International Journal of Innovative Technology and Exploring Engineering (IJITEE)
ISSN: 2278-3075 (Online), Volume-8 Issue-5, March 2019

Design of Rectangular DRA for IOT Applications

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Abstract*: The proposed goal is to design a Dielectric Resonator Antenna (DRA) for Internet of Things (IOT) applications.In the proposed research work, rectangular shaped DRA is choosen to overcome the narrow bandwidth and high conductive losses of conventional microstrip patch antennas. The Diamond is choosen as dielectric material with dielectric constant ϵ_r=5.7.The proposed antenna is designed with dimensions of 28mm x 14mm x 9mm.Using HFSS software the simulation results obtained as gain = 4.57 dB,VSWR = 0.832.It is evident that the proposed antenna resonating at frequency 2.4 GHz with $|S_{11}| < -10$Db.

***Index Terms*: DRA, IOT, HFSS.**

I. INTRODUCTION

In the past few years,the rise in the development of the wireless communication industry needs antenna technology with increased performance.In the 1980's,Dielectric Resonator (DRs),which radiates as an antenna on suitable excitation technique, a huge scope for exploration got initiated. Dielectric resonator antennas have received prodigious attention because of a number of a number of advantages such as small size, light weight, high radiation efficiency,considerable bandwidth, low conductor loss, no excitation on surface waves, easy of excitation and so on. Thus, DRAs that posess a high degree of design flexibility have emerged as an ideal candidate for wideband, high efficiency, and cost-effective applications. They are quite useful for high frequency applications, where ohmic losses tend to be a serious problem for conventional metallic antennas.As we know, many existing and emerging wireless communication applications operate over wide frequency bands and thus require broadband antennas.Moreover, the high power capability and high radiation efficiency of such an antenna are considered as an advantage when to be used.

II. DESIGN METHODOLOGY

Dielectric structure can become a radiator at defined frequencies.the size of dielectric material is inversly proportional to the relative permitivity of the constitutive material.Dielectric resonator acts as an antenna which can radiate with out no conductive boundary when feeded through slot.

Manuscript published on 30 March 2019.
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Design Challenges:

One of the major part of antenna designing is the selection of substrate which has particular dielectric constant and should not change it's characteristics in any circumstances. Even a small change in dimensions of patch effects the fringing fields from the edges.It effects the effective length,thereby changing the resonance frequency.Assigning proper boundary conditions in simulation process is the most critical parameter.Most boundary conditions are used to define electromagnetic characteristics such as conductivity (or) resistivity.This also includes exciting the structure, and hence error can result in inaccurate results

The proposed antenna design realized by DRA is placed above a ground plane with dimensions length x width = 112mm x 27mm. FR4 is used as a substrate with dimensions length x width x thickness = 112mm x 27mm x 0.5mm with dielectric constant 4.4 and is fed through the slot from its bottom with the help of a 50Ω microstrip line with dimensions length x width = 84mm x 1.2mm is used to feed the DRA the dimensions of slot should be designed according to the desired characteristics of DRA a slot with length x width = 14.32mm x 2.86mm dimensions is made to feed DRA.The structural design of rectangular DRA is shown in fig 2 and the designed model of proposed DRA in HFSS software is show in fig 3.

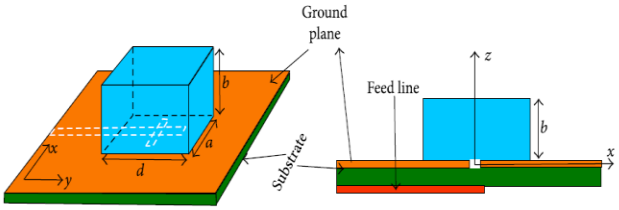

Fig 1 : Structure Of Rectangular Dra

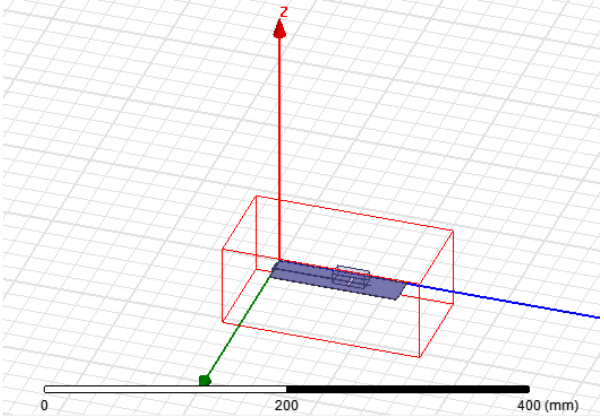

Fig 2 : design model of proposed rectangular DRA

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Table 1: Design parameters of the presented DRA

DIMENSIONS		
Dimensions of Antenna	a(mm)	28
	b(mm)/h(mm)	28/14
	d(mm)	9
Dimensions of Substrate	Length(mm)	112
	Width(mm)	27
	Thickness(mm)	0.5
	Dielectric Constant	4.5
Dimensions of Ground Plane	Length(mm)	112
	Width(mm)	27
Dimensions of 50Ω microstrip line	Length(mm)	84
	Width(mm)	1.2
Dimensions of the slot	Length l_s (mm)	14.32
	Width w_s (mm)	2.86

III. EXCITATION MECHANISM

The feeding technique for DRA is done through slot in the ground plane.the excitation method is called aperture coupling. The DR is directly disposed on the ground plane.it is excited by a microstrip line through substrate. The DR is directly placed on the microstrip line on the ground plane and fed through a slot from its bottom. Strongest coupling occurs when there is an overlapping 'X' between microstrip line and DR is slightly less than quarte of a dielectric wavelength of resonating frequency is shown in fig 3.

