Design of Miniature Wideband Micro-Strip Antenna

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***Abstract* – In this paper a 1x2 miniature wide-band rectangular patch antenna is proposed. The antenna is designed for 4.45GHz to 7.15GHz frequency band. The miniaturization of antenna has been achieved by monopole configuration and implementation of Electronic Band-gap Structure (EBGs) in between the two identical antennas. Proposed antenna is simulated using HFSS-13 and measured results are compared with simulated results.**

Keywords– Miniature Antenna; Miniaturization of patch antenna; MIMO antenna; Wide-band Antenna;

I. INTRODUCTION

Due to the emerging need mobile wireless devices has to provide faster access, brighter and higher resolution screens, additional connectivity all with compact size[1] . The size of devices can be reduced by using compact components. Antenna is one of the important components that must be considered for size reduction and other performance enhancement of the transmitting and receiving devices. In 4G communication systems, not one but two antennas are required each with specific requirements: Bandwidth, Mutual Coupling, Size and cost. Wide-band antennas are one of the important components of the wide-band communication systems. Different techniques have been implemented to achieve wideband response of antennas as: Fractal Micro-strip antenna [2], Aperture coupled antennas[3] , slotted antennas[4][5] and ,Psi-shaped antennas[6] meta-material antennas and modified ground plane antenna .The factors affecting the performance of MIMO antennas are categories in three main types: Antenna Size, device usage models and mutual coupling between a pair of antennas. The size of antenna is dependent on bandwidth of operation, frequency of operation and required operation of frequency. In 1x2 antennas both the antennas are placed on same longitudinal chassis, they will produce the same radiation pattern. Since both the antennas are coupled in the same mode, they experience mutual coupling. The power introduced into one antenna is partially coupled in second antenna source resistance, and is subsequently lost[1] .Various techniques have been deployed to minimize the mutual coupling in MIMO antennas as: placement of Electronic Band-gap Structures in between the two antennas , slotted complementary split ring resonator ,negative magnetic meta-material and meta-material monopole antennas .

II. ANTENNA DESIGN AND STRUCTURE

The proposed reception apparatus has been planned in four sections:
The receiving wires are based on a FR4 Epoxy dielectric substrate with dielectric consistent 4.4, dielectric misfortune digression 0.02 and thickness 1.6mm. The receiving wire is intended for 50ω micro-strip encouraging line.

A) Design of single component:

Single components of minimized rectangular patch reception apparatus are portrayed in Figure.1. To accomplish the conservative size dipole miniaturized scale strip receiving wire is changed into monopole receiving wire. The ground plane of the dipole reception apparatus is evacuated to change it to monopole receiving wire. An incomplete ground plane is stacked at sustaining point to present extra reactance which brings about wideband reaction.

Measurements of incomplete ground plane (Lgm= 6mm and Wgm=17.6mm) Wgm = Wg (8) Lgm = (9)

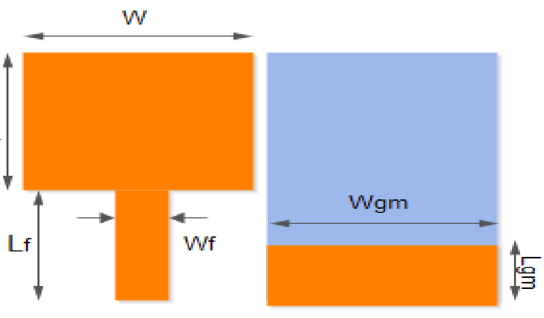


Figure.1. Incomplete ground plane rectangular patch receiving wire (W=8mm, L=5mm, Wf= 1.6mm, Lf=10mm, Wgm=17.6mm and Lgm=6mm)

The fractional ground plane presents a parallel capacitive reactance in the monopole arrangement reception apparatus which results in second full recurrence and subsequently the transmission capacity of receiving wire is upgraded. Monopole and incomplete ground plane receiving wires are poor radiator than ordinary dipole reception apparatus.

Likewise the monopole design results in undesired back projection and extremely poor front to back proportion, henceforth poor radiation productivity and increase. To improve the radiation effectiveness and increase of radio wire various receiving wires can be utilized. Numerous radio wires will build the general size of receiving wire. So there is an exchange off of Size, transfer speed and radiation productivity if these radio wires are utilized for Single Input Single Output (SISO) frameworks however this radio wire will be exceptionally viable for the Numerous Input Multiple Output (MIMO) frameworks.

B) Design of mushroom sort EBG structure:

A straightforward mushroom sort EBG structure has been outlined that comprise of occasional metallic patches associated to shared view through shorted stubs. The measurement of extension is 0.25x1mm2. Every component comprise of a 4x4mm2 rectangular patch, a stub of range 0.2mm, FR4 Epoxy substrate of thickness 1.6mm and ground plane of measurement 4x4mm2. Figure.2. Demonstrates the structure also, equal circuit of two fell components of EBG structure.

