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Design and Simulation Based Study of Microstrip E–Shaped Patch Antenna Using Different Substrate Materials

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Abstract

In this paper, E shaped microstrip patch antenna is being proposed. Here E shaped microstrip patch antenna is being designed using FR4-epoxy and epoxy-kevlar material. The permittivity of FR4-epoxy and epoxy-kevlar is 4.4 and 3.6 respectively. The return loss, radiation pattern & gain of the proposed antenna show that it has promising characteristics for various wireless communication applications. In this paper the effects of changing the permittivity of the substrate is also studied. It is analyzed that how antenna performance varies while changing the value of dielectric constant. The proposed antenna is co-axially fed. The design is being simulated using HFSS (High Frequency Structure Simulator) software.

Keywords: Co-axial fed;microstrip patch antenna.

1. Introduction

A microstrip patch antenna comprised of a radiating patch on one side of dielectric substrate while has a ground plane on the other side [1]. The radiating patch can be of any geometrical configuration like square, rectangle, circular, elliptical, triangular etc [2]. The material which has the dielectric constant in the range of $2.2 \leq E_r \leq 12$ can be used as substrate. A microstrip patch antenna finds tremendous attention because of several advantages which it has over the conventional antennas. Some of the merits of microstrip patch antenna are low profile, light weight, low volume, low cost and can easily be integrated with the microwave integrated circuits [3].

In this paper, a microstrip patch antenna having shape of alphabet E is being proposed. The objective of this paper is to study the effect of different substrate material on E shaped microstrip patch antenna [4][5][6][7]. The effect of changing the

dielectric constant is analyzed in this paper. The two different materials used here are FR4-epoxy and epoxy-kevlar with value of dielectric constant as 4.4 and 3.6 respectively. The proposed antenna is fed co-axially. The simulation is being done using HFSS software.

2. Antenna Geometry

The design geometry of the E shaped antenna is shown in Fig. 1. The dimension of the substrate is taken as 41mm x 31mm. The thickness (H) of the substrate is taken as 1.5mm. The patch is being formed by cutting the slots so that the required designed can be formed and the desired characteristics can be obtained. The two arms of the patch are of the size 8.5mm x 3.5mm. The middle arm is of the size 8.5mm x 7.5mm. The antenna configuration proposed in this article is co-axially fed. The feed point is being searched using the hit and trial approach. The other dimensions of the design are given below in the table.

W	L	H	A	B	C	D	E
31mm	41mm	1.5mm	31mm	21mm	8.5mm	7.5mm	3.5mm

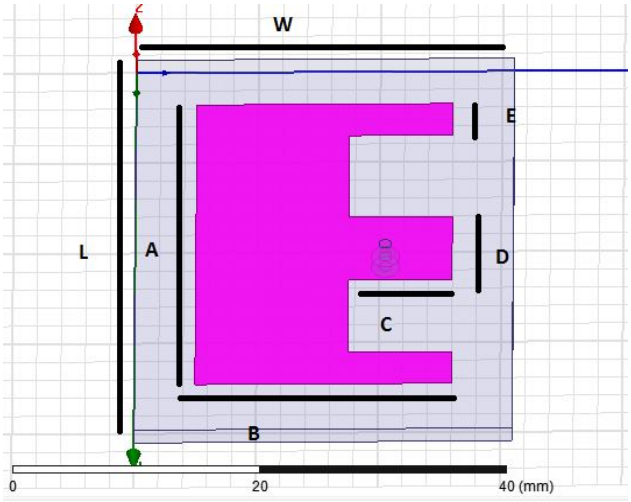

Fig. 1

3. Simulation Results Using Fr4 As Substrate

The simulation of the design is being done using HFSS software. The substrate used here is FR4 having dielectric constant 4.4. The above given dimensions are used to simulate the structure. The operating frequency of this design is 9.8 GHz and the obtained return loss is -21.4158dB. The gain obtained at this frequency is 4.45 dB which is better than conventional antennas. The simulation results are shown with the help of Fig. 2 and Fig. 3. The proposed antenna is radiating very efficiently as can be seen by the Fig. 4.

