DESIGN AND ANALYSIS OF CIRCULAR MICROSTRIP PATCH ANTENNA FOR ISM APPLICATIONS

K SUSHMITA
Student
Geethanjali College of Engineering and Technology
. Cheeryal.
sushmita9492@gmail.com

E.TEJASWINI
Student
Geethanjali College of Engineering and Technology
Cheeryal
tejaswinigunu@gmail.com

ABSTRACT
In this paper coaxial feed circular Microstrip patch antenna is designed in order to obtain the required parameter responses for 2.5GHz and 5GHz frequencies. The dual band is Obtained by inserting a circular slot in a circular Radiator as well as bandwidth enhancement is obtained by modifying the ground plane .The Substrate used is FR-4 having dielectric constant of 4.4 and thickness of 1.6mm.the designed antenna is simulated using HFSS (High frequency simulator software).the proposed antenna achieves a gain of , bandwidth of the performance of designed antenna was analyzed in terms of bandwidth, gain, voltage standing wave ratio and radiation.

KEYWORDS: *Microstrip antenna, Dual band, Circular*

1. INTRODUCTION

Antennas are the basic components of any electrical system and are connecting the transmitter and receiver through space as the communicating medium. They play a vital role in wireless communications. Antennas were used for the first time, in 1889, by HenrichHertz (1857-1894) to prove the existence of electromagnetic waves predicted by the theory of JamesClerk Maxwell. An antenna (or aerial) is an electrical device which converts electric currents into radio waves and vice versa.. The patch is very thin ($t<<<\lambda o$ usually $0.003\ \lambda o \leq h \leq 0.05\ \lambda o$) above the ground plane. There are numerous substrates that can be used for the design of microstrip patch antennas and their dielectric constants are usually in the range of $2.2 \leq \varepsilon r \leq 12$.

Microstrip patch antennas radiate primarily because of the fringing fields between the patch edge and the ground plane. The radiation increases with frequency, thicker substrates, lower permittivity, and originates mostly at discontinuities. The radiating element and the feed lines are usually photo etched on the dielectric substrate.

Circular patch microstrip antennas are becoming a popular for portable wireless system because they are light weight, low cost, low volume, easily manufacturable and also other characteristic such as low profile and conformable due this reason antenna can use airborne and spacecraft application.

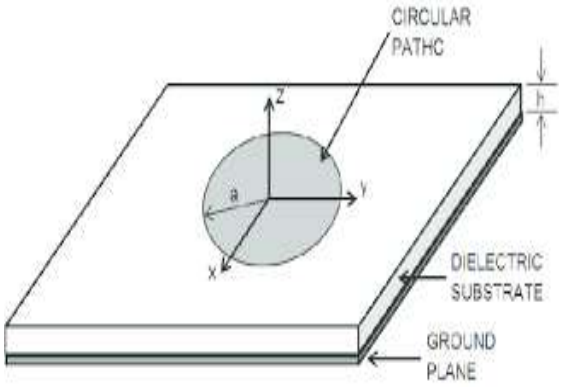

Fig. 1:Microstrip Patch Antenna

2. ANTENNA GEOMETRY

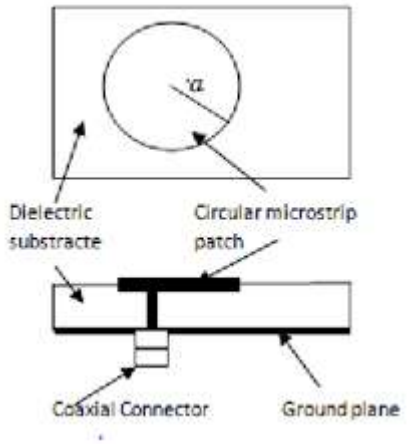

Fig. 2: Dimensions of circular microstrip patch Antenna

Circular Microstrip patch antenna (Dual band) is simulated by using 1.6mm thick FR-4 dielectric substrate which has permittivity and loss tangent of 4.4 and 0.02 respectively with 53 *53 mm ground area. Coaxial feeding is used for proposed dual band circular Microstrip patch antenna. Circular slot with radius, r is 2.5mmis used. The antenna resonates at 2.5GHz and 5GHz for ISM and WLAN band respectively. For designing dual band CMPA, by increasing the size of circular slot resonant frequencies are not adequate. Therefore, it is required to maintain the size of circular slot2.5mm. However, it is observed that, if size of Bandwidth enhancement of designed dual band CMPA get enhanced using circular shaped Defected Ground Structure (DGS). The feed point is optimized and selected location is in between center and edge of the patch.

