A Broadband Cylindrical Dielectric Resonator Antenna Excited By Conductor Backed Coplanar Waveguide

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ABSTRACT

The radiation and resonance characteristics of cylindrical dielectric resonator antenna excited by a conductor backed co-planar waveguide (CB-CPW) is presented in this paper. The proposed antenna configuration offers a 2:1 VSWR bandwidth of 18 % with excellent gain and cross-polar level.

INTRODUCTION

The rapid progress in microwave communication demands miniaturization of microwave circuits. Dielectric resonator placed over the ground plane can serve as an effective radiator since the electromagnetic waves extends beyond the geometrical boundary of the cavity [1]. The Dielectric resonator Antennas (DRA) have attracted the antenna designers in microwave and millimeter band due to its features like high radiation efficiency, low temperature coefficient of frequency, zero conductor losses and suitable scale in microwave band. DRs with $30 < \varepsilon_{dr} < 60$ is ideally suitable for antenna applications, so that a compromise can be made between size, operating frequency and other antenna radiation characteristics [2]. Coaxial probe, direct Microstrip line feed, printed coplanar waveguide, soldered-through probe, conformal-strip feed and rectangular wave guide [3] are the different techniques employed to excite a DRA. Due to uniplanar nature of CPW line, it offers advantages from point of view of integration with active and passive devices. Moreover, due to the low loss and less dispersive nature of the CPW line, the CPW line has emerged as an attractive alternative to traditional Microstrip and probe feed. Radiation and resonance characteristics of cylindrical dielectric resonator antenna excited by a conductor backed coplanar waveguide are presented in this paper. The antenna offers good reflection and radiation characteristics.

ANTENNA DESIGN

The proposed antenna configuration comprises of Conductor Backed Coplanar Waveguide (CBCPW) excited cylindrical dielectric resonator with high dielectric constant (ε_{dr} =48, Diameter D=24.15mm, Height H=6.81mm) prepared from a low loss ceramic material $Ca_5Nb_2TiO_{12}$ as single phase ceramic route. The design parameters of CBCPW are, 2G+S=24.15mm (Diameter of the DR), Signal strip width S=3.28mm, Slot width G=10.435mm, width of the lateral ground planes W=10mm, εr=4.7, h=1.6mm. The geometry of the proposed CB-CPW excited cylindrical DRA is shown in Figure.1.

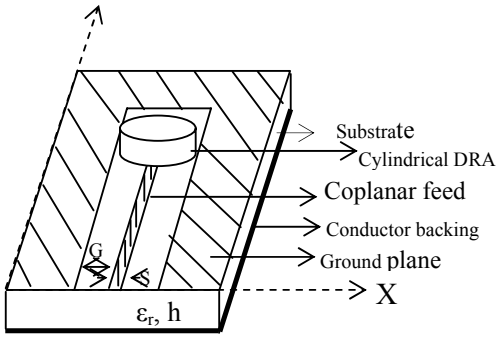

Figure.1. Geometry of the proposed CB-CPW fed Rectangular dielectric resonator antenna

RESULTS

The coupling between the DR and CBCPW can be easily controlled by varying the position of the DR along the feed line. The position of the DR on the etched feed line was optimized to get best resonance with excellent radiation performance, gain and bandwidth. The DR was placed at different position on the feed line along the x-direction with its center axially symmetric to the feed in y-direction. At the optimum position the proposed antenna offers a 2:1 VSWR bandwidth of 475MHz from 2.325 GHz to 2.8 GHz. The reflection characteristics obtained from experiment are confirmed by simulation using Zealand's Fidelity software. Experimental and simulated return loss characteristics of the antenna are depicted in figure.1 Gain of the antenna is measured by gain transfer method. The proposed antenna offers a peak gain of ~9dBi and an average gain of ~7dBi in the operating band. The gain of the antenna is shown in figure 3.

