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Circularly Polarized Dielectric Resonator Disc Monopole Antenna for Mobile Communication and IoT Applications

B T P Madhav, K Mayukha, M Mahitha, M Manisha, J Somlal

Abstract**: *A circularly polarized disc monopole antenna is designed with dielectric resonator. The designed antenna is occupying the dimension of 17.39 mm in the disc and constructed on inner dome permittivity of 9 mm and outer dome permittivity is 3 mm. The antenna working in the range of 2.2 to 5.2 GHz and covering most of the applications like Bluetooth, LTE, Wi-Fi and WiMAX. Design and simulation characteristics are analyzed with Antenna magus electromagnetic tool and the performance characteristics like reflection coefficient, radiation characteristics and axial ratio are presented in this work.***

Index Terms**: *Circular Polarization, Dielectric Resonator, Disc Monopole, Mobile Communication.***

I. INTRODUCTION

Antenna having lot of demand these days because of their usage in the communication systems. Researchers proposed several antennas for different applications to full fill the requirements of the communication devices [1-4]. In recent years the development it in wireless communication technology tremendously increased with different communication protocols with the advent it of wireless network Technology [5-8]. People started designing different communication systems based wireless modulus to fill the gap in different areas where the high-speed data rates are required. Printed antennas with compact dimension, low profile and flexible nature providing solutions for future communication applications [9-14]. The applications like IOT require compact antennas with low-cost materials with light weight for mass production. The structure of the antenna, the operating bands, bandwidth and gain which decide the applicability of the device as per the situation and the application [15-18]. These days antennas became crucial elements in the communication modules for internet of things related applications. The mobile communication, personal communication, Bluetooth, Wi-Fi, WiMAX, LTE and 5G are the main platforms to establish and to design advanced communication systems [19-24].

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B T P Madhav, ALRC-R&D, Professor, Department of Electronics and Communication Engineering, Koneru Lakshmaiah Education Foundation, Vaddeswaram, AP, India
K Mayukha, Project Scholars, Department of IT, PVPSIT, Vijayawada,
M Mahitha, Project Scholars, Department of IT, PVPSIT, Vijayawada,
M Manisha, Project Scholars, Department of IT, PVPSIT, Vijayawada,
J Somlal, Professor, Department of EEE, Koneru Lakshmaiah Education Foundation, AP, India

IoT based devices require compact communication modules interconnection with advanced protocols and sophisticated setup in user friendly environment [25-26].

II. ANTENNA GEOMETRY

In this work we have proposed a circularly polarized disc monopole antenna is designed for mobile communication and for IoT applications. The designed disc monopole is a compact antenna with coverage of dielectric resonator on the top. The disc monopole consisting of 17.39 mm diameter radius and dielectric resonator consisting of 43.48 mm diameter radius. The pin diameter is 1.7 mm and pin height are around 1.04 mm. The relative permittivity of inner dome is 9 and Outer dome is around 3. Figure 1 shows the structure of the antenna and DRA structure shown in Figure 2.

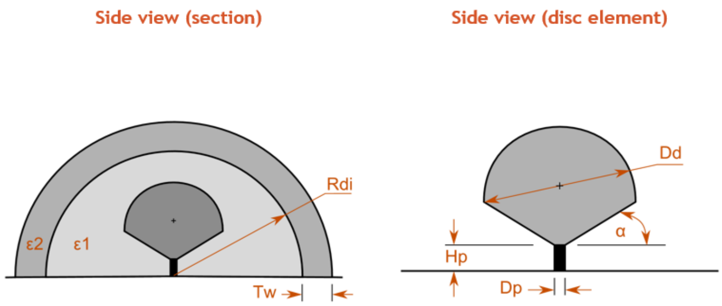

Fig 1. Antenna Constructional View

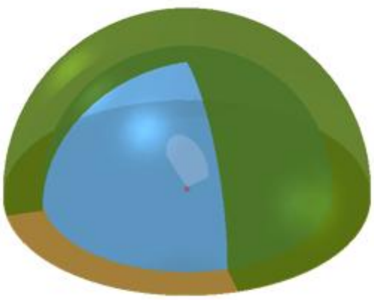

Fig 2. DRA Loaded Disc Monopole

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Name	Description	Value
Dd	Disc diameter	17.39 mm
α	Angle of the bevel with respect to the ground plane	40 °
Dp	Pin diameter	1.739 mm
Hp	Pin height	1.043 mm
ε1	Relative permittivity of material 1 (inner dome)	9
ε2	Relative permittivity of material 2 (outer dome)	3
Tw	Wall thickness of the outer dome	10.75 mm
Rdi	Radius of the inner dome	43.48 mm

Table 1. Antenna dimensions

III. RESULTS AND DISCUSSION

The reflection coefficient of proposed antenna is hown in Figure 3.It is found that the antenna is operating frequency range form 2.2 to 5.2 GHz. A small notch is at 3.2 GHz can be neglected and in the measurement results this was not appeared. Fig 4 shows the three-dimensional gain plots of the antenna at four resonant frequencies. The cross-sectional view of the DRA with disc monopole placement inside can be observed here. The Fig 5 presents the polar plots at operating frequencies. The cross-polarization levels are low and the antenna is providing monopole like patters.

