

Efficient Rectenna For Microwave Energy Harvesting In 2.1 GHz GSM Band

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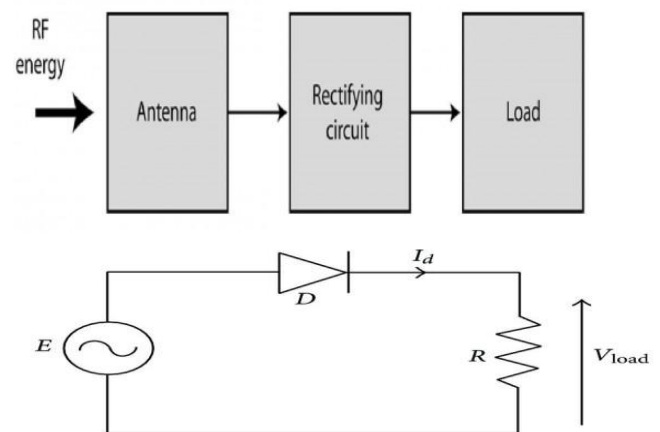
Abstract - This paper introduces a dual band rectenna operating at 2.1 GHz is presented. The Rectenna consist of a truncated square patch antenna and a rectifying circuit. The CP has more fade resistant than linear polarization (LP) and low polarization loss between transmitting and receiving antennas without regarding its rotating angle. The combination of CP property and harmonic rejection would bring the advantages of low polarization loss. The main design parameter of the rectenna considered. The Rectenna use a dual patch antenna with a circularly polarized gain of 32dB. The maximum radio frequency to direct current conversion efficiency of the rectenna is 68%.

Keywords - CST Software, A Doul circular polarization, return loss, rectifying circuit, Defected Ground Structure (DGS).

I. INTRODUCTION

In recent time, There is a widely interest in microwave energy harvesting. Because the world is focusing toward green and renewal energy [1]. Brown used a GaAs-Pt Schottky barrier diode and aluminum bar dipole and transmission lines to achieve 90.6 % conversion efficiency at an input microwave power level of 8 W. Later, Brown developed a printed thin-film version at 2.45 GHz with a 85 % conversion efficiency [2].through free space without wire connections or a battery thus rectenna plays a key role for wireless power transfer applications and a truncated corner square patch antenna [3].was usually adopted for microwave power reception. Afterward, many function were added to

enhance the performance of the rectenna array, such as arbitrary polarization [4].The rectifying antenna is one of the main components for above considered techniques, which has great potential to convey, collect and convert radio frequency (RF) energy into useful direct current (DC) power for be nearby electronic device or to recharge batteries through free space without using the physical transmission line [5] . a dual-rhombic-loop antenna[6].or wireless sensors. the used in rectenna design. However, rectennas with circular polarization features [8]. This information then must be sent to an suitable destination. Traditionally, a mobile test unit (UMT) will perform the function of the interrogator. We propose that in addition to data telemetry the MTU will also deliver microwave power to the embedded wireless sensor. The power will be received and converted to dc using an on-board rectenna (9)



Rectifying circuit diagram

The main design parameters of the rectenna considered; are dimensions and conversion efficiency which is defined as:-

$$\eta = \frac{P_{dc}}{P_{inc}}$$

The main component of the rectifying circuit is Schottky diode, which has voltage current characteristics

defined by:-

$$i_D = I_s(e^{\alpha v_D} - 1)$$

III. CIRCUIT DESIGN

The design of the proposed antenna and its parameters are describe fig. 1, The antenna is very important component in a microwave energy harvesting system. The microwave energy harvesting high gain have not a achievement but bandwidth is high simultaneously. The antenna has a defected ground structure (DGS) with a hexagonal slot of radius 8.6mm fig. 2. The design frequency use hare 2.1 GHz. The design of micro-strip patch antenna is CST microwave studio software and parameter is given as:-
 RF4 (lossy) substrate with Dielectric constant $\epsilon_r=4.4$
 Height of the substrate =1.6mm
 Lass tangent of the substrate =0.02
 Total size of the antenna =50x50mm

