A Efficient Rectenna using loop antenna at 900MHz GSM Band

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Abstract— Electromagnetic wave has a most important part of power and electromagnetic energy industry. In this paper introduced is a rectenna. The high efficiency has rectifying antenna (Rectenna) used is a wireless energy harvesting system. The history of rectenna for wireless energy harvesting and transmission has then analysed. The harvest wireless energy expeditiously under the sure conditions and have the capacity to arise a power supplier for some particular applications. The rectenna is uses cyclic antenna as a frequency 900MHz and gain 22.5dB. the maximum RF to DC conversion efficiency of the Rectenna is 76%.

Key words: CST Software, Rectifying Circuit, Wireless Energy Harvesting, Rectenna Conversion Efficiency

I. INTRODUCTION

Over the past two decade, many wireless systems has improved and we are used widely around the whole world. The rectenna has been a growing area of research work in recent years. The radio and television broadcasting system with the energy of electromagnetic waves/energy in the usual continuously large amounts is wasted. Increasingly interesting topic. Recycle wireless electromagnetic energy harvest and environment has become an the best examples are cellular mobile radio and Wi-Fi system. When a person makes a call or an app exchanges data with the Internet, a phone transmits radio signals on a 2G, 3G or 4G cellular network to communicate with a cellular base station. When a user's hand moves through space near the phone, the user's body reflects some of the transmitted signal back toward the phone. The new system uses multiple small antennas to capture the reflected signal. A more products are designed with wireless charging ability, resonant wireless power-transfer (WPT) technology is growing present in the wireless market. Having faster and more reliable.

One of the most promising methods to harvest the wireless energy is to use a rectenna which is a combination of a rectifier and an antenna. A typical block diagram is shown in Fig. 1.

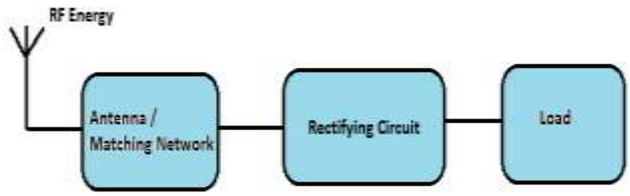

Fig. 1: Rectifier device

The most important two advantages of rectenna:

- The life time working of the rectenna and it will not need replacement of the rectenna
- It is "green" for the environment (No deposition to pollute the environment).

II. BACKGROUND OF WIRELESS POWER TRANSMISSION AND ENERGY HARVESTING SYSTEM

Over 100 years ago, the concept of wireless power transmission has proposed and demonstrated by Tesla [1, 2], In general it is difficult to predict how the rectenna system is optimized for the maximum conversion efficiency. However, there are several theoretical methods to overcome this problem. These methods can be divided into two groups; the first one is to directly simulate the rectenna circuit in time domain [3], whereas the other is to find a closed-form equation which can explain the relationship between diode parameters and the

Conversion efficiency [4-5]. An annular ring-slot rectenna designed for low power densities and operating at 5.2 GHz was introduced in [6]. This information of must be sent to appropriate destination. Traditionally, a mobile test unit (MTU) will perform the function of the interrogator. the propose 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 [7]–[9].

This system Minimum numbers of components are used in the design of the RF Energy harvesting system to reduce power dissipation in the circuit itself.

III. ANTENNA DESIGN

The geometry of the proposed antenna with the parameter is shown in fig.2. Its physical dimensions are Length L=100mm, Width W=100mm, loop Length=λ/4. FR4 (lossy) has been taken as substrate whose dielectric constants are one sided and thickness is respectively 4.4 and 1.6 mm. The design frequency use hare 900MHz. The design of loop antenna is CST microwave studio software.

