Compact Dual Band Hemi Spherical Dielectric Resonator Antenna

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Abstract— A compact Hemispherical Dielectric Resonator Antenna fed by coplanar wave guide inductive slot for dual band application is proposed. In this structure the CPW inductive slot acts as an effective radiator and the feeding structure of DRA. The proposed antenna gives the appreciable gain and better radiation pattern at the resonant frequencies. The proposed antenna can be used for WLAN at 2.4GHz band.

In this paper a compact hemispherical dielectric resonator antenna fed with CPW inductive slot which acts as one of the resonator is presented. The proposed antenna operates at dual frequency one at 2.4GHz which can be used for WLAN for IEEE 802.11 standard and other resonator is at 9.10GHz. The proposed antenna is very compact with good gain and can be used in mobile communication systems, WLAN dongles etc.

Keywords- Dielectric Resonator Antenna(DRA), Radiating slot, WLAN, Dual band.

I. INTRODUCTION

Dual or multi frequency operation is highly desirable in modern wireless communication systems. If a single dielectric resonator antenna (DRA) can support multi frequencies then the need for multi single frequency antenna is not necessary. Applications requiring different frequency bands can be operated simultaneously with one radiating element. This reduces the circuit size and leads to compact systems. The dielectric resonator antenna [1, 2] has many attractive features like wide bandwidths, low dissipation loss at high frequencies, high radiation efficiency due to the absence of conductors and surface wave losses, high permittivity, light weight and ease of excitation.

HYBRID DRA has attracted attention due to their dual band and wide band operation with increasing antenna size. The hybrid structure is a combination of DRA and another radiating resonator of feeding structure. These two radiating resonators are stacked tightly in order to get dual frequency of operation[3, 5] or wide band [6, 12]. The different types of feeding applied to DRA can be probe feeding, Microstrip line feeding, slot feeding, CPW feeding. The CPW fed slot arrangement offer more flexibility and is directly compatible with different mounting surfaces. The CPW feeding structure has many useful characteristics like low radiation leakage, less dispersion, little dependence of the characteristics impedance on substrate height and uniplanar configuration. There are two types of coupling mechanism for CPW fed line one is inductive coupling and the other is capacitive coupling. They also allow easy mounting and integration
with other microwave integrated circuits and RF frequency devices.

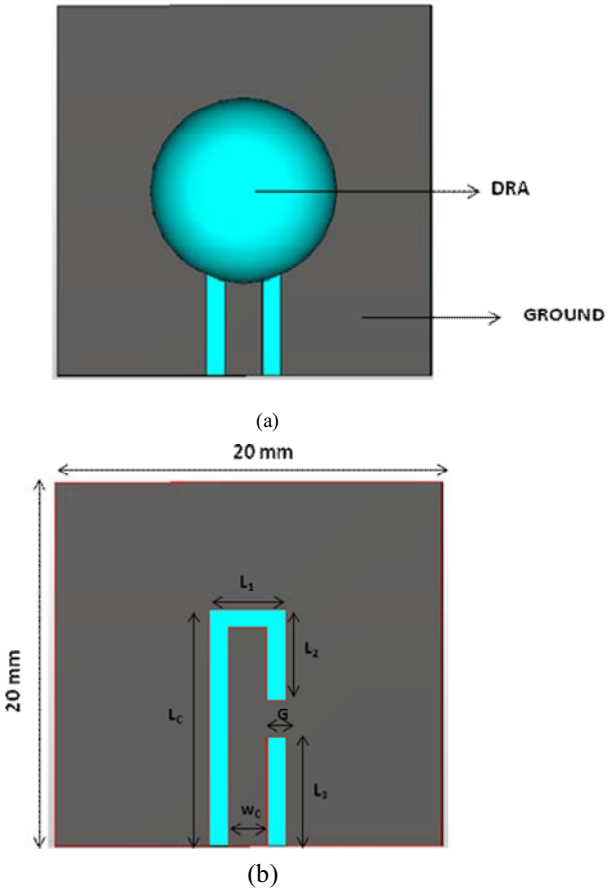


Fig. 1. Proposed antenna (a) Front view (b) Geometry

II. ANTENNA DESIGN

The proposed hemispherical DRA is shown in the fig. 1. It consists of a hemispherical DRA fed with CPW inductive slot. The ground of size 20mm × 20mm is printed on a FR4 substrate of thickness 1.6 mm and the dielectric constant 4.2. The hemispherical DRA has the radius R=5mm and dielectric constant 10 is properly placed over the ground with feeding structure in order to obtain dual frequency. The inverted L– shaped inductive slot resonates at approximately half wave length ($L_1+L_2+2R-2S\approx\lambda_g/2$) where λ_g is the guided wave length of the slot with Dielectric Resonator (DR) placed on it. The rest of the antenna parameters are shown in Fig.2. L_c=13mm, L_1=4mm, L_2=4mm, L_3=6mm, G=1mm, W_c=2mm, S=2.

