RESEARCH ARTICLE

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MIMO Antenna for 5G Applications with Polarization Diversity

Punna Bharghava*[1] , Pachiyaannan Muthusamy[2]

1,2 Advanced RF Microwave & Wireless Communication Laboratory, Vignan's Foundation for Science, Technology & Research (Deemed to be university), Andhra Pradesh, India, e-mail : punnabharghava@gmail.com, pachiphd@gmail.com

ABSTRACT

Two element MIMO antenna with left and right hand circular polarizations is written in this work. The size of the proposed MIMO antenna is of 58.2 x 36.3 mm^2. The coaxial feed is used for the individual patches. Without any decoupling network high isolation of 18dB is accomplished. It is due to orthogonal orientations of the micro strip patches. The envelope correlation coefficient (ECC) is in the acceptable range.

Keywords: Circular Polarization, Envelope Correlation Coefficient (ECC), Multiple Input Multiple Output (MIMO).

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INTRODUCTION

Now a days, the problem in communication system like multipath fading is overcome by MIMO antennas. Because of the presence of multiple numbers of antennas at transmitter point and/ or receiver point, channel capacity is enhanced. Some MIMO systems are reported in the literature where isolation is achieved by different techniques between the patches. In many popular methods to get high isolation, usage of parasitic stubs is one [1]. But the drawback is size and complexity of design. The placement of radiating elements orthogonally without any decoupling network also provides good isolation [2, 3] and this technique is providing dual polarization or polarization diversity.

In papers [4]-[8], different MIMO antennas were proposed. To have information about diversity nature of MIMO antennas, calculation of ECC [9] is very essential. To have polarization diversity [10] & [11], square patches with notches are used. Notches on patches also provide miniaturization of antenna.

In this paper, 2 – element MIMO antenna of 58.2 x 36.2 mm^{2}size is presented. The elements in MIMO configuration have different polarizations. Good amount of isolation is achieved by placing antenna elements perpendicularly without decoupling network. The ECC provides diversity nature of MIMO antenna.

Corresponding Author : Punna Bharghava, Advanced RF Microwave & Wireless Communication Laboratory, Vignan's Foundation for Science, Technology & Research (Deemed to be university), Andhra Pradesh, India, e-mail : punnabharghava@gmail.com.

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ANTENNA CONFIGURATION

Figure 1 represents proposed MIMO antenna. The material FR4 is used as substrate for the fabrication of antenna. The substrate FR4 is with height of substrate h=1.6mm and loss tangent is 0.02.

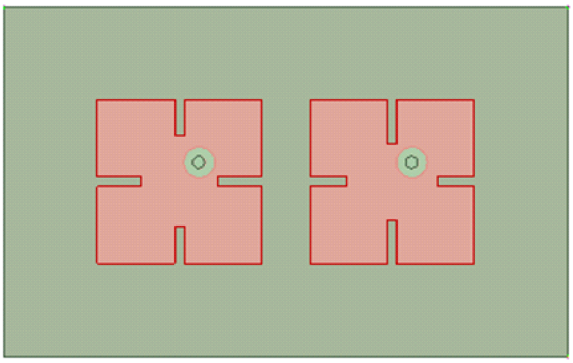
Notched Square patch

The square patch element with small dimensions 17 x 17 mm^2 for 4GHz. By providing notches on radiating and non radiating edges for the square patch, resonant frequency is decreased to 3.5 GHz because the path length for current is increased with same dimensions of 17 x 17 mm^2. To have circular polarization coaxial feeding is provided in

such a way that two orthogonal modes are excited because of slight difference in between the notch lengths. The reflected power notation return loss $S_{11}$of single radiating element is in Figure 2. The impedance band width is about 96MHz.

Two Element MIMO Antenna

The two coaxial feeds are given to two patches and two patches are oriented in an orthogonal manner. The designations were given to two antennas as ant-1 & ant-2. These are excited by port 1 & port 2. The simulated S-parameters are in Figure 3.



58.2mm

Figure 1: Two Element MIMO Antenna

Isolation Mechanism between Ant-1 & Ant-2

Isolation is accomplished by placing the antennas orthogonal to each other. The distance between the patches determines the isolation as a key point. Radiation pattern is shown in Figure 7.

RESULTS & DISCUSSIONS

The simulated results of the antenna like S11, S12 are in Figure 2 and in Figure 3. Because of two radiating elements are similar, S- parameters of one antenna only are represented in this paper. The impedance bandwidth is 96MHz and mutual coupling effect between the antennas is less than 20dB. The radiation pattern of single antenna is given in Figure 4 & Figure 6 represents Gain plots. The MIMO antenna characteristics can be described by using two parameters: Diversity gain and ECC. ECC is given using the equation.

$$\frac{|S_{11}S_{12} + S_{21}S_{22}|^2}{(1 - |S_{11}|^2 - |S_{21}|^2)(1 - |S_{22}|^2 - |S_{12}|^2)}$$

The ECC for the presented MIMO antenna is 0.001 which is very much effective.