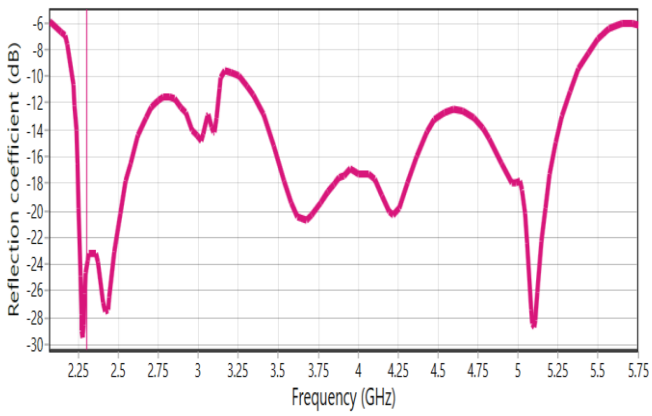


Fig 3. Reflection Coefficient Vs Frequency

Fig 4 shows the three-dimensional gain plots of the antenna at four resonant frequencies. The cross-sectional view of the DRA with disc monopole placement inside can be observed here. The Fig 5 presents the polar plots at operating frequency. The cross-polarization levels are low and the antenna is providing monopole like patters.

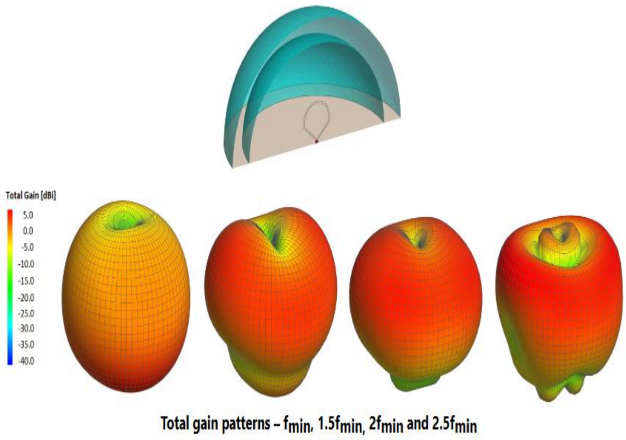
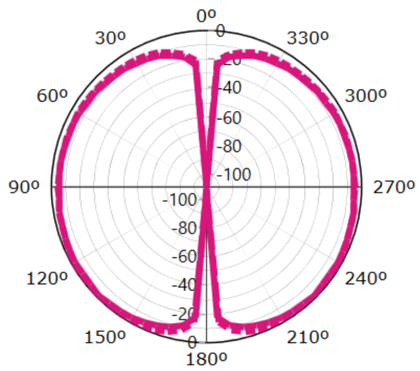
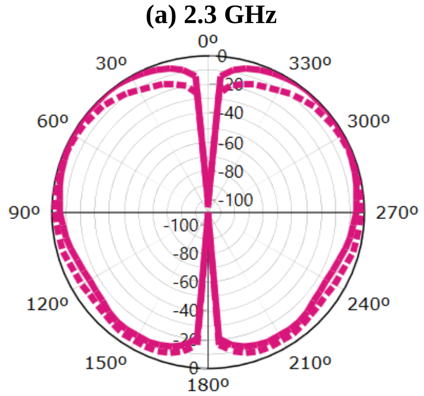


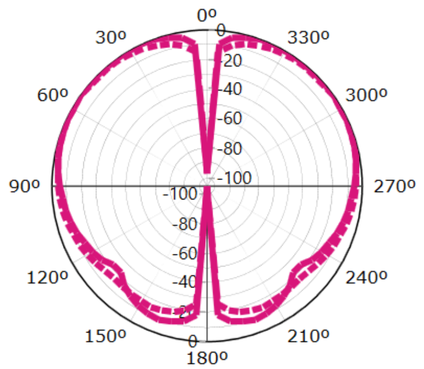
Fig 4. 3D polar plot at resonant frequencies



(a) 2.3 GHz



(b) 3.4 GHz



(c) 4.6 GHz

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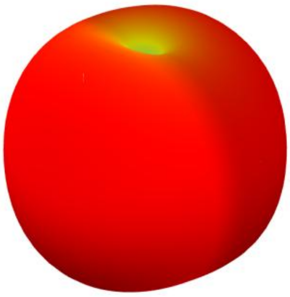
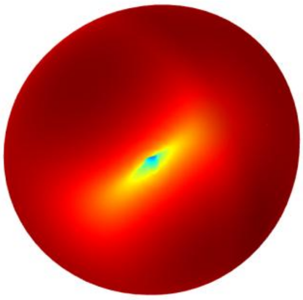
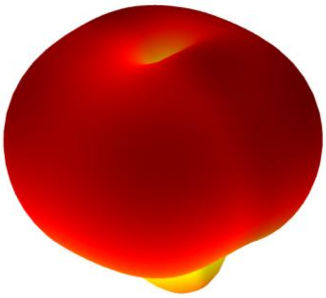
Fig 5. Polar plot at (a)2.3 (b)3.4 and (c)4.6GHz