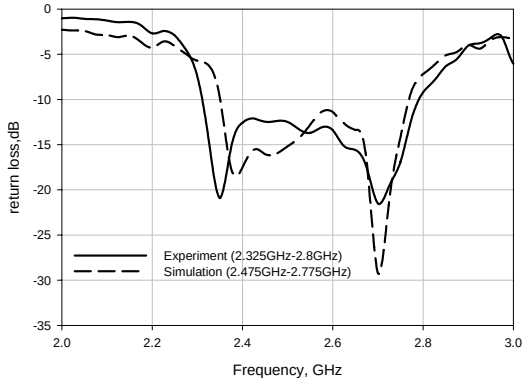

Figure 2: The variation of return loss with frequency of CDRA on CBCPW 2G+S =24.15mm, ε_{dr} =48, D=24.15 mm H=6.81mm and h=1.6 mm ε_r =4.7.

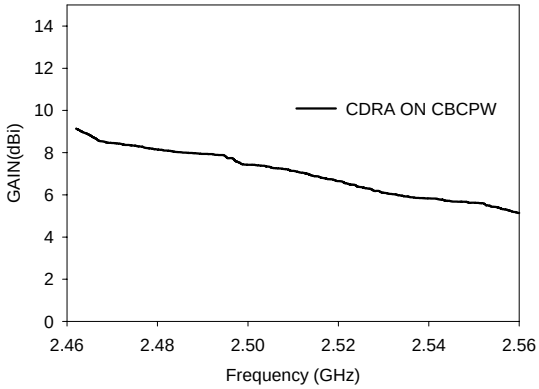

Figure 3: The gain of the CDRA on CBCPW 2G+S =24.15mm, ε_{dr} =48, D=24.15 mm H=6.81mm and h=1.6 mm ε_r =4.7.

The proposed antenna exhibits good broadside radiation patterns in both the principal planes. The pattern exactly resembles other conventionally using microstrip patch antennas. The radiation patterns of cylindrical dielectric resonator antenna at centre frequency are shown in figure 4. From the figure it can be inferred that there is a cross polar isolation of more than –32 dB which is an essential requirement for practical applications in various fields.

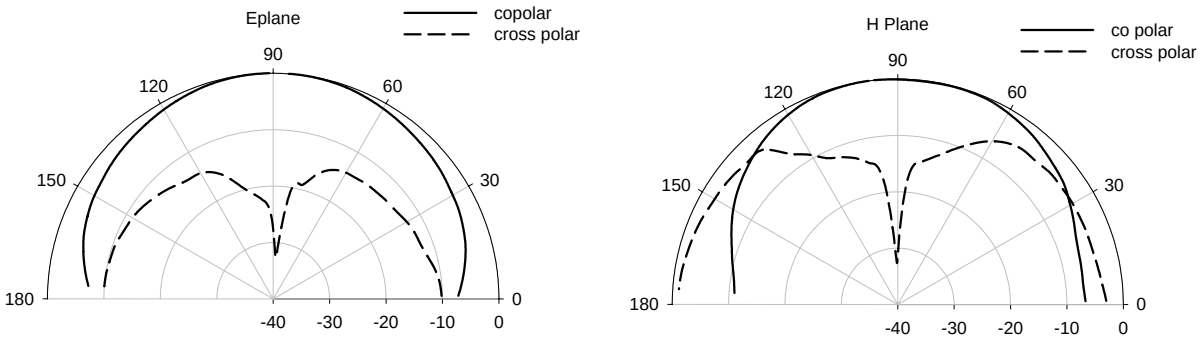

Figure 3: Radiation patterns of the Cylindrical DRA at 2.56 GHz.
2G+S =24.15mm, ε_{dr} =48, D=24.15 mm H=6.81 mm and h=1.6 mm ε_{r} =4.7.

CONCLUSION

A Conductor Backed Co-planar Waveguide is demonstrated as an effective excitation technique for a Cylindrical Dielectric Resonator Antenna. The radiation performance, wideband width and high gain of the proposed antenna makes the antenna highly suitable for mobile communication and blue tooth applications.

ACKNOWLEDGEMENTS

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