III. RESULTS AND DISCUSSION

The full wave EM-simulator CST Microwave Studio is used for the designing of antenna. The proposed antenna resonates at the dual frequency. The lower band is due to the CPW inductive slot while the higher band is due to the DR. the simulated lower band achieves impedance bandwidth of 18.63% (for S_{11}<-10 dB) from the Return loss graph shown in the Fig. 2. Ranging from 2.2 to 2.65 GHz with center frequency at 2.42GHz and the higher band achieves band width of 7% with center frequency at 9.13 GHz. The current distribution shown in the Fig.3. Shows that at 2.4GHz total current is distributed across the inductive slot and the slot resonates at that frequency at 9GHz the current is totally distributed across the DR thus it gives the higher resonant frequency and dual is obtained.. The radiation patterns at 2,4 and 9 GHz are shown in the Fig.4. the patterns in the YZ-plane are near Omni directional when compared to the conventional dipole antenna because the asymmetric DR loading on the CPW inductive slot. The proposed antenna radiates a maximum in the broad side direction at both the frequencies. The gain vs frequency graph shown in the Fig. 5. shows that the gain at 2.4GHz is 2.36dBi and 9GHz it is 5.91dBi

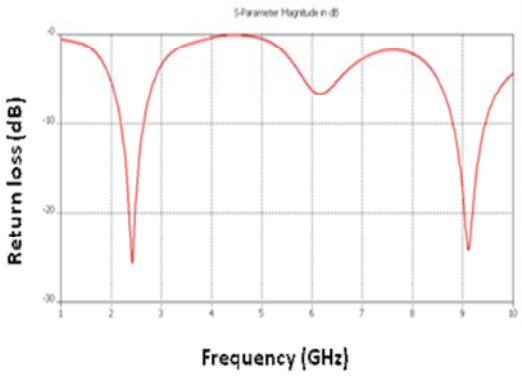
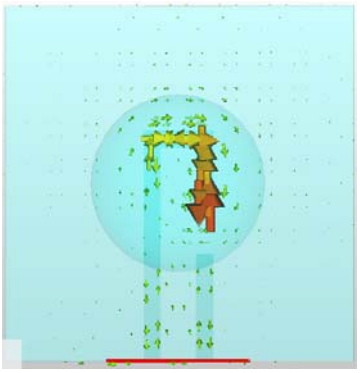
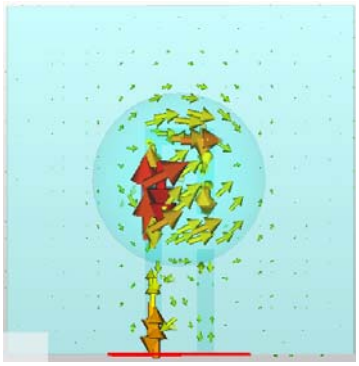


Fig. 2. Simulated Return loss of the proposed antenna

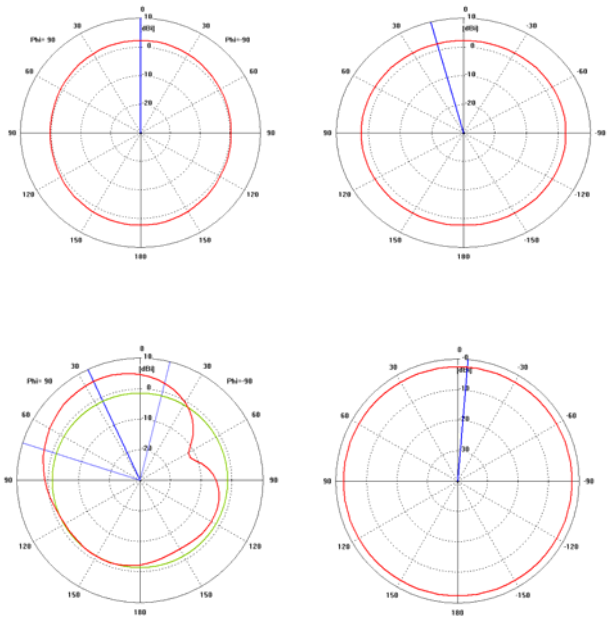


(a)



(b)

Fig. 3. Current distribution at (a) 2.4GHz (b) 9GHz



E-Plane H-Plane

Fig. 4. Radiation pattern at 2.4 GHz and 9GHz.

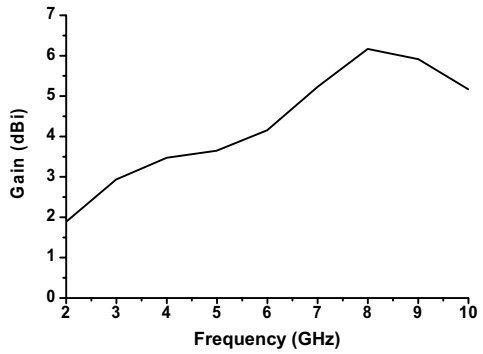


Fig. 5. Simulated gain of the proposed antenna.

IV. CONCLUSION

A compact Hemi Spherical dielectric resonator antenna fed by CPW inductive slot has been proposed. The proposed antenna has a bandwidth of 18.63% at lower resonant frequency and 7% at higher resonant frequency. The gain at 2.4 GHz is 2.36 dBi and at 9GHz is 5.91dBi. the proposed antenna is very compact, effective feeding structure and adequate operational bandwidth with Omni directional radiation pattern. The proposed antenna can be used in mobile communication systems, WLAN dongles.

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