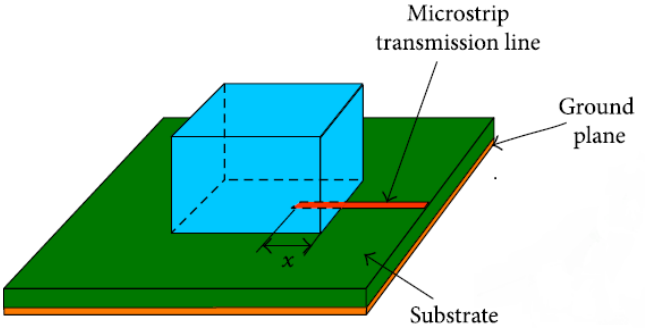

Fig 3: overlapping of microstrip line and DR material

IV. RESULTS

The design and simulation of proposed antenna is carried out using HFSS software and the obtained results are shown in the following figures 4,5,6,7.

Return Loss:

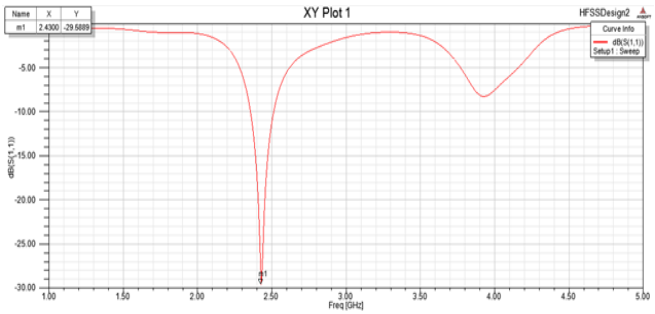

Fig 4 : Return Loss

The proposed antenna resonating at 2.4 GHz with |S11| = -26.38 dB as |S11| is much lower than -10dB, good impedance matching is obtained.

VSWR:

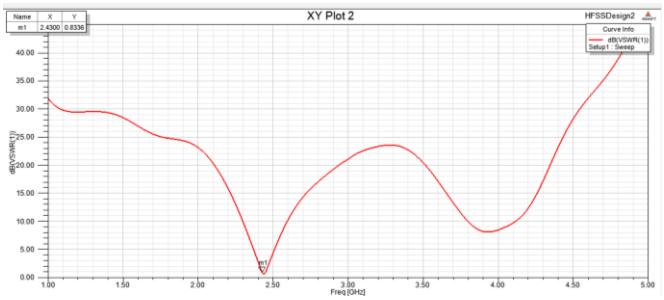

Fig 5 : VSWR plot for proposed antenna

The proposed antenna VSWR value obtained as 0.832 for 2.4 GHz

Radiation Pattern:

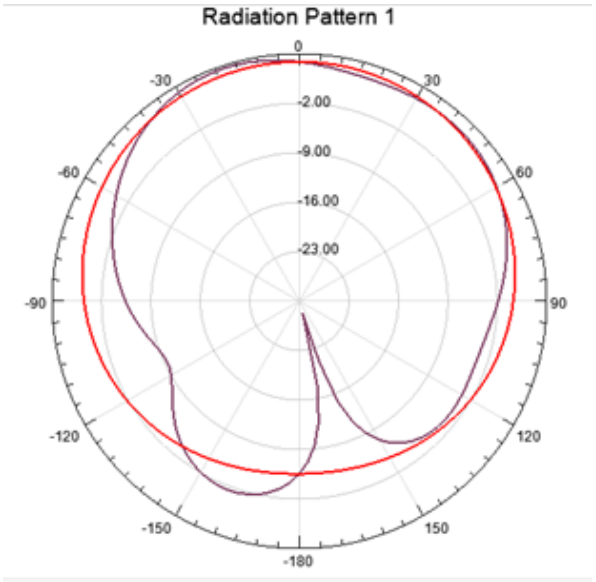

Fig 6: Radiation Pattern

Gain:

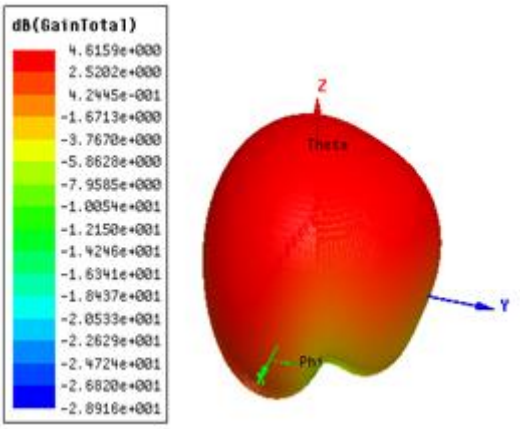

Fig 7: Gain Plot

The gain of proposed antenna resonating at 2.4 GHz is obtained as 4.615 dB

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V. CONCLUSION AND FUTURE SCOPE

The Rectangular Dielectric resonator antennas were proposed in the research.This work aimed mostly at the designing of rectangular dielectric resonator antenna which is having a dielectric material resonating at 2.4 GHz with |S11| = -29.38 dB,VSWR = 0.832 and gain = 4.615 dB.It is evident that the proposed antenna is suitable for IOT applications especially for Wi-Fi and Bluetooth.

Though the study and the design of Rectangular dielectric resonator antenna has been carried out in this work, still there is enough scope for improvement and further research. Rectangular antennas are mostly useful for UWB Applications where the scope of improvement is more.This study and designs can take place for the further studies on the rectangular DRA's. The DRA's can be further studied and analyzed by change of substrates where the research and development is taking place.

ACKNOWLEDGMENT

I am thankful to Acharya Nagarjuna University for allow me to use the ISRO research centre, COE in VLSI Design & Antennas, and Koneru Lakshmaiah Education Foundation for continuous encouragement and use of Liquid Crystal research lab.

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