Circular Polarized Cylinderical Dielectric Resonator Antenna Using A Single Probe Feed

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Abstract*—in this paper a novel dielectric resonator antenna (DRA) with circular polarization and a single probe feed is proposed. The antenna structure includes a Dielectric Resonator (DR) which is chopped thorough the y axis diameter and fed by single coaxial line. Circular polarization (CP) is obtained by exciting two orthogonal modes of a cylindrical DR in phase quadrature. Exciting two orthogonal modes of a cylindrical DR is the results of DRA cutting. The proposed antenna provides axial ratio of less than 3dB over a *** MHz (%) bandwidth with a minimum value of *** dB in this range. The impedance bandwidth of the antenna is **** MHz (*** %) which is *** times greater than conventional cylindrical dielectric resonator antenna. Comparison between simulations, based on HFSS software and measurements are provided.**

Keywordst; Dielectric resonator antenna ,circular polarization, axial ratio bandwidth, impedance bandwidth.

I. Introduction

Dielectric resonator antennas (DRAs) attractions including high efficiency, ease of excitation, simple geometry and compactness make them a practical element for antenna applications [1]. Circular polarized DRAs incorporating additional hardware consisting of 3dB quadrature phase coupler or 90° transmission line phase shifters have been reported [2], [3]. A circular polarized cylindrical DRA excited by dual conformal strips which is offer axial ratio bandwidth of 20% has been investigated [4]. Simple design method for a cylindrical DRA to achieve single microstrip line feed dualband circular polarization has been proposed [5]. A rectangular dielectric resonator antenna which produces circular polarization with a single slot feed [6] and single probe feed [7] have been investigated. A design method of circular polarization DRA consisting of a cubical dielectric and an external feeding probe have been proposed [8]. Investigations of rectangular dielectric resonator antenna for circular polarization have been accomplished [9].

In this paper a novel cylindrical DRA provides circular polarization with a single probe feed is proposed. The dielectric as shown in Fig. 1 chopped through y diameter and feed at **** position. The axial ratio bandwidth is *** MHz (*** %) with a minimum value of *** dB over this bandwidth. The impedance bandwidth of the proposed antenna is *** MHz (*** %) which is *** times greater than conventional cylindrical DRAs. This antenna is analyzed by using the HFSS simulation software based on Finite Element Method (FEM) and experimental studied. Measurement results are in agreement with simulations one.

II. Antenna Configuration and simulation results

Fig. 1 shows the top and side view of the proposed antenna. The resonator has a relative dielectric constant of ε_r=38, radius of r=10mm and height of h=20mm. The DR is placed on the circular ground plane with a radius of d=60mm and fed by single coaxial line. The probe feed is located in φ=*** closed to DR. The probe is excited through connector placed on the back of the ground plane. Several simulations for achieving best matching by varying the probe height and its diameter are carried out.

The proposed antenna cut thorough y axis diameter for x=*** mm in each side. In order to achieve minimum axial ratio the y axis diameter should be *** times of x axis diameter of cylindrical DRA. By cutting the y axis diameter of conventional cylindrical DR and placing the feed at φ=*** two orthogonal modes of DR is excited. The result of two orthogonal mode excitations is circular polarization.

Fig. 2 shows the simulated return loss of the proposed antenna. As you see the proposed antenna have two resonant frequencies. These two close resonant frequencies yield wide impedance bandwidth at return loss of less than -10dB. The impedance bandwidth of the proposed antenna is *** MHz (*** %) with center frequency of *** GHz. The simulated axial ratio of the reported antenna is depicted on Fig. 3. The axial ratio (AR) bandwidth (AR < 3dB) is *** MHz (** %) with a minimum value of *** dB over this wide AR bandwidth.

III. Measurment Results

Return loss was measured and compared with those simulations with good agreement as shown in Fig. 4. The bandwidth of this antenna measured at -10 dB return loss is *** % which is an obvious improvement from the conventional cylindrical DRA. The measured E- and H-plane radiation patterns of the proposed antenna are shown in Fig. 5 (a) and (b) respectively. Both co- and cross polarizations are included.