3. PHYSICAL PARAMETERS OF ANTENNA

Antenna parameters can be calculated by the transmission line method.

1.Radius of Circular patch:

$$a = \frac{F}{\sqrt{\{1 + \frac{2h}{\pi\varepsilon_r f}[\ln\left(\frac{\pi F}{2h}\right) + 1.7726}}$$

Where $F = \frac{8.719*10^9}{f_r\varepsilon_r}$

2.Width and length of Circular patch:

Width (w) = $\frac{c}{2f}\frac{2}{\boldsymbol{\varepsilon_r+1}}$

$$L = Leff \ - 2\Delta$$

L_{eff} $=Effectivelength=c/2f\sqrt{\boldsymbol{\varepsilon_{reff}}}$

$$\Delta L = 0.412h * \frac{(\varepsilon_{reff} + 0.3)(\frac{w}{h} + 0.264)}{(\varepsilon_{reff} - 0.258)(\frac{w}{h} + 0.8)}$$

$$\Delta L = Normalised\ extension\ length$$

Substrate length L_g=L+6h
Substrate width W_g=L+6h
Substrate height h =L+6h

3.Efficiency

$$Efficiency = \frac{Gain}{Directivity} * 100\%$$

4.Radiation Box Dimensions

$$Axis\ position\ = -\frac{\lambda_g}{6} - \frac{\lambda_g}{6} - \frac{\lambda_g}{6}$$

$$Length = \frac{\lambda_g}{6} + \frac{\lambda_g}{6} + L_g$$

$$Width = \frac{\lambda_g}{6} + \frac{\lambda_g}{6} + W_g$$

$$Height = \frac{\lambda_g}{6} + \frac{\lambda_g}{6} + h$$

3.5. Antenna Dimensions

The designed parameters and its dimensions are given in table 1. The rectangular plot for the design antenna is show in figure 4. It is observed from the graph that the antenna offers dual band with resonant frequencies 2.6GHz and 5.2 GHz which is mostly used in ISM applications.

Table 1: Antenna dimensions

Parameters	Dimensions
Length	53.2
Width	53.2
Thickness	3.2

4. SIMULATION RESULTS

The antenna is designed using ANSOFT HFSS simulator and the designed antenna is shown in figure 3.The Directivity plot is shown in the figure 5 and the Gain plot is shown in the figure 6.The Impedance plot and Radiation pattern is shown in figure 7 and 8 respectively.

