Based on Modified SRR and CLS Unit Cell for UWB Microwave Imaging Applications ",2015, *8*, 392-407.

[2] Dushyant Marathe, Kishore Kulat, "A compact dual, triple band resonators for negative permittivity metamaterial", International Journal of Electronics and Communications, 28 February 2018.

[3] R. Samson Daniel, R. Pandeeswari, S. Raghavan," Dual-band monopole antenna loaded with ELC metamaterial resonator for WiMAX and WLAN applications", Applied physics A materials science and processing, July 2018

[4] Raphael Samson Daniel, Ramasamy Pandeeswari, and Singaravelu Raghavan, "Design and Analysis of Open Complementary Split Ring Resonators Loaded Monopole Antenna for Multiband Operation", Progress In Electromagnetics Research C, Vol. 78, 2017.

[5] Raphael Samson Daniel, Ramasamy Pandeeswari, and Singaravelu Raghavan, "Design and Analysis of Open Complementary Split Ring Resonators Loaded Monopole Antenna for Multiband Operation", Progress In Electromagnetics Research C, Vol. 78, 2017.

[6] R. Samson Daniel, R. Pandeeswari, S. Raghavan, "A miniaturized printed monopole antenna loaded with hexagonal complementary split ring resonators for multiband operations", International Journal of RF and Microwave Computer-Aided Engineering, March 2018.

[7] R. Samson Daniel, R. Pandeeswari, S. Raghavan , "Multiband monopole antenna loaded with complementary split ring resonator and C-shaped slots", International Journal of Electronics and Communications, March 2017.

[8] Bo Yuan, Yan He Zheng, Xiao Hong Zhang, Bin You, Guo Qing Luo," A bandwidth and gain enhancement for microstrip antenna based on metamaterial", Microw Opt Technol Lett, 2017.

[9] Tanweer Ali A.W. Mohammad Saadh, R.C Biradar, Jaume Anguera, Aurora Andúja, "A miniaturized metamaterial slot antenna for wireless applications", International Journal of Electronics and Communications, October 2017.

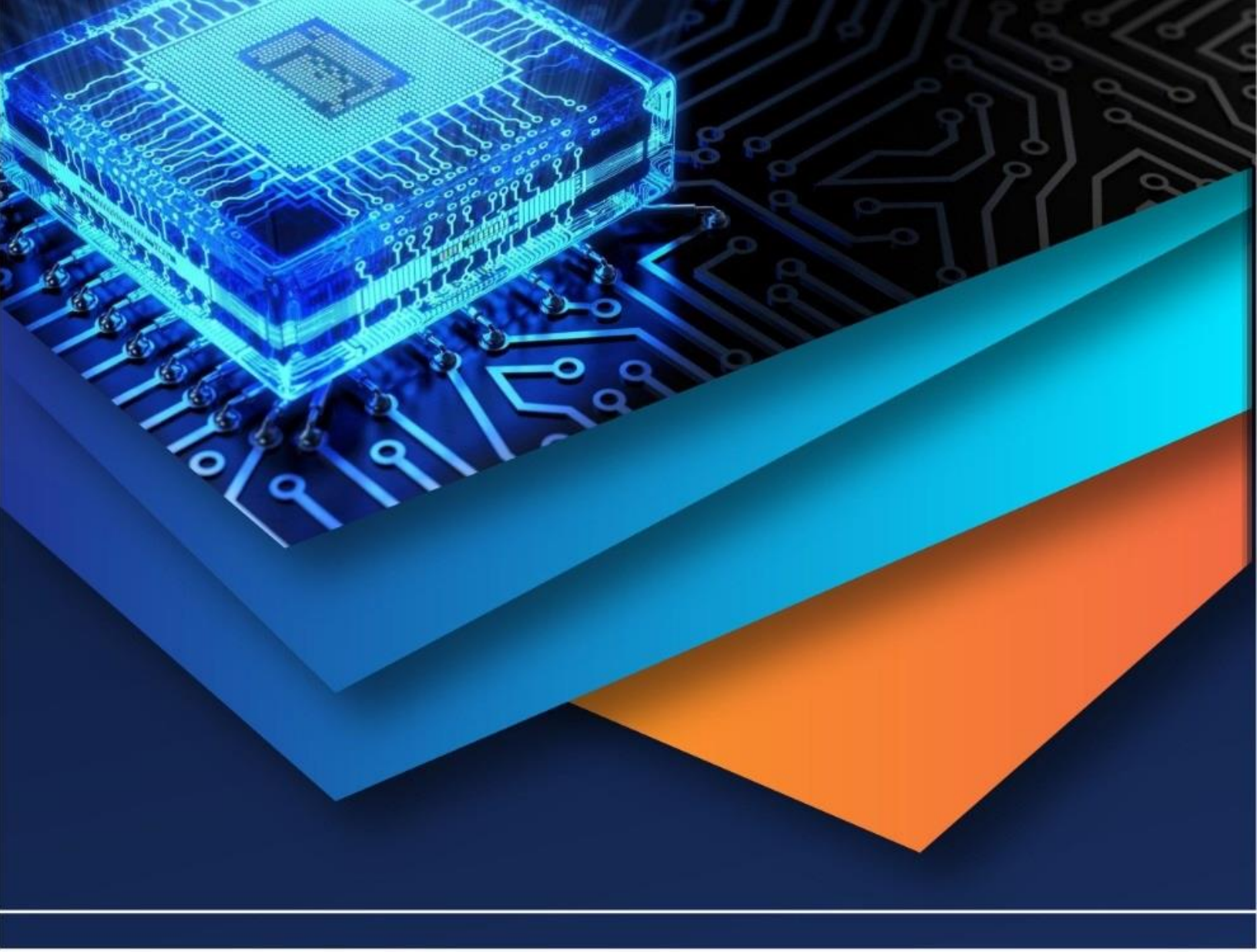
[10] Ramasamy Pandeeswari and Singaravelu Raghavan, "broadband monopole antenna with split ring resonator loaded substrate for good impedance matching", microwave and optical technology letters / Vol. 56, No. 10, October 2014.

[11] S. Imaculate Rosaline & S. Raghavan, "Design and analysis of a SRR superstrate for SAR Reduction", Journal of Electromagnetic Waves and Applications, October 2015.

[12] Raphael Samson Daniel, Ramasamy Pandeeswari, S. Deivalakshmi, "A CPW-fed dual band antenna based on metamaterial inspired split ring structure", IEEE 2nd International Conference on Signal and Image Processing, 2017.

[13] S. Syedakbar, S. Ramesh, J. Deepa,"Ultra wide band monopole planar MIMO antenna for portable devices",IEEE International Conference on Electrical Instrumentation and Communication Engineering,2017.

[14] J. Deepa, S. Suganthi, G. Shenbaga Ranjani., J.Candice Freeda , M. Jayaprabha, "Multiband Planar MIMO Antenna for GSM 1800/ LTE2300/ WiMAX/ WLAN Applications", International Journal of Engineering Research & Technology (IJERT) 2016,Vol.4 No.19 pp: 38-43



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