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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.

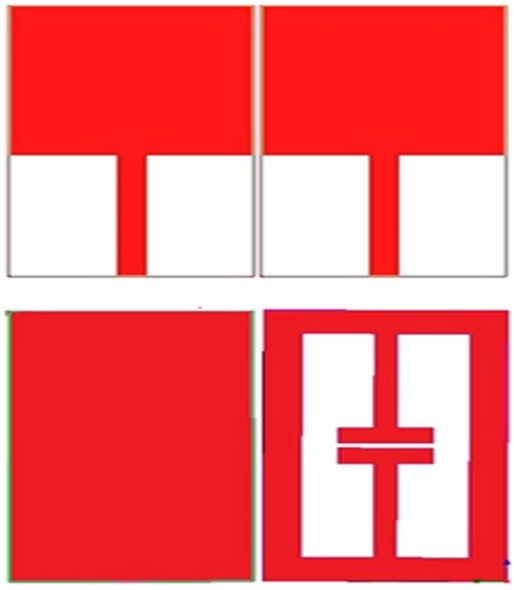


Fig 1: Design steps of the proposed antenna

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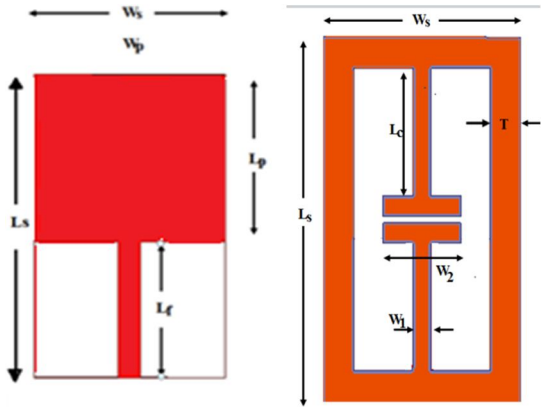


Fig 2: Top view and bottom view of proposed antenna.

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

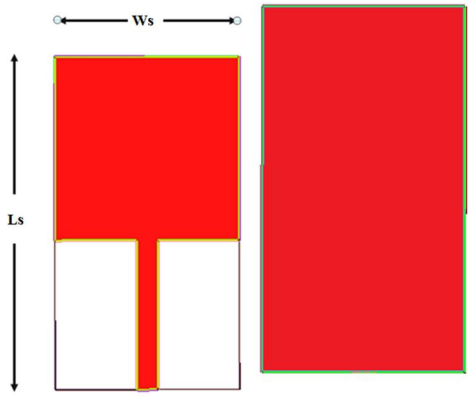


Fig 3: Configuration 1.

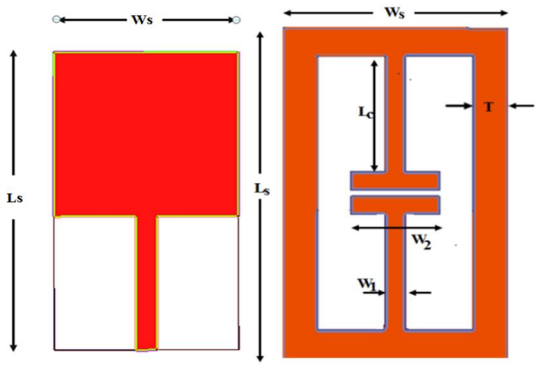


Fig 4: Configuration 2.

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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.

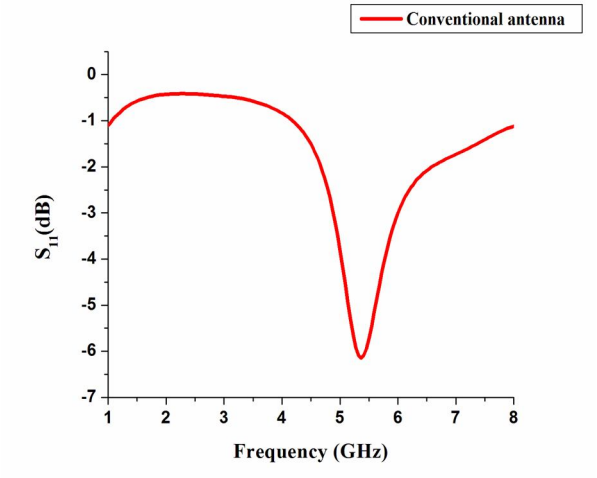


Fig 5:Simulated S_{11}(dB) of config 1.

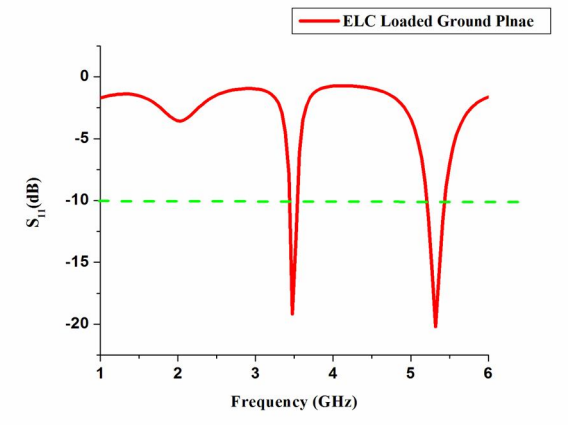


Fig 6:Simulated S_{11}(dB) of config 2.