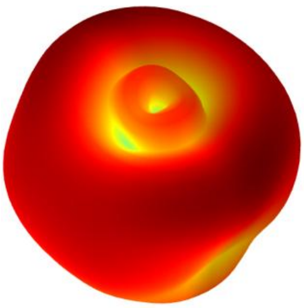
(a) 2.3 GHz



(b) 3.4 GHz



(c) 4.6 GHz



(d) 5.7 GHz

Fig 6. 3D Radiation at (a) 2.3 (b) 3.4 and (c) 4.6 (d) 5.7 GHz

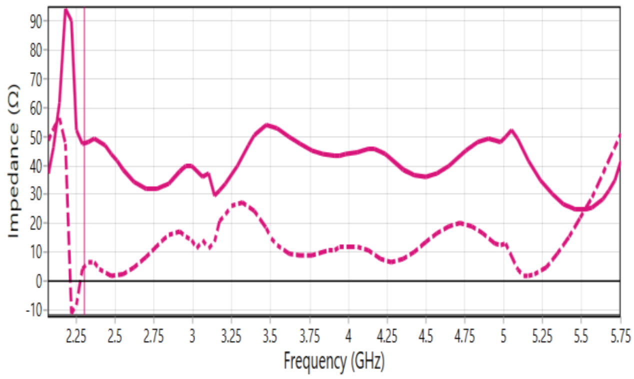


Fig 7. Impedance Vs Frequency

Fig 6 shows the radiation at different operating bands and Fig 7 presents impedance characteristics of the proposed antenna in real and imaginary planes. The two-dimensional way of radiation pattern is presented from Fig 8 to 10. The Co and Cross polarizations are presented at each individual frequency.

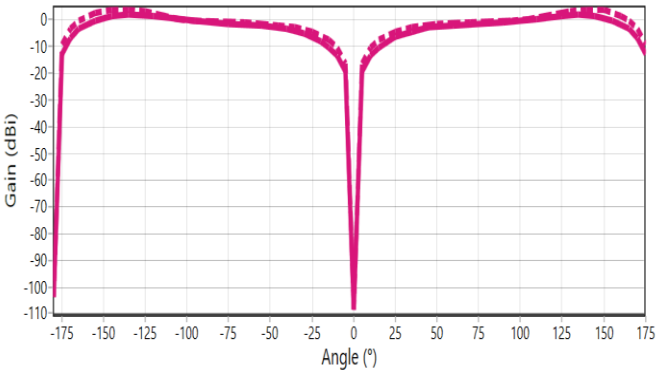


Fig 8. At 2.3 GHz

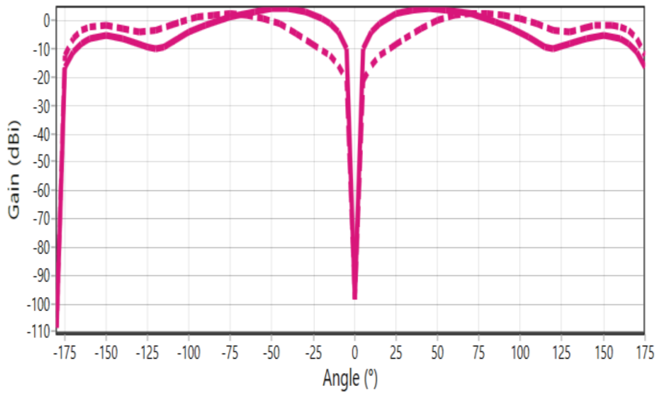


Fig 9. At 3.4 GHz

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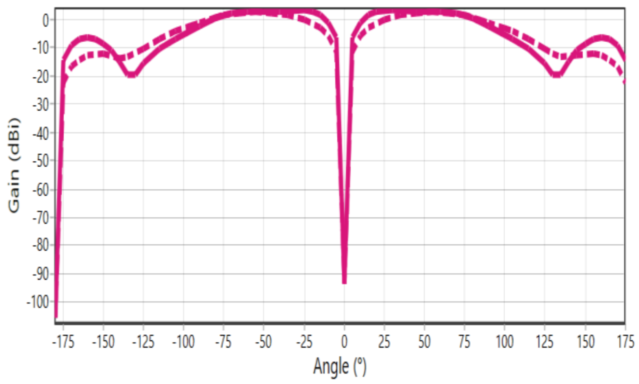

Fig 10. At 4.6 GHz

IV. CONCLUSION

A dielectric resonator antenna is designed with disc monopole structure radiating element. The designed antenna is providing circular polarization at the operating frequency with axial ratio less than 3dB. The operating range of antenna is between 2.2 to 5.2 GHz and fractional bandwidth of 68%. The gain of 4.2 dB is attained at lower bands of 2.3, 3.4 and 4.6 GHz with realized peak gain of 6.2 dB is attained at 5.6 GHz. The proposed antenna is covering Bluetooth, LTE i.e. 4 G, Wi-Fi, WiMAX and well suited for wireless communication and IoT applications.

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