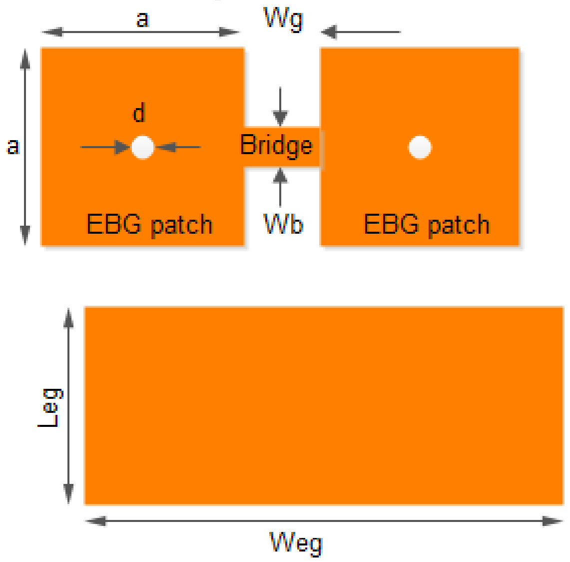


Figure.2. Span association between two unit cells (a=4mm, Wg=1mm, d=0.2mm, Wb=0.25mm and d=0.2mm) Figure.4. Ground plane of EBG structure (Weg=9mm and Leg=4mm) Figure.5. Proportionate circuit of two fell unit cells fLow= (10).

C) Design of 1x2 antennas:

Single Input Single Output monopole patch antennas gives compact size and wideband response but it is a poor radiator. With the introduction of 1x2 or 2x2 Multiple Input Multiple Output protocols not one but two antennas are needed in 4G communication systems. That is, the proposed partial ground plane antenna is a good choice for the 4G communication systems if mutual coupling between the elements are less.Two achieve a 1x2 monopole antenna two single patches are incorporated on the common substrate and common partial ground plane. To avoid the mutual coupling between them both the patches should be placed apart from their near field regions.

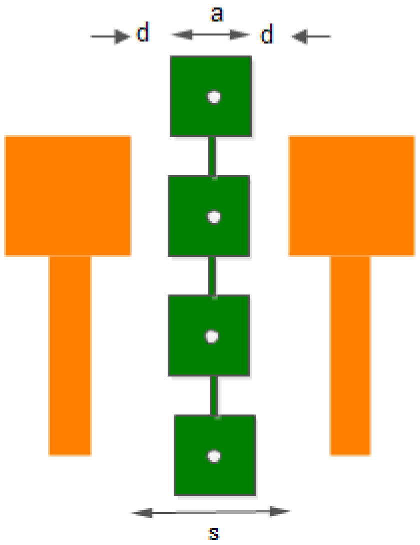
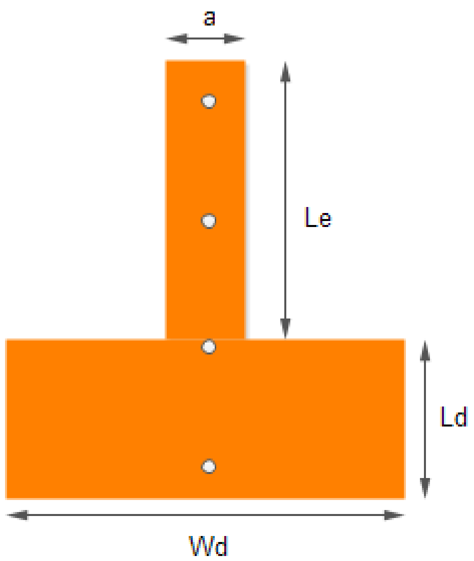


Figure.3. Structure of 1x2 rectangular patch antenna with EBG structure (d=0.5mm, a=4mm and s=5mm) .

D is the maximum dimension of the antenna. λmin is associated with the higher cutoff frequency of the wideband antennas.Figure.3 shows the 1x2 configuration of rectangular patch antennas. The ground plane of proposed antenna is depicted in Figure.4.



The edge to edge separation between the patches is 5mm and the ground plane of EBG structure and antennas forms a backed T-shape Ground plane. The patches are placed more than four times closer than their near field regions. Figure.4. Ground plane of 1x2 patch antennas with EBG structure (Ld=8mm,Wd=17.6mm, Le=11.6mm and a=4mm) The ground plane of 1x2 antennas is quite larger than the single element Ld= (16) For the proposed monopole rectangular patch antenna -10dB and D is 19.6mm.That is the patches must be placed at a separation of 22mm,this will lead to a larger antenna size. As mushroom type EBG structure is placed in between the patches the separation is reduced to 5mm with good radiation characteristics.

