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Time Domain Characteristics of Metamaterial Inspired wide Band Antenna For C-Band Application

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ABSTRACT

A compact (20×20mm2), high-gain wideband antenna with a frequency range of 4 .57 to 8.15 GHz is presented . A Novel wide band antenna with a truncated ground plane makes up the antenna structure. The proposed wideband antenna's time domain characteristics, such as group delay, phase response, and isolation characteristics, are addressed in depth for both face to face and side to side conditions. Over the entire operating bandwidth, the antenna exhibits stable radiation performances, effective impedance matching, high gain, and acceptable time domain characteristics.

Keywords: *Novel wide band antenna, group delay, Phase response, isolation characteristics.*

I. INTRODUCTION

An antenna is used to radiate electromagnetic energy efficiently and in desired directions. Antennas act as matching systems between sources of electromagnetic energy and space. The goal in using antennas is to optimize this matching.An antenna is a transitional device, or transducer, that forms an interface for energy traveling between a circuit and free space.It is reciprocal in the sense that it can transfer energy from the circuit to free space (transmission) and from free space to a circuit (reception).a. If there were no antenna and the circuit terminated in an open circuited transmission line, then theoretically all the power from the transmitter would be reflected backwards along the line.The X shape is used due to its simple design and DGS is utilized to achieve size reductionwith multiband and wideband features in the frequency range of 1–7 GHz.During the most recent decade, economical and miniaturized microstrip antennas (MSA) has pulled in a critical examination interest for different electronic and handheld gadgets [1]. This is because of the way that MSA give benefits like light weight, planar construction, conformal plan, effectively mountable and combination with different Monolithic Integrated Circuits (MICs) and so on Be that as it may, MSA experiences the genuine hindrance of limited bandwidth[2-6].

Publication reports different strategies to improve the bandwidth of a MSA, for example, fractals [7-8], slots [9-10], metamaterials [11] and so on. Ali et al. [7] proposed a UWB antenna dependent on sierpinsiki square fractal spaces where the wide bandwidth activities were constrained by truncation at the ground plane. In [8], creator proposes a GuisepePeano fractal space alongside right calculated triangle and symmetrical triangle opening to get wide impedance data transfer capacity from 4.5- 12 GHz. In [9], a UWB antenna was planned utilizing Volkswagen logo and spaces at the ground plane. A concentric ring based UWB antenna with openings at the ground plane was acquired in [10]. A layer of metasurface involving reciprocal split ring resonator was used by Neha et al. [11] to improve the bandwidth around 6GHz.

Nonetheless, in this paper we propose a straightforward, high increase, planar wideband monopole antenna with stable radiation exhibitions and time area attributes.

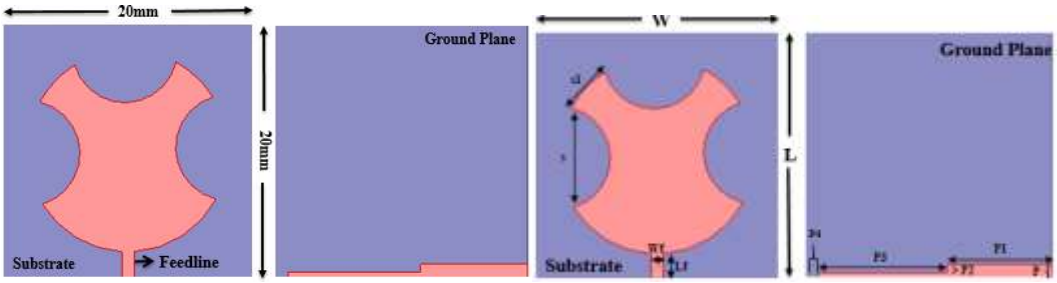
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The principle commitment of the paper is as per the following:

- A conservative of wideband antenna working at C band (for example 4.57-8.15 GHz) is proposed.
- The time area examination of the antenna for face to face&side to side is talked about in detail.
- The truncation at the ground part helps the antenna in accomplishing activity data transmission from 4.57-8.15GHz.
- The fundamental benefit of the proposed configuration is its straightforward planar design, reduced size, satisfactory time domain attributes and radiation exhibitions.