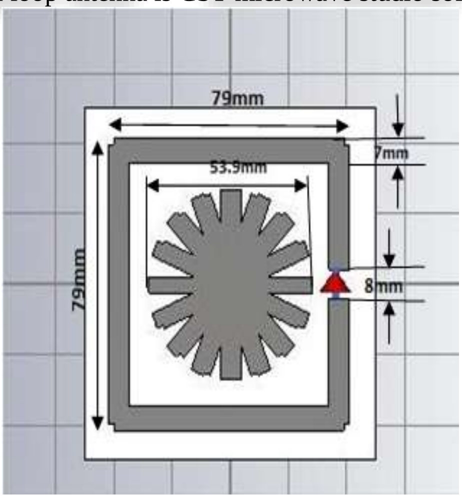

Fig. 2: Top view of cyclic loop antenna

Simulation reflection coefficient plot of proposed loop antenna is shown in fig. 3. The maximum value of reflection coefficient is 22.5dB at a centre frequency 900MHz. Simulated VSWR (voltage standing wave ratio) plot of proposed loop antenna are shown in Fig.4. VSWR of proposed antenna is less than 2 from 875MHz to 985MHz.This is under the tolerable VSWR. At resonant frequency 900MHZ, VSWR is 925. Fig.5 shows the gain plot of proposed antenna. At centre frequency, gain of proposed antenna is 3.75dB.

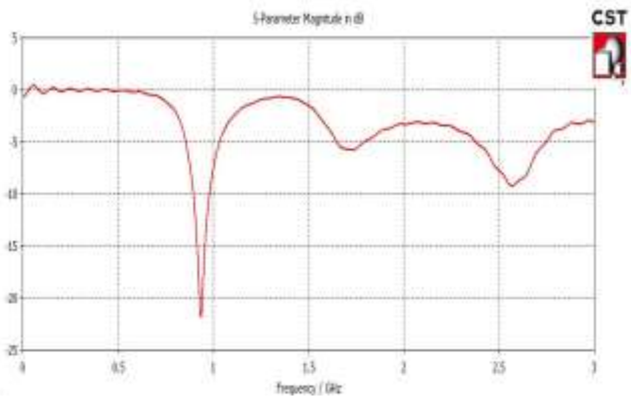

Fig. 3: Simulated reflection coefficient (S11) of proposed loop antenna

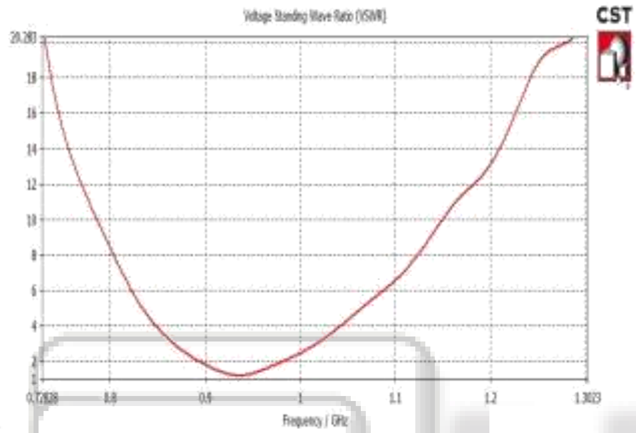

Fig. 4: VSWR of proposed antenna.

Simulated VSWR (voltage standing wave ratio) plot of proposed loop antenna are shown in Fig.4: VSWR of proposed antenna is less than 2 from 875MHz to 985MHz.This is under the tolerable VSWR. At resonant frequency 900MHZ, VSWR is 925. The VSWR or Return Loss determines the matching properties of antenna. It indicates that how much efficiently antenna is transmitting/receiving electromagnetic wave over particular band of frequencies.

Fig (6) & (7) Shows smith chart and angular radiation pattern of loop rectenna respectively and Axial ratio of rectenna is shown in figure (7). In order to optimize the rectenna for maximum power transfer, the antenna impedance must be matched to the impedance of rectifier diode.

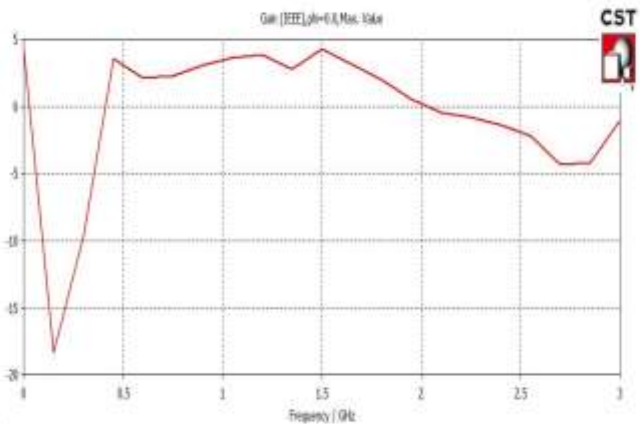

Fig. 5: Simulated gain plot of proposed antenna.

