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Investigation of T-Shaped Compact Dielectric Resonator Antenna for Wideband Application[1]

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Abstract—In this paper, a novel T-shaped compact Dielectric Resonator Antenna (DRA) is proposed for wide band application. The proposed antenna covers C- and X-band. Two different techniques namely partial ground plane and multi stacked elements have been used in the designing of the proposed antenna to improve the performance of the antenna. It is observed that the air gap between two dielectric materials stacked together in DRA enhances the bandwidth of the antenna. Impedance bandwidth offered is 84% which covers a range from 4.18 to 10.27 GHz (6.09 GHz) for $|S_{11}| < -10$ dB. The analysis of field lines shows that $TE^z_{11\delta}$ mode exists at 5.66 GHz and $TE^z_{12\delta}$ mode exists at 9.76 GHz, when it is excited by center probe feed in z direction. Maximum gain achieved over the frequency range is 4.72 dBi at 5.77 GHz and 4.3 dBi at 9.76 GHz. The maximum radiation efficiency is 95% at 5.66 GHz. The proposed antenna is simulated in CST and HFSS softwares and simulated results have been validated through the comparison of the experimental results of a fabricated prototype.

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1. INTRODUCTION

Dielectic Resonator Antenna (DRA) exhibits very attractive features for wireless communication like wide bandwidth (BW), high efficiency etc. DRA scores over the microstrip antenna in the term of impedance bandwidth as no conduction loss occurs in DRA due to the absence of any conducting material. Besides microstrip antenna radiates only within a specific area of patch [1] while in DRA fields are radiated from the whole structure.

There are three basic structures that have been investigated namely rectangular, cylindrical and hemispherical DRA [2]. Among these structures, rectangular shape DRA offers a higher degree of freedom i.e. two, as compared to cylindrical and hemispherical shape for optimizing the physical dimension of the DRA. Modes in a DRA specify the orientation of the fields that exists in the DRAs. Many excitation methods like probe feed, microstrip feed, aperture feed, coplanar feed, etc. [2, 3] have been investigated to excite suitable modes.

Use of high dielectric constant (ε_r) material [4], metal plate along the symmetry of DRA [5], electric monopole in DRA, sectored cylindrical DRA [2, 3], etc. are some of the methods used for designing compact DRAs while hybrid DRA, stacked DRA [6, 7], composite shapes [8], notched DRAs, ring DRAs, fractal DRAs [9, 10], partial ground plane DRAs etc. are some of the techniques used for enhancing the bandwidth and performance of the DRA [11–21].

In this paper, a partial ground plane with stacked T-shaped compact DRA which is excited by probe feed is proposed. Probe feed excitation has been used as it gives better impedance bandwidth response and efficient coupling [2, 3]. The stacking of two different dielectric resonators and the insertion of the air gap

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