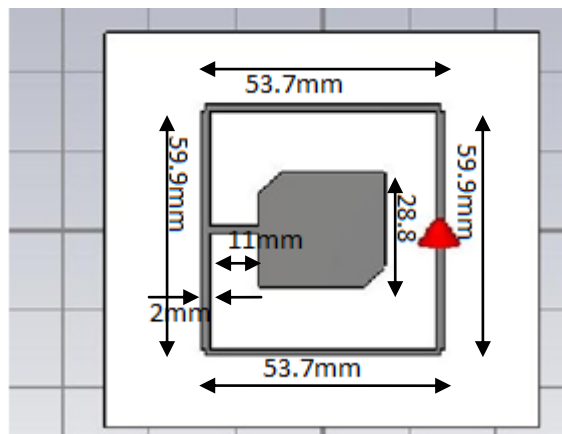


Fig 1: Top View of Truncated-corner square microstrip patch antenna

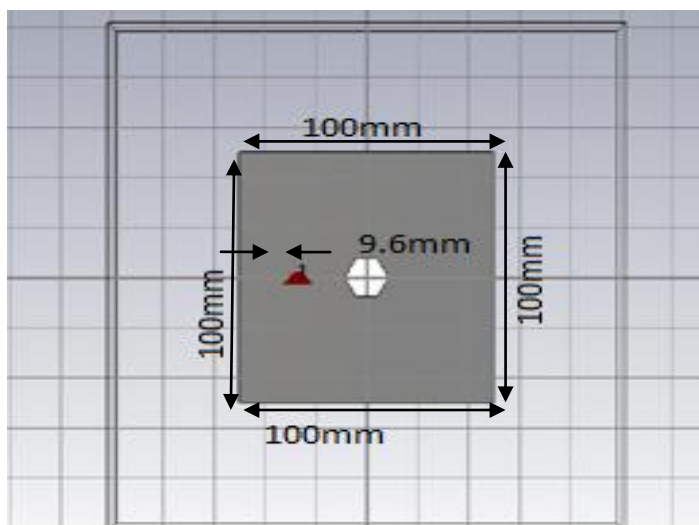


Fig 2: Bottom view of micro-strip patch antenna Defected ground structure.

The simulated result of reflection coefficient in microstrip patch antenna is shown in fig.3. The 2.1GHz radiation is realized cutting a slot in bottom side. This slot force the current in bottom side.

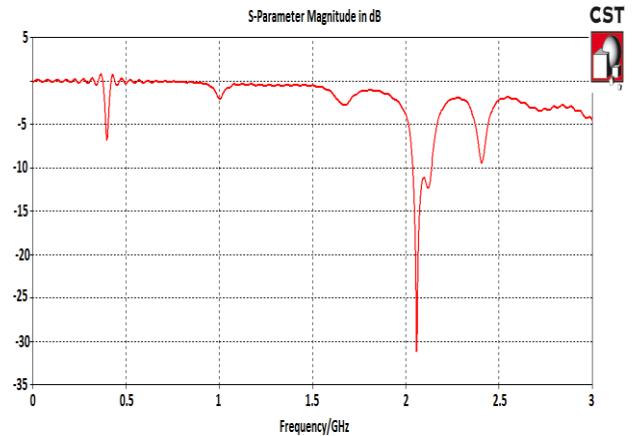


Fig.3: Simulated reflection coefficient (S11) of proposed antenna.

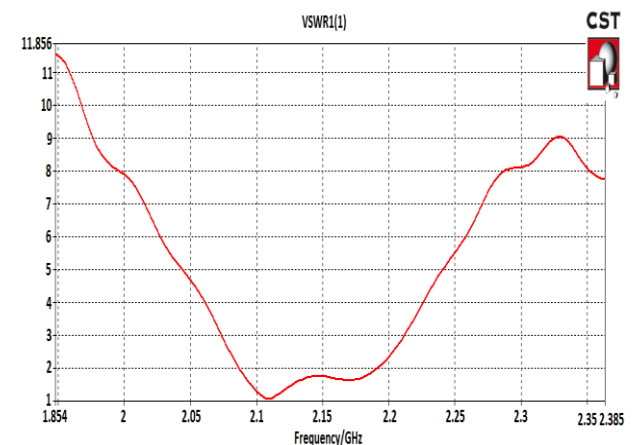


Fig.4: VSWR of proposed antenna.

Simulation reflection coefficient plot of proposed micro-strip patch antenna is shown in fig. 3. The maximum value of reflection coefficient is 32dB at a center frequency 2,1 GHz. Simulated VSWR (voltage standing wave ratio) plot of proposed square micro-strip patch antenna are shown in Fig.4. VSWR of proposed antenna is less than 2 from 1.075GHz to 2.18GHz.This is under the tolerable VSWR. At resonant frequency 2.1GHZ, VSWR is 1.2. Fig.5 shows the gain plot of proposed antenna. At center frequency, gain of proposed antenna is 3.75dB.

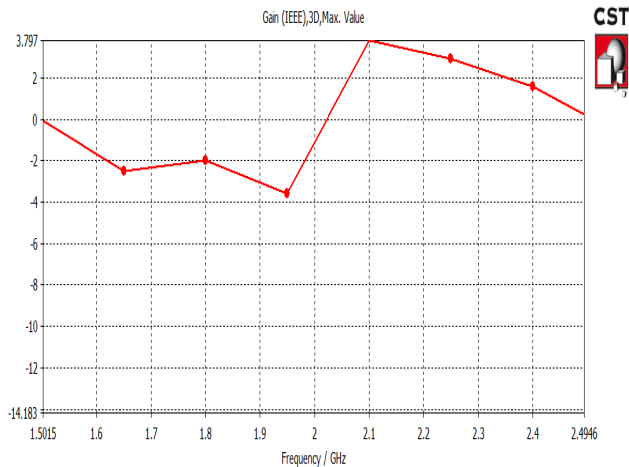


Fig.5: Simulated gain plot of proposed micro-strip patch antenna.