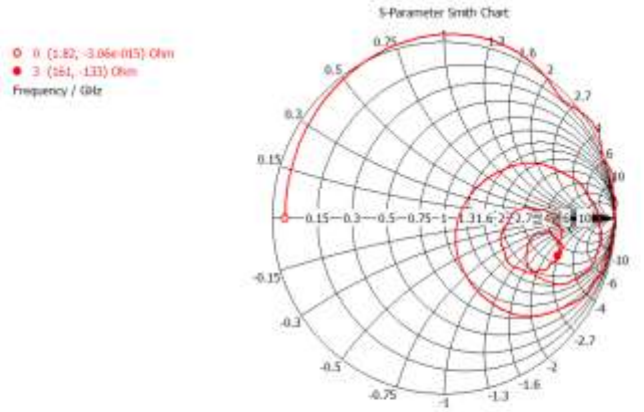

Fig. 6: smith chart in loop antenna.

Fig.5 shows the gain plot of proposed antenna. At centre frequency 900MHz, gain of proposed antenna is 3.75dB. After the applying loop antenna concept Gain and Bandwidth of a Rectenna has increased. The antenna gain describes the antenna's ability to radiate in certain direction when connected to a power source. Gain is usually calculated in the direction of maximum radiation. Gain is given by the referencing the antenna under tested against a standard antenna.

As shown in Figure 3.6, the surface current gives the good explanation why the proposed antenna can work at frequencies 900MHz, the current is whole two direction. It also can be explained the reason why the maximum radiation direction is two sided at each frequency.

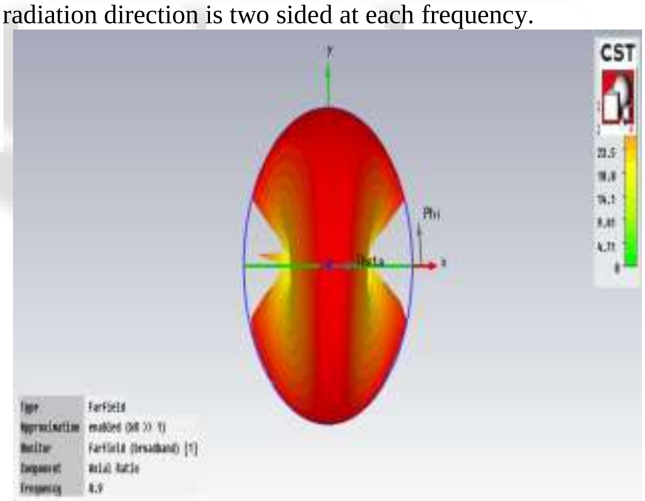

Fig. 7: Axial ratio of circularly polarization rectenna.

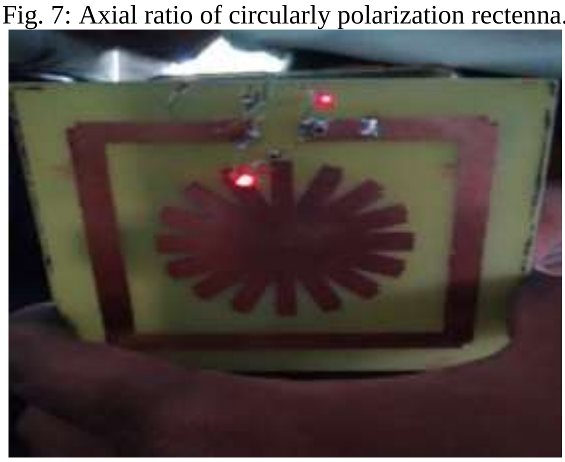

Fig .8: Experimental demonstration of proposed system by LED glowing.

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 Vf 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 900MHz. 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 loop antenna. After applying loop antenna concept Gain and Bandwidth of a Rectenna has increased. Gain is increases from 19 dB to 22.5dB.

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