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Biconvex Patch Antenna with Rectangular Slot for 15 GHz Application

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Abstract

In this paper, the modification of the circular patch has been done which resulted the biconvex lens structure and then the design has been done by using the HFSS software. The modified structure results a perturbed patch. The ground plane and the substrate have the dimension 40×40 mm. FR4 Epoxy material has been taken as the material for the substrate. After that the simulation is carried out by giving the solution frequency 15 GHz. Then from the simulation result the return loss, VSWR , Antenna Gain , Current distribution and directivity has been calculated.

Keywords*: HFSS, Perturbed Patch, S-Parameter, VSWR.*

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1. Introduction

In recent years many perturbation has been done in patch geometry to get the optimum results. In the year 2016, a perturbed elliptical patch antenna has been designed for 50GHz frequency [1]. In the same year, the biconvex lens structured patch antenna has been designed with and without slot for different range of frequencies like 10 GHz and 5.9 GHz [2, 3]. The log periodic implementation of the biconvex patch antenna has been done for Ku Band applications [4]. Recently the biconcave lens structured patch antenna has been designed for Ku Band Application [5]. Similarly the log periodic implementation of a modified patch resulting the shape similar to a crescent moon has been implemented for specified application [6]. In this paper, the patch design has been modified in such a way that the intersecting area of two circular patch will remain as the main radiating element on the substrate. A line feed is given to the patch. To enhance the bandwidth different slots like L slot, E slot, U slot etc. has been implemented [6]. Here a simple square slot has been implemented and the simulation results were calculated.

2. Antenna Design

Generally patch antenna has four parts named as ground plane, substrate, patch and the feed [7]. The proposed antenna also has basically 4 parts; first one is the ground plane having a dimension of 40×40 mm and the copper material has been used, second is the substrate having the material FR4 epoxy substrate which is

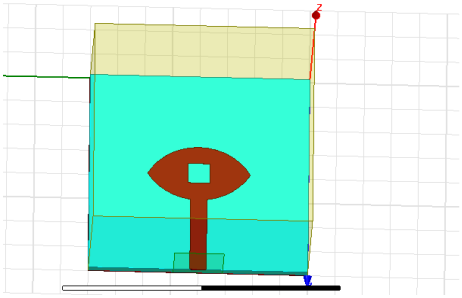

Fig. 1: Structure of the Proposed Patch

having the dielectric constant 4.4 and the dimension of the substrate is same as that of the ground plane (40×40 mm), then the patch was designed in such a way that it will lead to a biconvex lens structure, and then the line feed has been calculated which resulted 3 mm. A wave port has been assigned and then simulation was carried out with the help of High Frequency Structure Simulator software (HFSS). HFSS Software is very nice electromagnetic software which is suitable for all the electromagnetic simulation. This uses finite element method.

3. Simulation Results

From the simulation result, it was found that the antenna is resonating at a frequency of 14.7 GHz with a return loss of -13dB, and then VSWR was found out to be 1.21 which is nearly equal to 1. Generally, VSWR is termed as Voltage Standing Wave Ratio which is ratio between the maximum voltages to the minimum voltage of a standing wave which is produced by terminating one end of a transmission line [8]. Then the radiation pattern has been calculated and the peak gain was found out to be 3.47 and peak directivity was found out to be 5.06.