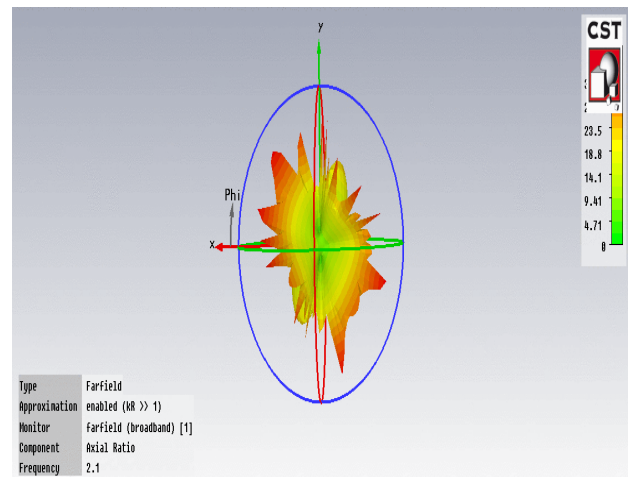


Fig 7. Axial ratio of circularly polarization rectenna.

Fig (6)& (7) Shows Absolute radiation pattern and angular radiation pattern of circularly polarized rectenna respectively and Axial ratio of rectenna is shown in fig(7).

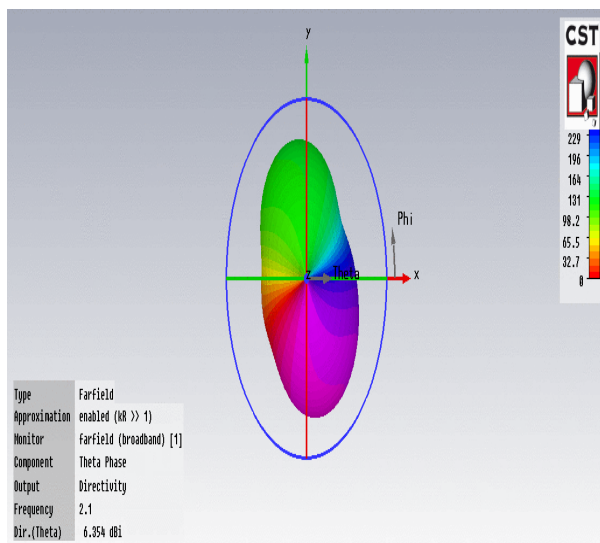


Fig.6: Absolute radiation pattern of micro-strip patch antenna.

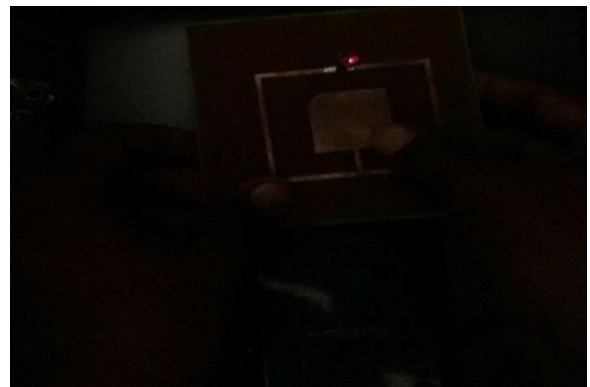


Fig.8: Experimental demonstration of proposed system by LED glowing.

In this project we glow an LED without connecting it to any power source by wire. Fig.8 shows an LED glowing with microwave energy harvesting system. LED is operating because V_f of this LED is 2V. This proposed energy harvesting system harvest more than 2V DC voltage.

IV. CONCLUSION

A Rectenna is a microwave energy harvesting for microwave wireless power transmission at 2.1 GHz. The proposed rectifying antenna should be useful as a virtual battery in application where the receiver is rotating relative to the transmitter. In this paper we have applied the concept of Defected Ground Structure. After applying DGS Gain and Bandwidth of a Rectenna has increased. Gain is increases from 25 dB to 32dB and bandwidth is increases from 94 MHz to 101 MHz .

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BIOGRAPHIES



Prof.P.K.Singhal presently working as a professor & Head in Department of Electronics in Madhav institute of technology & science, Gwalior, and published more than hundred research paper, which include paper in IEEE transaction, international and national journals international & national conference.



Mr. Rajesh Kumar Banoriya received B.E. Degree in Electronics And Communication from MPCT Gwalior (RGPV) in 2012. Currently he is pursuing M.Tech. in microwave engineering. From MITS College Gwalior, his current research interests are rectenna