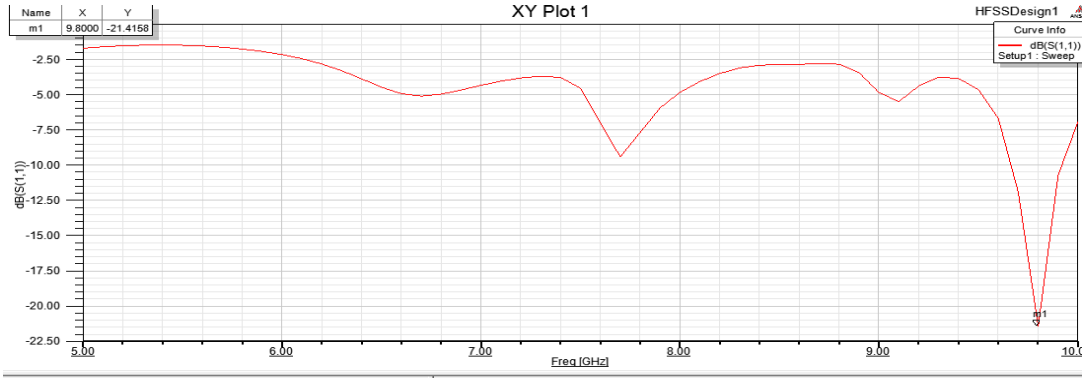

Fig. 2

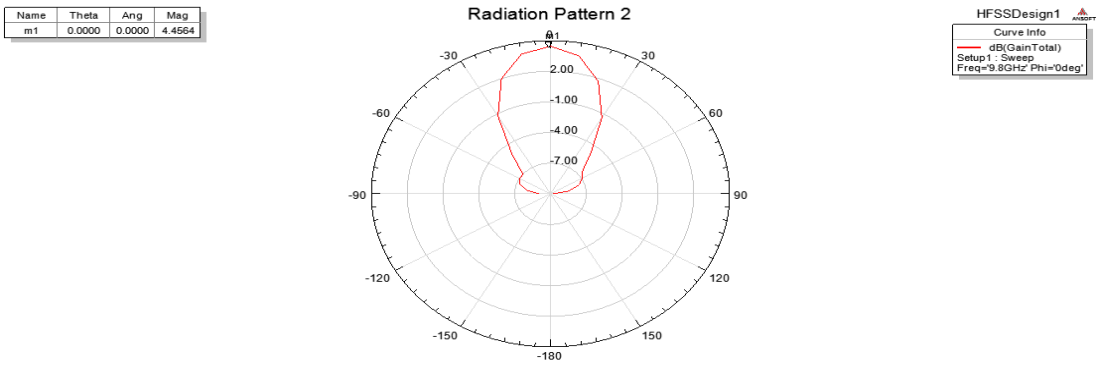

Fig. 3

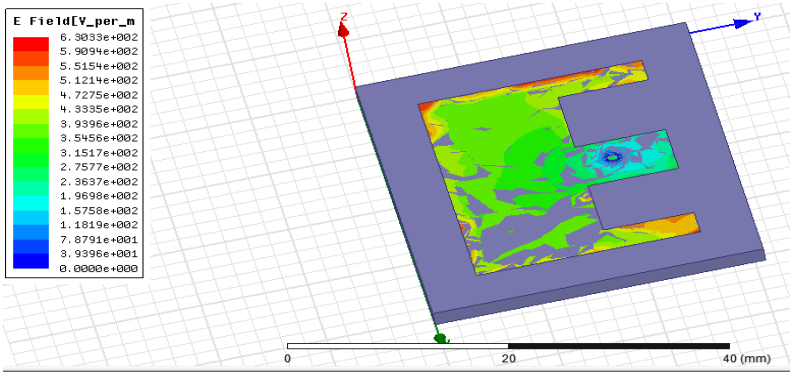

Fig. 4

4. Simulation Results Using Kevlar as Substrate

Here the substrate used is epoxy-Kevlar having dielectric constant 3.6. The other dimensions of the design are same except the substrate. An antenna is operating at a frequency of 10.8 GHz and return loss obtained is -21.2481dB. The gain obtained at this frequency is 6.2916 dB. The simulated results are shown in the Fig. 5 and Fig. 6. By changing the dielectric constant antenna performance increases. Fig. 7 shows field pattern.