II. DESIGN OF A X SHAPEDNOVEL WIDEBANDANTENNA

The proposed Novel wideband antenna format and detail setup is introduced in Fig. 1 and its last measurements are given in Table 1.



(a) (b)

Fig. 1 (a) Proposed antenna layout (b) detailed configuration

The wideband antenna comprises of aXshaped radiating patch, a rectangular microstrip feed line and a shortened ground plane. Impedance coordinating in the antenna is cultivated by utilizing microstrip feed line utilizing lumped port excitation. Additionally, somewhat the impedance match over the wideband width is constrained by utilizing radiator.The impact of truncation present in the ground plane of the proposed antenna is introduced in Fig. 2. When there is no ground truncation (for example "Plan A"), no wide bandwidth activity is accomplished. At the point when the truncation is carved out (for example "Plan B") the current circulation of the ground part is changed and the proposed antenna shows wide bandwidth activity going from 4.57-8.15GHz,then covering the C band of activity.

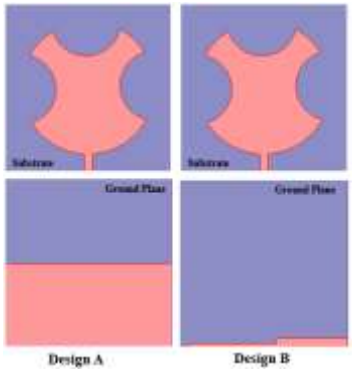


Fig. 2 Effect of truncation on the proposed wideband antenna

Table_ 1: Dimensions of the proposed antenna

Parameter	Dimensions(mm)
S	8.082
S1	4.025
Wf	1
Lf	2.015
P	1.125
P1	8.5
P2	0.625
P3	10.5
P4	1

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Additionally the surface current behavior of the proposed Novel wideband antenna is contemplated and is introduced in Fig 3.

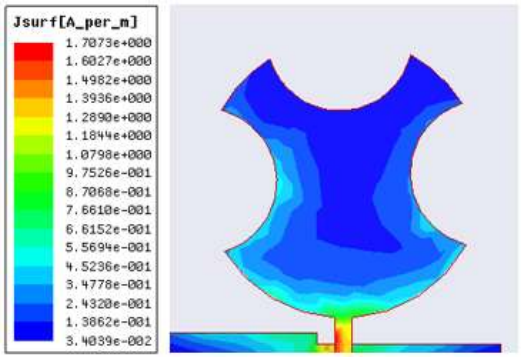


Fig. 3 Surface current Distribution

III. RESULTS

A Simulated Results

The proposed Novel wideband antenna yielded Fig.1 (a) is reenacted on broadly accessible minimal effort FR4 substrate with: εr=4.4, h=1.6mm and misfortune digression (δ) = 0.02.The antenna has a conservative emanating size of (20×20 mm^2). The reproduced S_{11} consequences of the antenna is introduced in Fig. 4.The antenna has a working reach from 4.57-8.15 GHz with fractional bandwidth of about 56.2%.

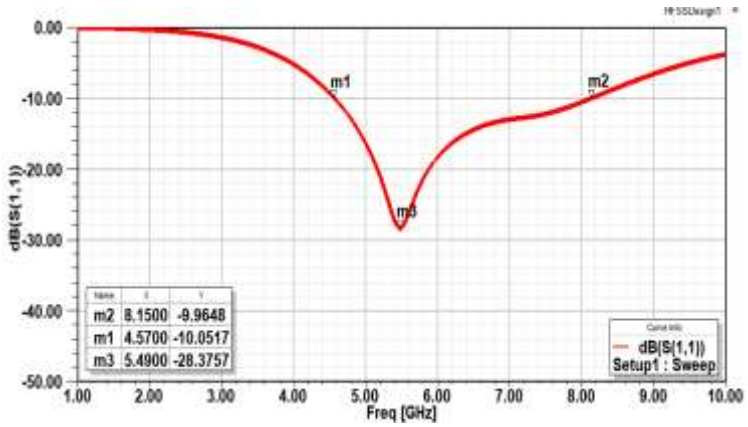
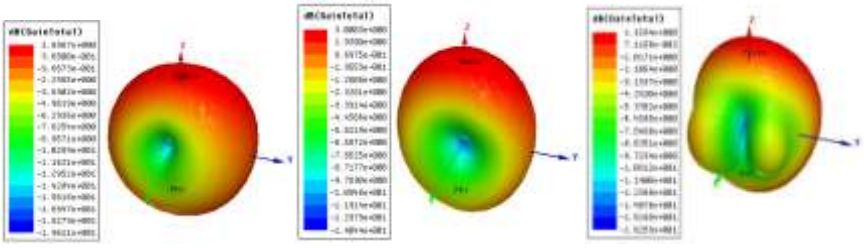