IV. RADIATION PATTERN

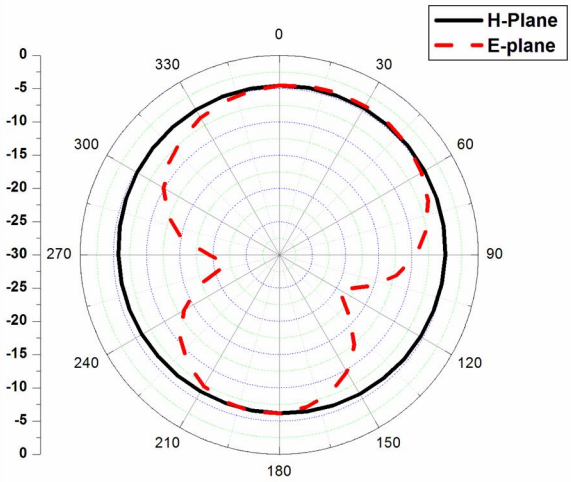


Fig 7(a):Radiation pattern of config 1.

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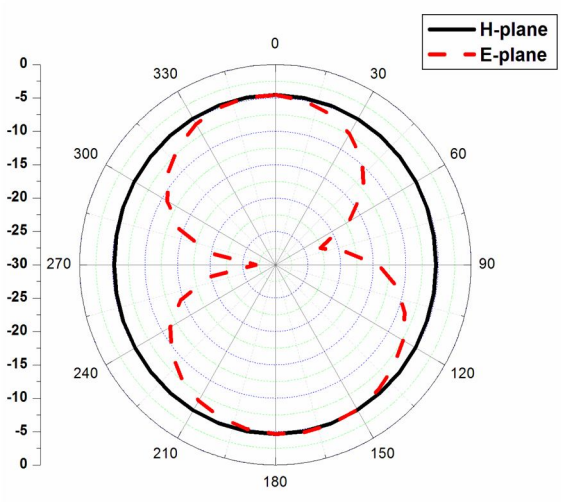


Fig 7(b):Radiation pattern of config 2.

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.

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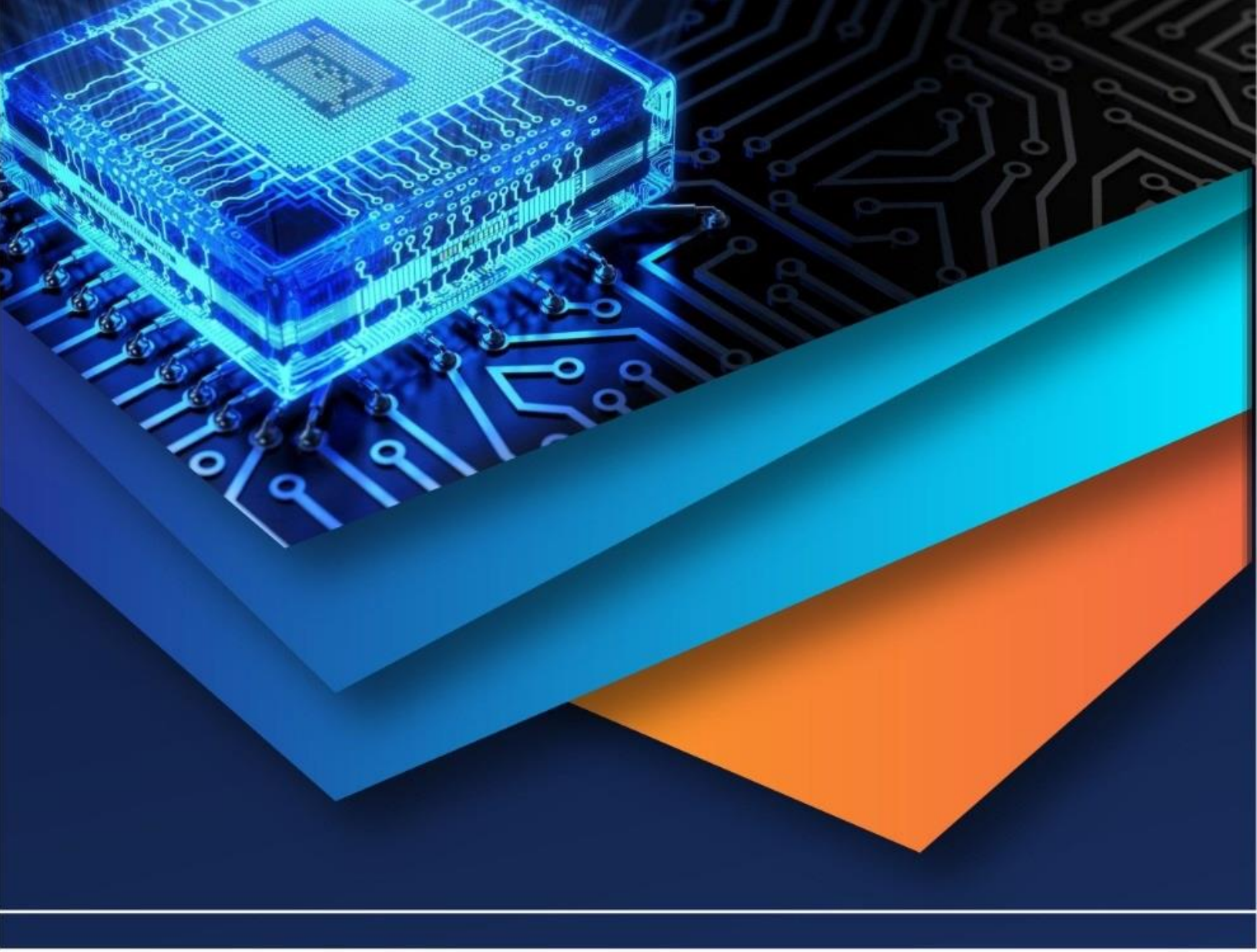
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