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1 Introduction

Microstrip patch antennas are most significant with their unique abilities of low profile and ease of fabrication. Though microstrip antennas are widely been used they are having some limitations in terms of gain and bandwidth [1]. Microstrip antennas have low gain and band width due to which they are not been used for specific applications. To overcome these limitations many techniques and design considerations are been proposed by researchers and are been successfully implemented. One of the technique for gain enhancement is to use a substrate with low dielectric constant and to enhance the bandwidth thickness of the substrate is to be increased [2]. But there are limitations for these methods also, with increase in the substrate after a significant height the bandwidth will again decrease and also the long probe length will increase inductance on the antenna and it will reduce the impedance bandwidth [3]. And the material cost increases with reduction in the dielectric constant. To overcome these limitation here we proposed a meandered E shape patch antenna with a air cavity. Air is having a dielectric constant of one and is having no material losses. So air cavity is been placed between the substrate and the ground plane so that the effective dielectric constant of substrate and air cavity will be very low and is useful for the gain enhancement[4]. This will also help in bandwidth enhancement as the height between the patch and the ground plane is high will give high bandwidth. By using air cavity we can also minimize the inductance effect of the long probe length and by having a meandered radiating patch the inductance effect of the probe will be cancelled. For the fabrication purpose the air cavity can be filled with a non radiating foam which will not affect the radiation characteristics of the antenna and will provide additional physical strength to the antenna [5].

2 ANTENNA DESIGN

The geometry of the proposed antenna is shown in Figure 1, the antenna consists of a aluminum ground plane, RT Duroid 5880 substrate, a meandered rectangular patch in the shape E shape and a air cavity in between the substrate and the ground plane. Coax feed is provided for excitation of the patch antenna. The air cavity is 12mm in height and the aluminum ground plane is 1mm in height. The substrate is having a thickness of 62mil. For fabrication purpose the air cavity can be filled with non radiating foam materials like ROHACELL which do not affect the radiation characteristics of the antenna and will provide additional physical strength to the antenna.

The ground plane and the substrate are having a length and width of 145mm145mm. The rectangular patch is having a dimension of 88.75mm110mm and the slots dimensions are 52mm7mm, four slots of equal dimensions are etched on the antenna edge which are placed at equal distance from each other. The feed is provided near to the opposite edge of the slotted edge. The patch is placed at the center of the substrate. The air cavity provides the high gain and bandwidth enhancement for the antenna and the meandered slot helps in improving the bandwidth of the antenna

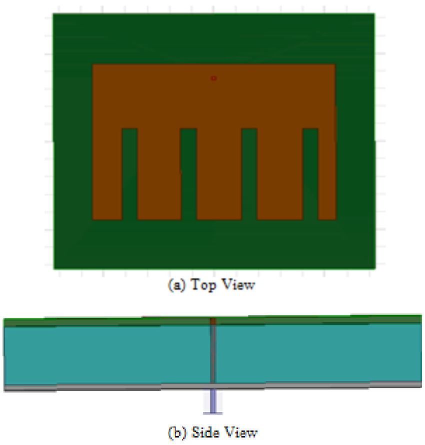


Fig. 1. Proposed patch antenna

3 RESULTS AND ANALYSIS

Figure 2 depicts the simulated S11 characteristics of the proposed antenna. A return loss of -15.47dB is observed at the operating frequency of 1.35GHz. A 10dB bandwidth of 89 MHz which is 6.7% of bandwidth and it is ranging from 1.30GHz to 1.39GHz. Observed a VSWR value of 1.4 at 1.35GHz as shown in Figure 3.

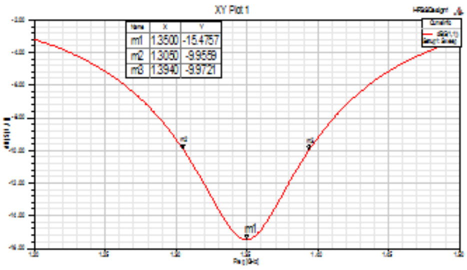


Fig. 2. Return loss

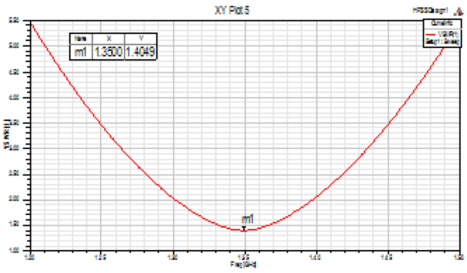
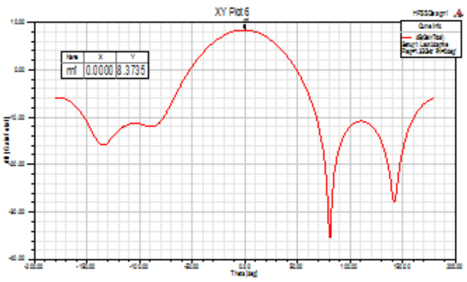
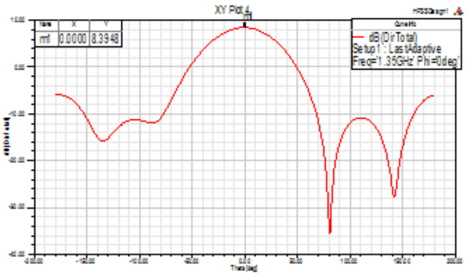


Fig. 3. VSWR

A air cavity is introduced in between the ground and the substrate which improves the gain of the antenna. The Air cavity height is adjusted such that the antenna radiates at the required operating frequency with a maximum achievable gain. The simulated gain and directivity plots of the proposed antenna are presented in Figure 4 below. The gain observed at the frequency of 1.35GHz is 8.37dB and directivity observed is 8.39dB.