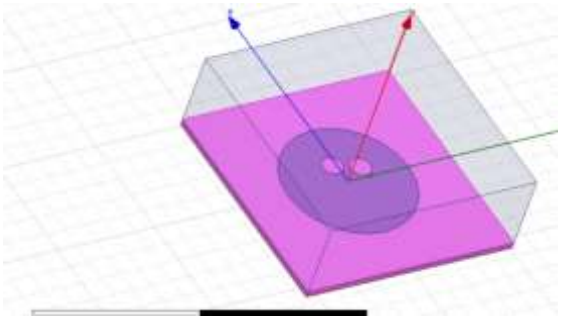

Fig.3:DesignAntenna

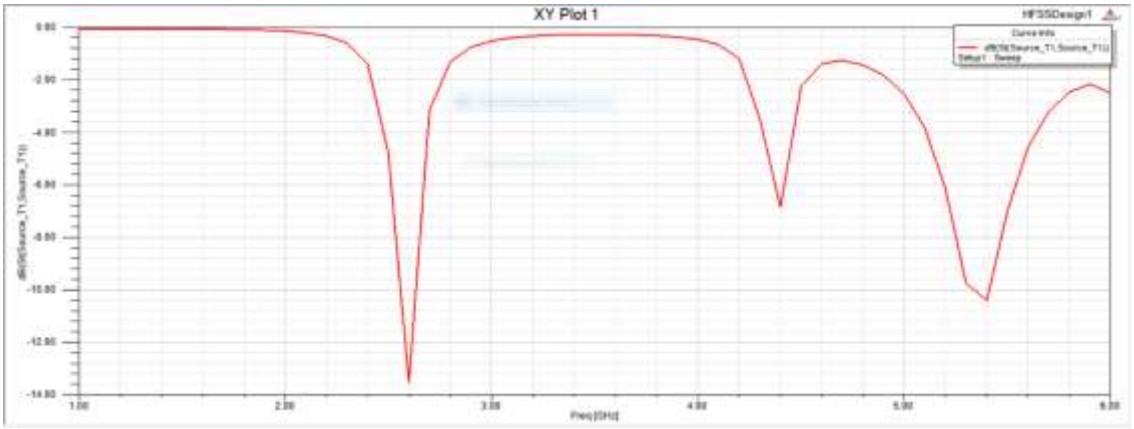

Fig.4:Rectangular plot of Circular Shaped antenna

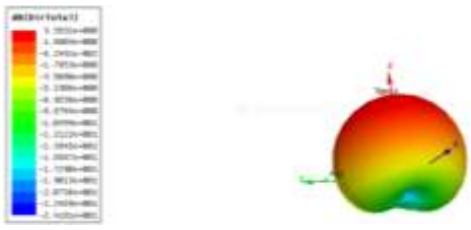

Fig.5:Directivity plot

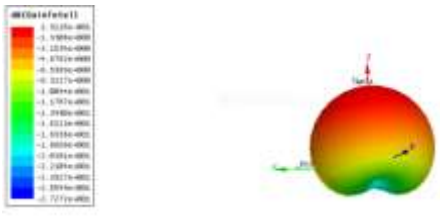

Fig. 6:Gain Plot

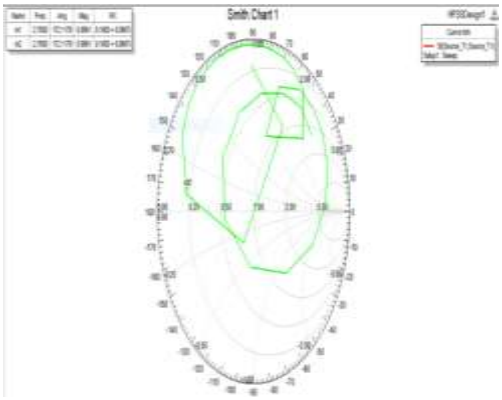

Fig.7:Impedance plot

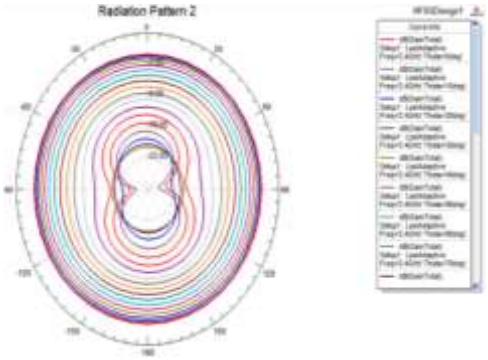

Fig.8: Radiation Pattern

REFERENCES:

[1] *SayaliJ.Pawar,MandarP.Joshi," Design of Dual Band Circular Microstrip Patch Antenna for ISM and WLAN applications ICACDOT 2016*

[2] *P. Naresh kumar,CH. Suresh kumar,RVNR suneel Krishna,"DESIGN AND ANALYSIS OF HIGHLY MINIATURIZED WIDEBAND PATCH ANTENNA",Anveshana's International Journal Research in EnginneringandApplied Sciences,VOL 3 ISSUE 2(2018 FEB) ISSN-2455-6602*

[3] *Sekhar M, S. N. Bhavanam, Dr. P. Siddaiah, "Triple Frequency Circular Patch Antenna",IEEE International Conference on Intelligence and computing Research, pp. 1-3, December 2014*

[4] *R. Srivastava, S. Ayub, V. K. Singh, J. P. Saini, "Dual Band Rectangular and Circular Slot Loaded Microstrip Antenna for WLAN/GPS/WiMaxApplications",Fourth International Conference on Communication Systems and Network Technologies,pp. 45-48, April 2014*

[5] *S. I. Hussain Shah, S. Bashir, S. D. Hussain Shah, "Compact Multiband microstrip patch antenna using Defected Ground structure (DGS)",The 8th European Conference on Antennas and Propagation (EuCAP), pp. 2367-2370, April 2014*

[6] *M. I. Sabran, S. K. A. Rahim, M. F. M. Yusof, A. A. Eteng1, M. Z. M. Nor, I. M. Ibrahim "Miniaturized Proximity Coupled Antenna with Slot Ring as Defected Ground Structure", IEEE Symposium on Wireless Technology and Applications (ISWTA), pp.81-85, Sept-oct 2014.*