RF Energy Harvesting

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Abstract- *The paper have the description of RF signal harvesting and reviving that energy into the DC energy. The characteristics of antenna such as gain and polarization are maintained to achieve high efficiency. The antenna provides low power ac output and that output is given to the booster rectifier circuit. The DC output obtained is utilised in a range of applications such as mobile charging circuits, wireless body area networks, medical implant devices.*

Keywords- Impedance Matching, RF Booster Rectifier, LNA, etc.

I. INTRODUCTION

Recently, the availability of the free RF energy has increased due to emergence of wireless communication and broadcasting systems. Wireless power transmission technology via microwave has advanced from the 1960's. Until this time, the electrical power generated by RF energy harvesting techniques is small; depending on techniques it is enough to drive low power application devices. Radio waves are available in our everyday lives in form of signal transmissions from TV, radios, wireless LAN and mobile phones[1].

The energy harvesting device can be subdivided into three components: Antenna Design, RF-DC Conversion, Charging circuit. Rectenna is a rectifying antenna which is used to harvest RF signal, and then it converts the RF signal to DC output. An impedance matching circuit between the received aerial and rectifier circuit is necessary to increase the voltage gain and further reduce reflection and transmission loss. For low-power and sensing applications, the main aim to satisfy after rectification is to recover the maximum amount of power and reduce the power loss caused by the rectifier circuit [4]. A key component in RF energy harvester which determines the system efficiency is the rectifier. Rectifier converts incident RF signal to DC voltage. The rectified DC voltage is further boosted to usable DC level via a DC-DC converter. The research aim is to design the impedance matching cir- cuit/series resonant circuit, with minimum insertion loss for impedance miss match is -0.086dB. Conventional rectifiers are constructed using diodes. However, the large forward voltage dropintherangeof0.7Vtol.0V[2].

II. THEORY

The design constraints of radio frequency energy harvesting which informs about the various for antenna design. The type of the RF antenna with respect to its design configurations should be choosen wisely, inorder to achieve maximum efficiency out of it.

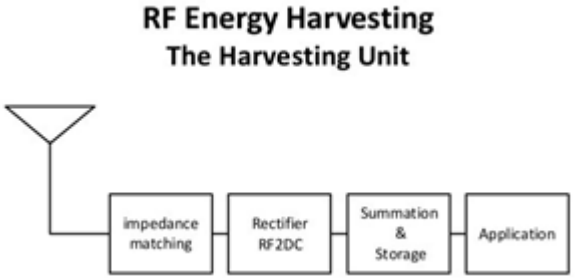

Fig. 1. Block Diagram of RF energy Harvesting

A. Matching Network

The matching networks are utilised for providing the maximum efficiency in the transmission line of antenna by equilizing the impedances of transmitting and receiving sides [3]. The matching network are the combination of the LC networks arranged in a specific manner to obtained the required efficiency. This makes the value of impedances equal i.e. 50ohms and the phase lag or lead between the two impedances as zero. A general impedance transformer and short stub are designed to match the complex impedance with 50 Ohm input port. Zin is 3.107 + j85.374 at 2.4 GHz and 84.565 – j235.735at 5.8GHz with load of 1000 [1].

$$PCE = P_{out}/P_{in}$$

B. Cockcroft Walton Booster Circuit

The Cockcroft Walton booster circuit is a rectifer stage for the signal received from the matching network. The need of boosting the received signal is needed, because the amplitude of signal available is verylow, such level is not

suitable to charge the battery. To overcome the charging issue, the cock croft walt on booster circuit is uesd.

The booster circuit have the simple network of diode and

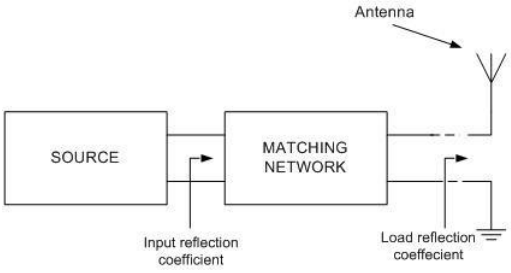

Fig. 2. Block Diagram of Matching Network

capacitor arranged in the ladder type structure. The cascading of several ladders provides the better value of signal which was given to the input of the circuit. The casdading of stages depends on the requirements of the user. The output of the booster circuit is the value two times the peak input value and the no. of stages.

$$V0 = 2NV_p$$

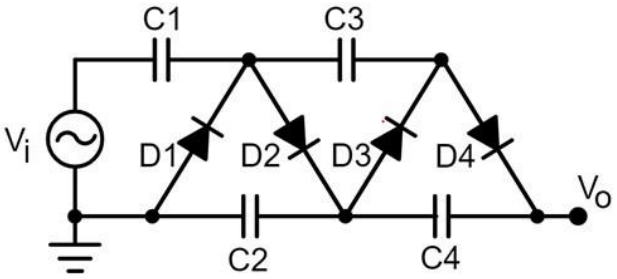

Fig. 3. Circuit Diagram of Cockcroft Walton Booster Circuit

C. RF to DC Conversion

The booster circuit output is feed to the converter and storage device. The RF to DC conversion ratio is given by Gv and it is defined as the ratio of output voltage of booster cicuit to the peak input voltage of the booster circuit [2]. The expression of RF to DC conversion is as follows:

$$Gv = Vout/Vinp$$

III. CONCLUSION

The paper has the description of the RF energy harvesting technique. The antenna characteristics which are necessary for the receiption are discussed along with the boosting rectifier circuit which provides the improved voltage levels. These signals are used to charge the electronics devices and use this energy for their own purpose.

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