Fig. 4 Simulated S_{11} plot of the proposeddesign

As we observe the 3D polar gain plot of the antenna is in Fig. 5. The acquired gain are 1.69, 3.0 and 1.59 dB at 4.57,5.49 and 8.15GHz, respectively. It can be acknowledged that the acquired is quite low that can be easily used for C band applications.

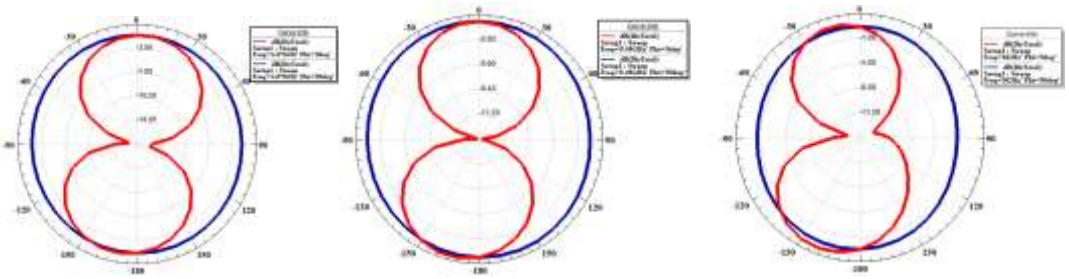


(a) (b) (c)

Fig. 5. 3-Dgainplot of the proposed design at (a) 4.57, (b) 5.49 and (c) 8.15GH

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The presented wideband antenna has steady radiation executions in both E-plane (phi=0) and H-plane (phi=90). The 2-D polar pattern of the wideband antenna is presented in Fig. 6.



(a) (b) (c)

Fig. 6. 2D-Polar pattern of the proposed design at (a) 4.57, (b) 5.49 and (c) 8.15GHz

The radiation Efficiency of the proposed antenna is given in Fig 7.The antenna has efficiency greater than 90% over the operating range of 4.49 to 8.1GHz and at the 5.49GHz resonating frequency the radiation efficiency observed 96%.

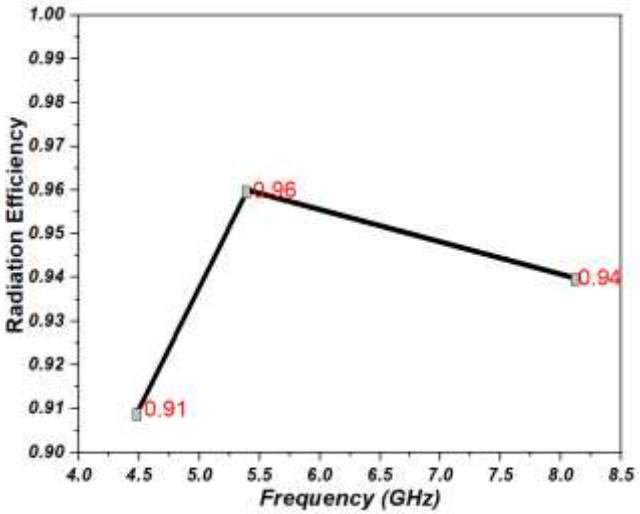
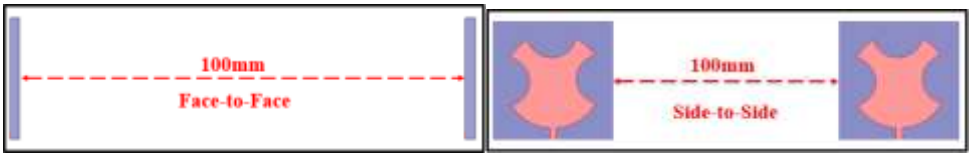