III. RESULTS AND DISCUSSION

A miniature 1x2 wideband antenna has been designed and the measured results are shown below prototype is presented. The proposed antenna is very compact with wideband response. The bandwidth of proposed antenna is 66% and antenna is 83% compact than the conventional antenna. The structure of antenna is very simple and can be easily fabricated. The results of proposed antenna are satisfactory and can be implemented for 4G application for 4.42 GHz to 7.15GHz frequency band.

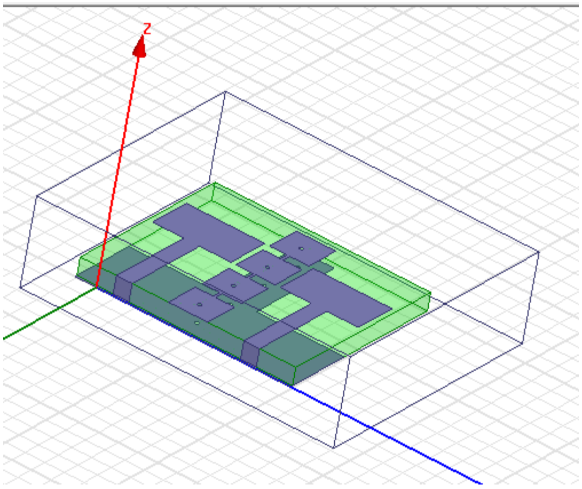


Figure.5.3D View of Design Element.

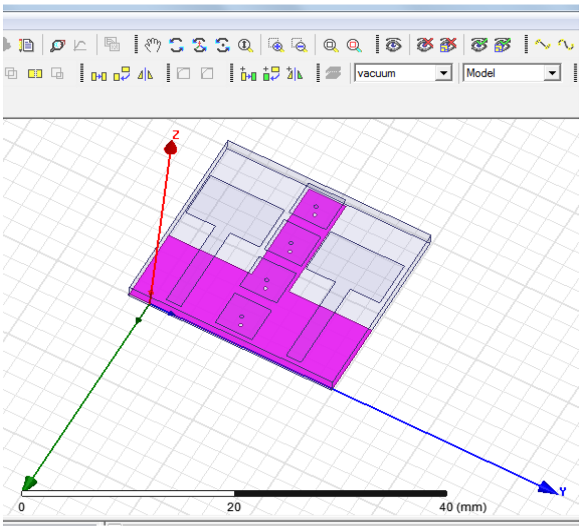


Figure.6.Top View of Design Element.

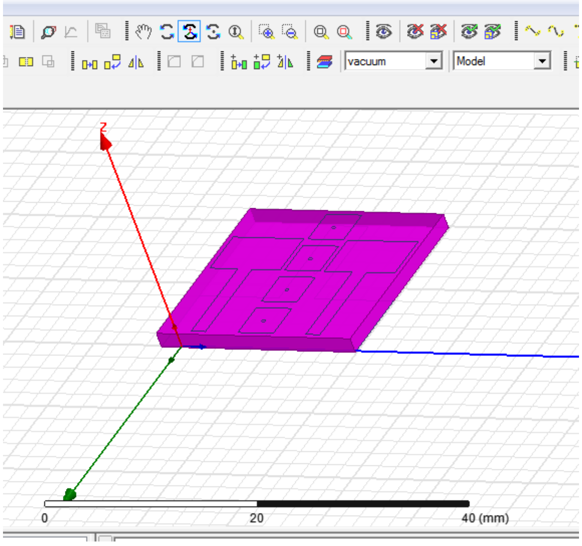


Figure.7.Side View of Design Element.

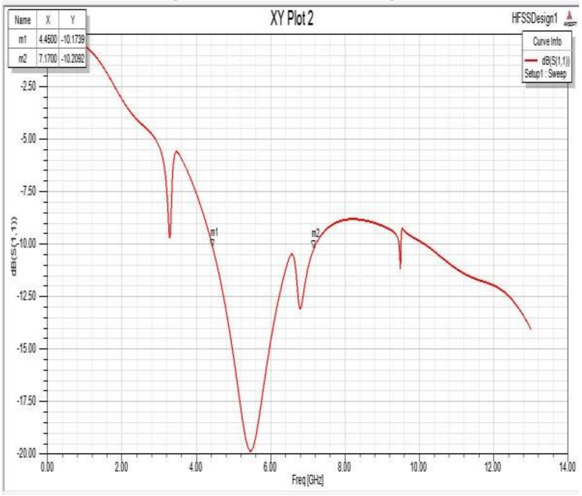


Figure.8.Measured results of Reflection Coefficient.

IV. CONCLUSION

The 1*2 miniature antenna is designed and prototype is presented. The proposed antenna is very compact with wideband response. The bandwidth of proposed antenna is 66% and antenna is 83% compact than the conventional antenna. The structure of antenna is very simple and can be easily fabricated. The results of proposed antenna are satisfactory and can be implemented for 4G application for 4.42 GHz to 7.15GHz frequency band.

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