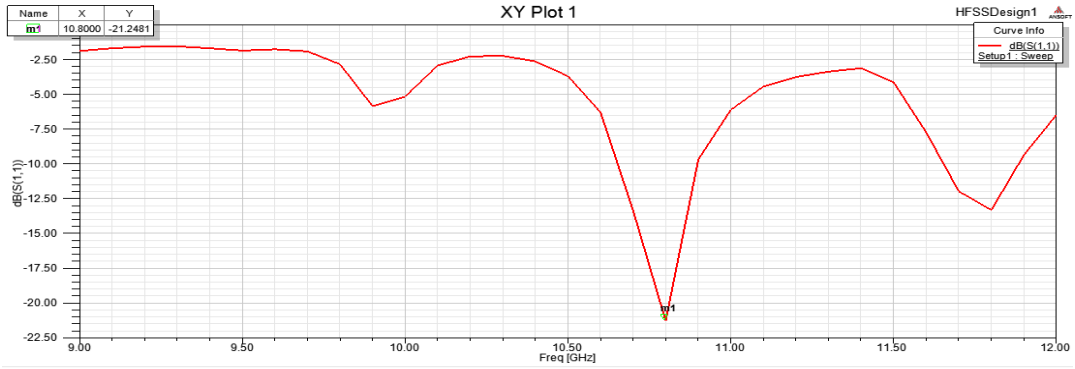

Fig. 5

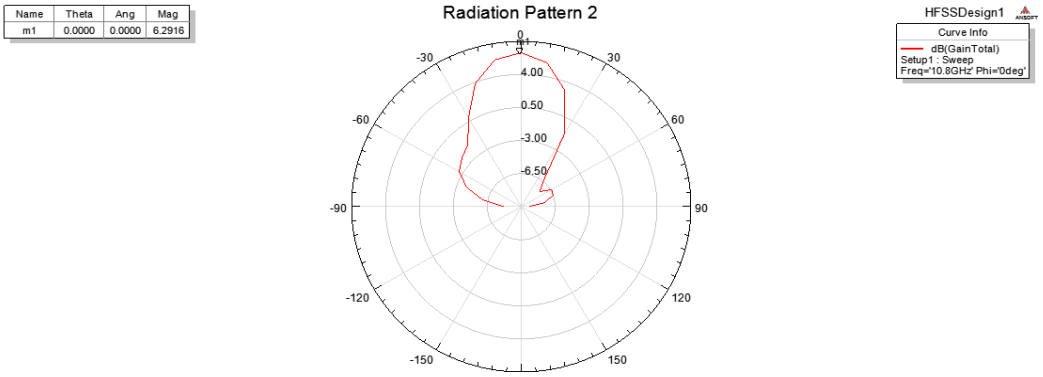

Fig. 6

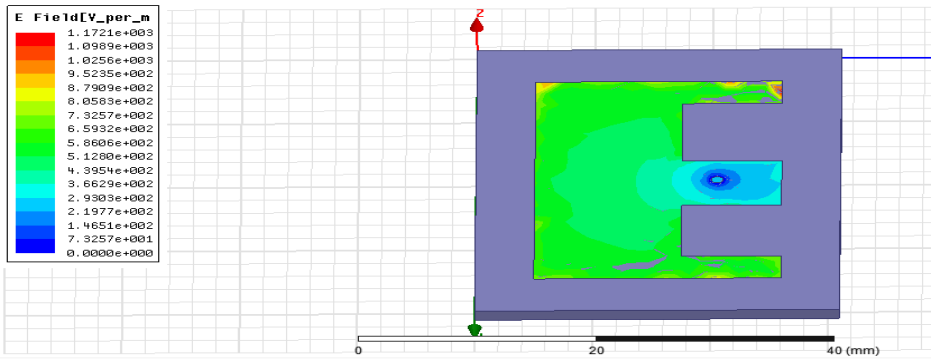

Fig. 7

5. Conclusion

In this paper E shaped microstrip antenna is being proposed & design is being simulated using two different substrates i.e. FR4 & Kevlar. It is being observed that when the value of dielectric constant is reduced i.e. from 4.4 to 3.6 then gain increases. When FR4 is being used as substrate the return loss & gain is obtained as -21.41 dB & 4.45 dB at operating frequency of 9.8GHz. To decrease the value of dielectric constant Kevlar is being used as substrate. The return loss & gain obtained after using Kevlar is

-21.24 dB & 6.29 dB respectively at frequency 10.8 GHz. This shows that substrate influences the performance of antenna to a great extent. Here it is analyzed that the performance improves when the value of dielectric constant is reduced. The gain increases from 4.45 dB to 6.29 dB when value of dielectric constant is changed from 4.4 to 3.6.

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