(a) Gain



(b) Directivity Fig. 4 Gain and Directivity at 1.35 GHz.

The current distribution in the meandered patch at the operating frequency of 1.35GHz is shown in the figure 5, it can be clearly observed that the slotted edges are radiating mostly at the operating frequency.

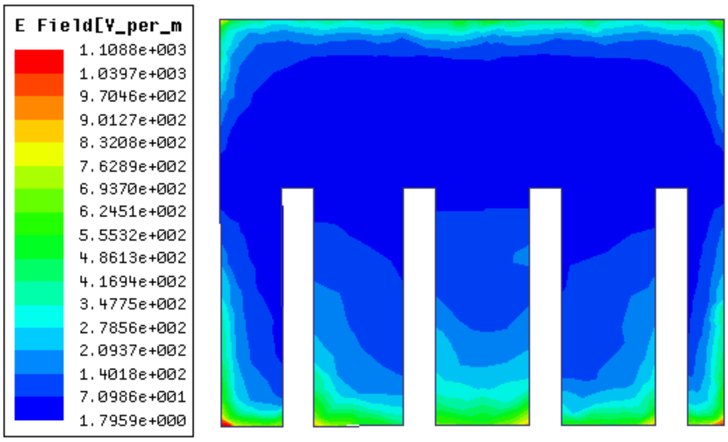
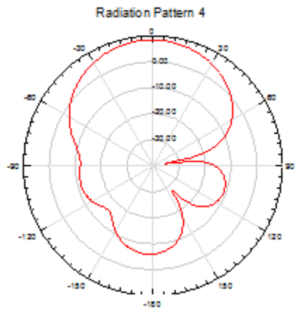
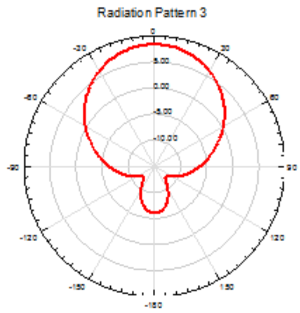


Fig. 5. Current distribution at 1.35GHz

Figure 6 below the radiation patterns of the proposed antenna at 1.35GHz for both Elevation plane and Azimuthal plane. Half power beamwidth of 63 and 67 are observed for the Elevation and Azimuthal planes respectively at 1.35GHz. Notable, radiation patterns obtained for the proposed patch antenna are broadside when compared to the radiation properties of the normal microstrip patch antenna[6]-[10].



(a) Elevation Plane



(b) Azimuthal plane

Fig.6 Radiation patterns of proposed antenna at 1.35GHz

4 CONCLUSION

In this paper, simple techniques are been proposed and investigated successfully to overcome the basic limitations of gain and bandwidth for a microstrip antenna. A coax fed meandered E shape patch antenna with a air cavity is presented. The meandered patch provides band width enhancement and the air cavity along with a thick aluminum ground plane combindly provided gain enhancement. E shaped patch has been formed by considering a basic rectangular patch and by etching slots at the edge of the patch. The simulated results show a bandwidth of 89MHz ranging from 1.30GHz to 1.39GHz with a maximum gain of 8.37dB at the operating frequency of 1.35GHz.. The proposed antenna have a compact dimension of 145mm145mm14.5mm and is best suitable for the L band applications.

5 ACKNOWLEDGMENT

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Printed circuit board (PCB) antenna commonly used in commercial and medical applications because of its small size, low profile, and low cost compared to low temperature cofired ceramic (LTCC) technology. The proposed structure of PIFA is implemented on PCB to gain all these advantages.Â This paper focuses on a printed inverted-F antenna (PIFA) with meandering line and meandering shorting strip under 2.4 GHz industrial, scientific, and medical (ISM) band for Internet of things (IoT) applications. Bluetooth Low Energy (BLE) technology is one of potential platforms and technologies for IoT applications under ISM band. Microstrip patch antenna consists of a thin metal foil mounted on a substrate, beneath the substrate there is a presence of ground[3]. This microstrip patch antenna can be integrated very easily on the surface of PCB, which can be used in mobile devices as well. Mostly these antennas are used in microwave and millimeter frequency bands. II. Design Equations For Patch Antennas. The blue print of microstrip patch antenna that is developed at 28 GHz and 50 GHz shown in figure 1. This uses an inset line feeding technique.Â T.Kiran "Design of Micro strip Patch Antenna for 5g Applications." IOSR Journal of Electronics and Communication Engineering (IOSR-JECE) 13.1 (2018): 14-17. DOI: 10.9790/2834-1301011417. Patch and loop antennas were designed with metamaterial dielectric substrates [10]. The aim here was to significantly decrease the physical size at the operating frequency. A loop antenna with approximately one wavelength perimeter that resonated in air at 2.58 GHz was mounted over a stack of pc boards on which were etched groups of split ring resonators as shown in Fig.Â The fundamental resonance of the cavity formed by the microstrip patch antenna will occur at the frequency where the total effective length of the patch antenna, b + 2Î”loc, is equal to one-half a guided wavelength in the microstrip cavity. The equation representing this concept is as follows: FIGURE 11.15. The following drawing shows a patch antenna in its basic form: a flat plate over a ground plane (usually a PC board).Â Therefore, the fundamental mode of a rectangular patch is often denoted using cavity theory as the TM10 mode. Since this notation frequently causes confusion, we will briefly explain it. TM stands for transversal magnetic field distribution.Â This tends to turn selecting the right antenna for a specific application into quite a burden. Directivity/gain bandwidth This is the frequency range wherein the antenna meets a certain directivity/gain requirement (e.g., 1 dB gain flatness). Efficiency bandwidth This is the frequency range wherein the antenna has reasonable (application dependent) radiation/total efficiency.