Survey of Different Rectifiers for RF Energy Harvesting Systems

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***Abstract*- Energy harvesting is gaining popularity as battery less operated systems are becoming a vital part of technology today. Design of RF (radio frequency energy) harvesting system includes an antenna to receive ambient RF signal and rectifier to convert received signal and finally a storage device or you can directly put this circuit in your application circuit of low powered device. This paper reviewed various type of rectifier circuit for RF energy harvesting system.**

I. INTRODUCTION

Different type of energy harvesting from renewable sources such as solar, wind, heat as well as vibration have been the focus of research in upcoming scenario. However, there is an alarming increase in number of user for different applications especially inside buildings where light or solar or wind energy is not sufficient to harvest energy.

Recent achievements in field of radio frequency for energy harvesting is becoming more successful as it enables power transport over distances and thus overcome the drawback of light, heat and vibration. RF harvesting system consists of an antenna which captures the transmitted RF signal and this is further connected to rectifiers which will converts the captured AC signal into a DC power signal which can be used to power low power devices. RF energy harvester basic components are shown in figure Fig.1.Some time to enhance the captured signal for maximum power transfer; a matching network is needed between the rectifier and the antenna. However to decrease the size of the system, the matching network should be removed for the system and the antenna could be directly matched to the rectifier [1].

We have witnessed several challenges which are inherited with RF energy harvesting system. Amount of input energy for harvester is very less so enhancement circuit to should be modified to obtain maximum efficiency. The main area of concern is the amount of power which is available in low amount and varies from location to location [2].

In this paper various experimental approaches for designing rectifier which is part of RF energy harvester are discussed. So it includes worked done and result s obtained with a particular configuration and future discusses the improvements which can be done for the same.

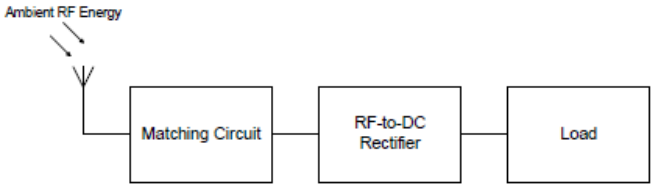

Fig1. RF energy Harvesting System

Field for which this system finds its application are devices such as wireless sensor nodes, calculators, remote controllers and phone chargers as they consume extremely low energy during its employment are the most suitable devices to be energize from RF energy harvesting system. This paper is organized as following section II discusses rectifier circuit design III discusses the result of various papers using different configurations and finally IV discusses the future modification and conclusion.

II. RECTIFIERS CIRCUIT DESIGN

The rectifier circuit is designed using various topologies which are good for ambient energy harvesting system. The different type of configuration of a rectifier circuit to be used for a harvester for RF energy is shown in Fig.2.

RF energy harvesting system has a complex design choice for designing a voltage multiplier. The incident electromagnetic energy is captured by receiving antenna and is fed to the RF to DC converting rectifier in the form of a high frequency sine wave.

Voltage doubler or multiplier consists of diodes and capacitors. The incoming signal should be able to pass through the voltage barrier of the diode. The doubler increases the voltage not the power but actually power decreases as the number of stages of multiplier circuit increases in the rectifier circuit. Therefore it imposes a limit of increasing the stages of multiplier as it consumes the incoming energy [3].

A. Different type of Rectifier Configurations

A good rectifier for RF harvesting system must have a low power consumption, good power sensitivity and good power handling capability to work. A single Series conventional diode rectifying circuit is as shown in Fig. 2.

The RF power received by the antenna is attenuated passing through the impedance matching circuit and the diode. The remaining power is converted into the dc power directly.

The capacitor here acts as a high-pass filter and energy storage element. In this configuration only the positive half cycle of the wave can be rectified by the diode and the negative half cycle is rejected so this is not an efficient configuration as it do0es not satisfy the biasing requirement for RF energy harvester.

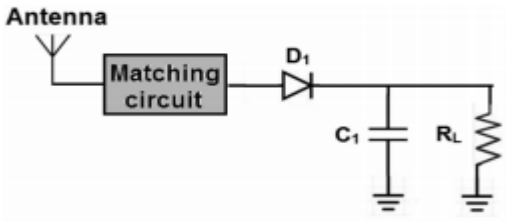

Fig2 Single Series Convectional Rectifier Circuit

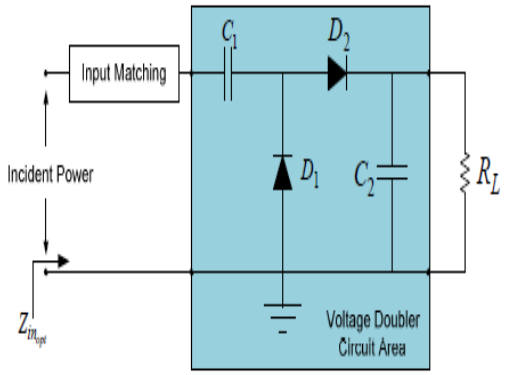

Fig3.Rectiifer Circuit for RF energy Harvesting

III. ANALYSIS OF VARIOUS COMPONENTS

Schottky diode is non-linear device and has input impedance changing as function of input power and frequency. The main objective for choosing a diode is too fast, accurate and at the same time reliable to calculate the impedance which are the features of schottky diode. In order achieve the high efficiency for RF-to-DC conversion the switching-time diode must be considered as it is a promising device to detect the ambient RF energy.

Diode proposed in this paper is Schottky diode HSMS-285C of Avago Technology. The commercial rectifier works for input power level -30dBm [4] [5].

V. CONCLUSION

This paper discussed different type of rectifier design along with component choice that can be used in RF energy harvesting system to obtain maximum harvested signal form incoming low ambient RF signal. To obtain maximum power transfer between the antenna and rectifier the input impedance of antenna should be matched with the rectifier circuit.

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