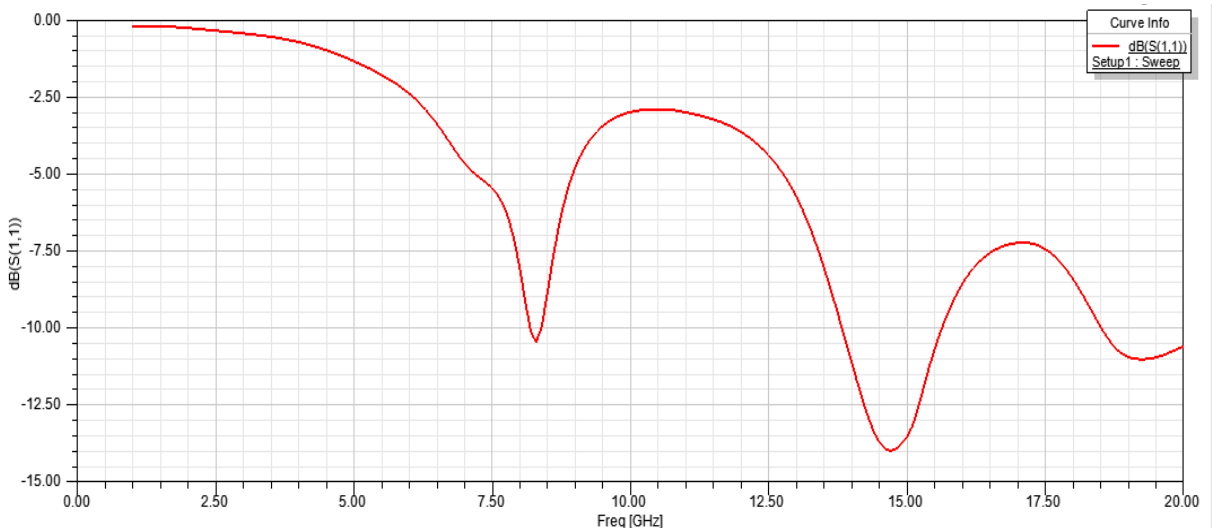

Fig. 2: Structure of the Proposed Patch

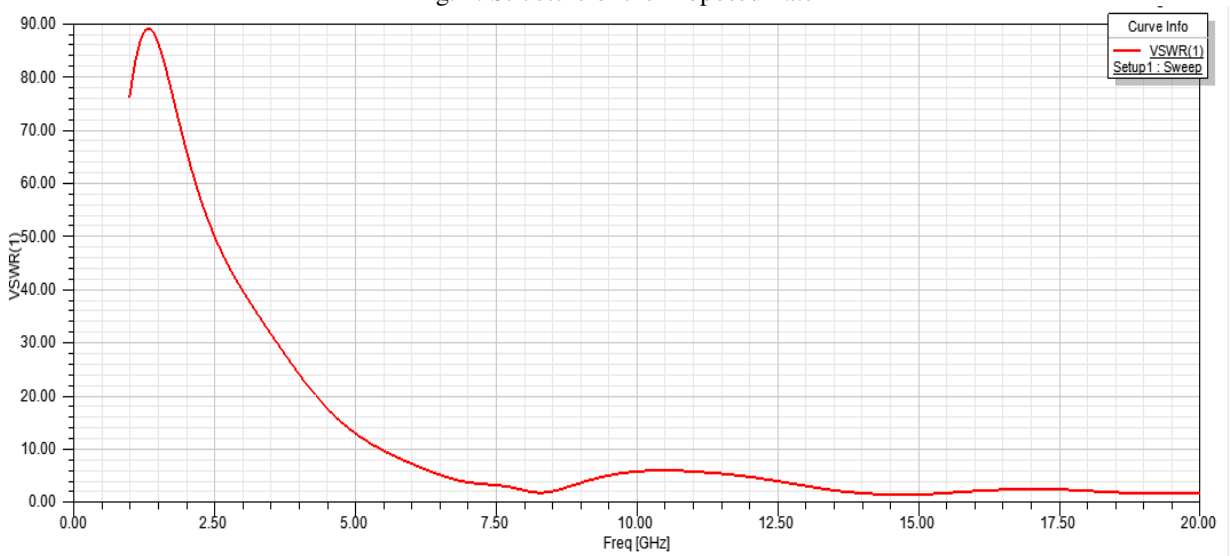

Fig. 3: Structure of the Proposed Patch

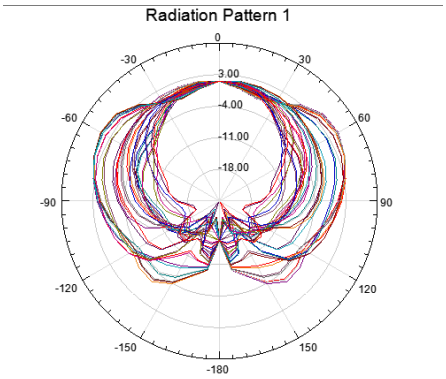

Fig. 4: Radiation Pattern

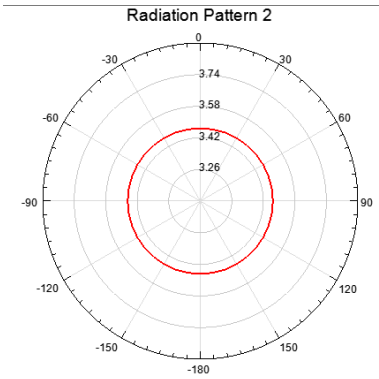

Fig. 5: Peak Gain

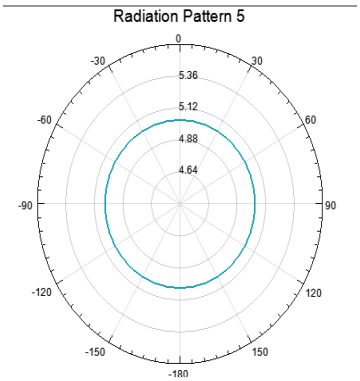

Fig. 6: Peak Directivity

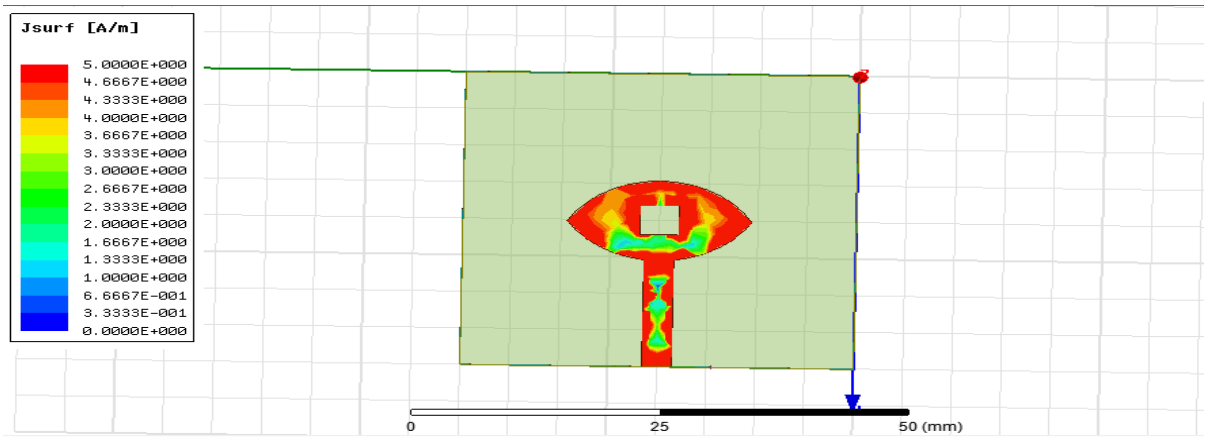

Fig. 7: Surface Curent Distribution

4. Conclusion

The proposed antenna has been designed using HFSS software and from the simulation result, it is found that the resonating frequency is at 15 GHz which is suitable for many applications like RADAR, military and wireless communication. The gain is optimum and directivity is high which makes the antenna suitable to use in practical field.

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