Investigation on Designing a Microstrip Patch Antenna Array for RF Energy Harvesting Application

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***Abstract*—With the increasing demand of alternative sources of energy, radio frequency energy harvesting is getting importance now a days. In this paper we presented different strategies of RF energy harvesting. The feasibility of harvesting is discussed, leading to the conclusion that RF energy Harvesting is preferred for powering small sized wireless devices. The ambient radio frequency energy used as a source is emitted from various sources such as mobile phones, wife, routers, towers**

Keywords- Radio Frequency; Energy Harvesting; Antenna

I. INTRODUCTION

Now a day's problems are arising due to excessive use of non-renewable energy sources. It has also caused major effect on environment. Therefore there is a need to find an alternative energy source. So here we can use energy harvesting. Energy harvesting is the process in which we collect energy from different sources such as radio frequency, cell towers, mobile phones etc.

As there are many renewable energy sources are available but cell towers may be used as eternal supply of renewable energy source. As we know cell towers are situated everywhere in the world and transmits radio frequencies 24 hours. In India cell towers transmit in the frequency range of 869- 890 MHz in CDMA, 935-960 MHz in GSM 900 and 1810-1880MHz in GSM 1800 bands. Cell towers are situated in roof top of buildings it mostly transmits 10 to 20W per carrier; there may be 3 to 4 carrier operator on a single tower. Here we can used Friis transmission equation to calculate the signal strength of transmitting towers of GSM900 band which is as given below.

$$P_r = P_t G_t G_r [\frac{\lambda}{4\pi R}]^2 \quad (1)$$

Where,

Pr = Received Power
Pt= Transmitted Power
Gt= Gain of the transmitted Antenna
Gr= Gain of the receiver Antenna
R= Distance between the transmitter and receiver antennas

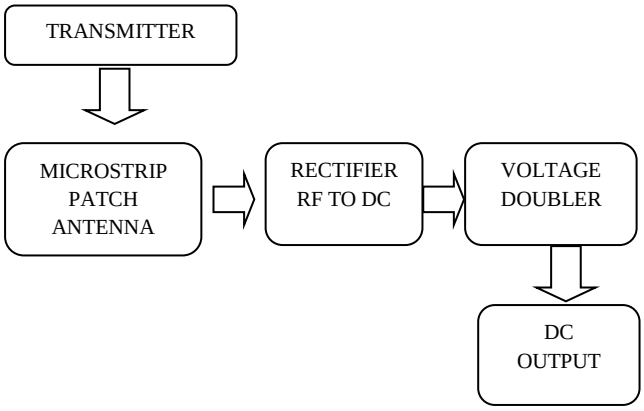

Fig1.Basic Block Diagram of RF Energy Harvesting System

As there are plenty of cell towers in India, therefore harvesting ambient RF energy would provide an alternate energy source for various applications and reduce radiation health hazards.

Fig.1 shows the basic block diagram of RF Energy harvesting system.

II. RF ENERGY HARVESTING CIRCUIT

This section gives the details of RF energy harvesting circuit and also describes some of the basics components which are important for hardware implementation of RF harvesting system.

A. Antenna

Antenna is one of the most crucial components in RF energy harvesting system to extract maximum power. Main aim of antenna technology for RF harvesting system is to achieve high gain.Microstrip antennas have become very popular in recent decades due to their thin planar profile which can be incorporated into the surfaces of consumer products, aircraft, radars and missiles. In this paper, broadband electromagnetically coupled square microstrip antenna (SMSA) is used for the proposed RF energy harvesting system. Antenna has a stacked configuration. The gain of

antenna is 9.1dB. The antenna is designed for the 935-960 MHz (GSM 900) band but it can also cover part of CDMA transmission band (869-890MHz) [1].

Patch Antenna:

The most common type of microstrip antenna is the patch antenna. Antennas using patches as constitutive elements in an array are also possible. A patch antenna is a narrowband, wide-beam antenna fabricated by etching the antenna element pattern in metal trace bonded to an insulating dielectric substrate, such as a PCB, with a continuous metal layer bonded to the opposite side of the substrate which forms a ground plane. Common microstrip antenna shapes are square, rectangular, circular and elliptical.

Rectangular Patch:

The most commonly employed microstrip antenna is a rectangular patch which looks like a truncated microstrip transmission line. It is approximately of one-half wavelength long. When air is used as the dielectric substrate, the length of the rectangular microstrip antenna is approximately one-half of a free-space wavelength. As the antenna is loaded with a dielectric as its substrate, the length of the antenna decreases as the relative dielectric constant of the substrate increases.

B. RF To DC Conversion Rectifier

The Radio frequency is AC signal to get a DC signal out of the AC signal, a rectifier circuit is required.

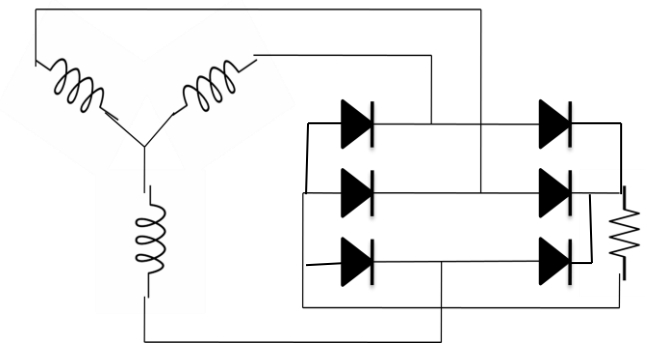

Fig2. RF to DC Conversion Rectifier

There are various types of rectifier they are as follows:

1. Single stage voltage doubler
2. Double stage voltage doubler
3. Triple stage voltage doubler

Rectifier includes matching circuit as well as voltage doubler circuit.

Matching Circuit:

Matching circuit is placed between source and the rectifier circuit to reduce the dissipated power between the source and the rectifier. It will then increase the output voltage of the circuit.

Voltage Doubler Circuit:

A voltage doubler circuit is an electronic circuit it charges capacitors from the input voltage and switches these charges in such a way that, in the ideal case, exactly twice the voltage is produced at the output as its input. In this paper we will be using three stage voltage

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III. CONCLUSION

We represented RF energy harvesting system using a high gain electromagnetic coupled antenna. We obtain voltage from RF signal through which we can charge low power consumption devices.

We concluded that RF energy can be obtained from different source Mobile phones, wifi towers, and cell networks.

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