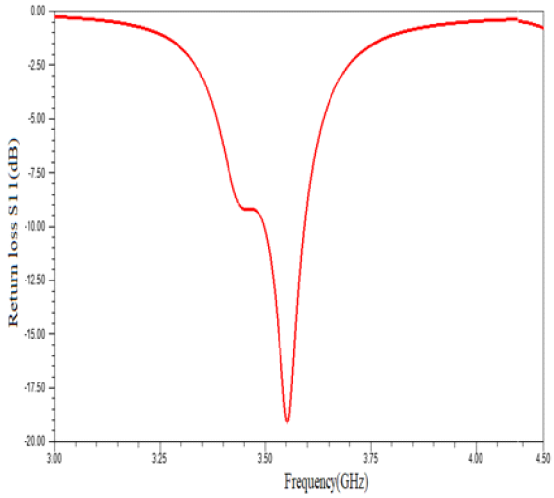


Figure 2: Return loss (S_{11}) plot for Ant-1

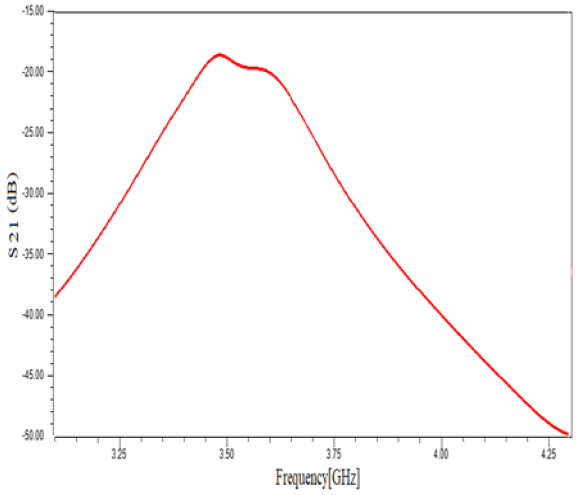


Figure 3: Isolation (S_{21}) plot for Ant-1

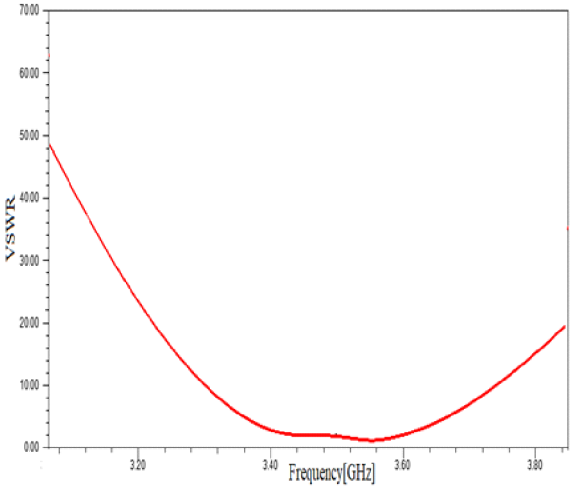


Figure 4: VSWR plot for Ant-1

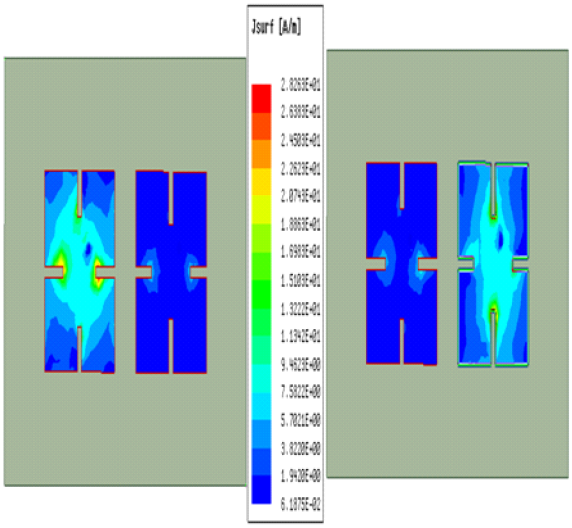


Figure 5: Distributions of surface current of radiating element-1 & -2 when next antenna is terminated with 50Ω