Fig. 7. Radiation efficiency of the proposed design

B. Time Domain Analysis

Aside from high gain and radiation proficiency the wideband antenna should display satisfactory time-domain characteristics. Uniquely, when the antenna is to be utilized at more extensive bandwidth for satellite communication, the time-domainanalysis turns out to be vital. Here, we have done the time area examination of the antenna for both eye to eye and side to side conditions. Isolation characteristics, group delay, phase response are some of the important time domain characteristics for analysis of wideband antenna.



(a) (b)

Fig. 8. Antenna position in HFSS to calculate time domain characteristics of a wideband antenna.

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I. Group Delay

For a decent wideband antenna, the gathering delay ought to be consistent ridiculous working reach. As it tends to be seen from that the antenna contribute nearly perpetualgroup delay over the whole working reach both in eye to eye and side to sideconditions.

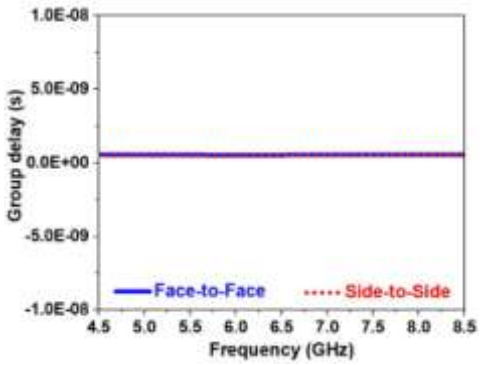
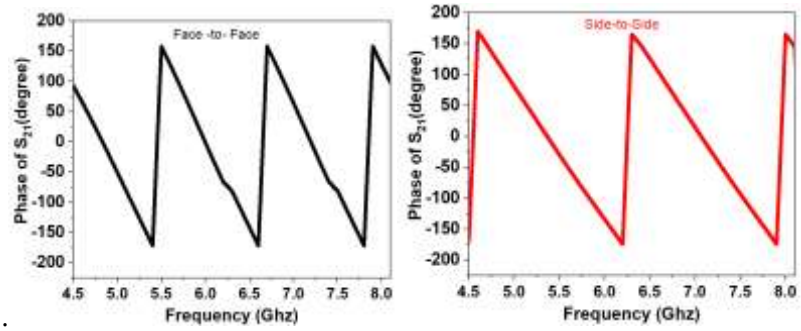


Fig. 9 Group delay of the antenna

II. PhaseResponse

A linear phase variation should be shown over the entire operating range by the wideband antenna. It canbe outwardly perceived from Fig. 10 that the proposed widebandantenna shows straight stage variety for both the conditions



(a)Face-to-Face (b)Side-to-Side

Fig. 10 Phase response of the wideband antenna

III. Isolation Characteristics

Over the entire wideband working range the wide band antenna ought to exhibit great isolation characteristics (preferably S11<-30dB) over the whole wideband working range., one can see that the antenna has great isolation for both the situations (for example side to side and eye to eye).

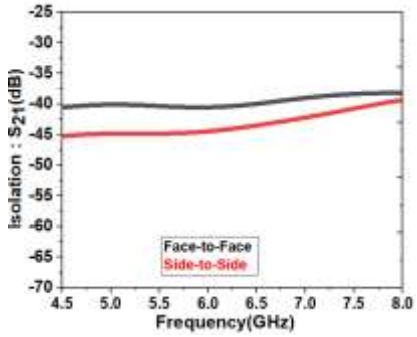


Fig. 11 Isolation characteristics of the wideband antenna

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IV. **CONCLUSION**

A conservative wideband antenna working from 4.57-8.15 GHz, is designed and analyzed. It is seen that the antenna displays satisfactory time domain attributes inside the working reach for both side to side and face to face conditions. High gain, great radiation proficiency and stable patterns are the extra benefits of the proposed Novel wide band antenna, along these lines making it a decent possibility for Wi-fi applications.

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