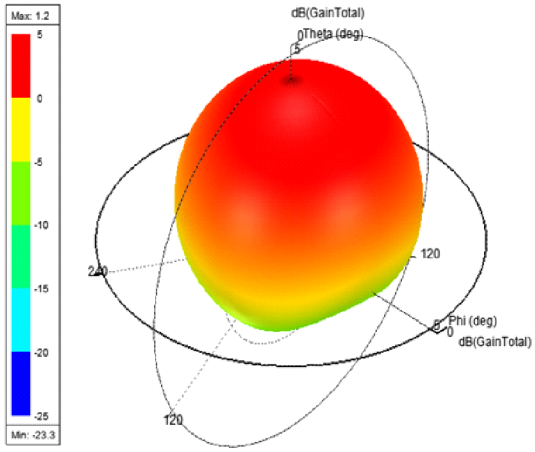


Figure 7: Radiation pattern of Ant-1

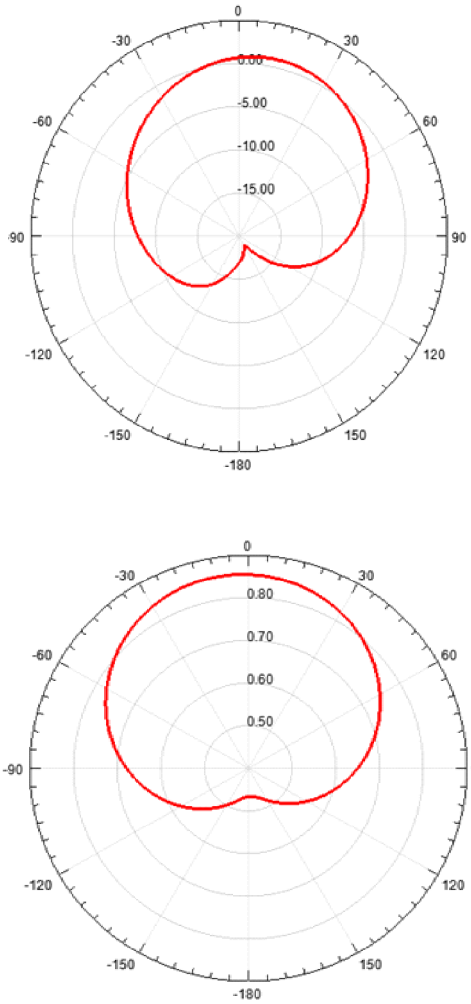


Figure 6: Gain plots

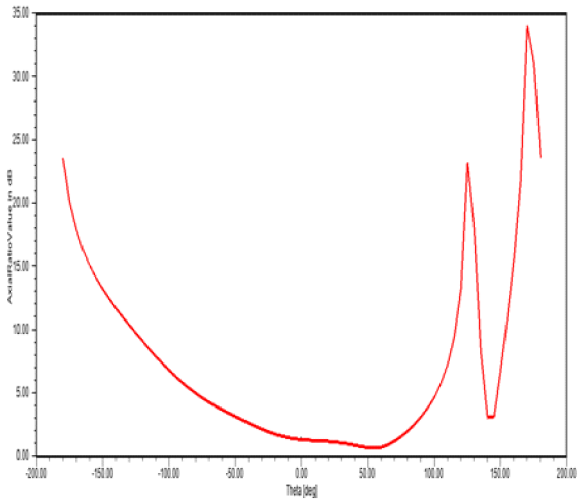


Figure 8: Axial Ratio

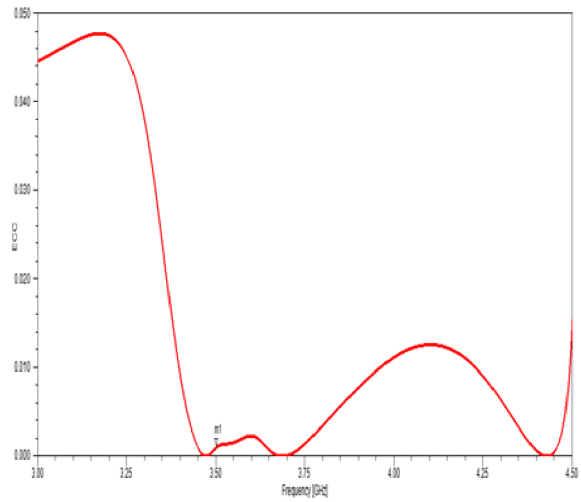


Figure 9: Envelope Correlation Coefficient

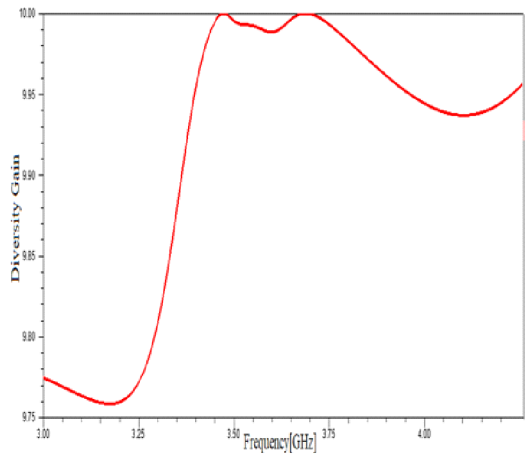


Figure 10: Diversity Gain

CONCLUSION

Two radiating element diversity antenna is described in the proposed letter. Notches are used for the square patches for getting circular polarization and miniaturization. The coaxial feeds are used for the two patches. Sufficient amount of ECC=0.001 and diversity gain is around 10 is obtained. Good amount of isolation S_{21}<= -18dB is obtained.

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