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A Novel Low Power RF to DC Converter for Wireless Sensor Network

Kousik Roy[1], Chiranjib Goswami [2], Naimul Hasan[3*], Rashmi Priya[4], Saswata Chakraborty[5]

[1,2,4,5]Dept. of Electronics and Communication Engineering,Asansol Engineering College, Asansol-713305
[3]Dept. of Electronics & communication Engineering, Sanaka Educational Trust's Group of Institution, Durgapur-713212, West Bengal, India

Corresponding Author naimul_hasan@yahoo.in, Tel.: +91-9732042853

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Abstract— In this paper the schematic diagrams for realization of low power RF to DC Converter have been illustrated. Here we have implemented the rectifier circuit at 2.45 GHz . -5 dBm,0 dBm,10 dBm input power are taken for the design and simulation of the rectifier circuit. Variation of input power with respect to DC voltage is shown at 2.45 GHz frequency. Likewise change of $S_{1,1}$ & variation of output power with respect to frequency is also presented. In this paper we have illustrated the schematic design of the rectifier circuit along with the matching circuit utilizing HSMS 2820. Simulations explain that the DC voltage of 0.459V, 0.859V, 3.120V can be obtained at -5dBm, 0dBm, 10 dBm input power when input frequency 2.45GHz and load resistance of 20kΩ

Keywords— *Return loss , Wireless Sensor Networks ,RF to DC converter.*

I. INTRODUCTION

The harvesting method is intended to give a special source of energy to enhance low power devices. Energy harvesting is the technique of gathering the energy from environment and changes it into well-suited electrical energy for power electrical appliances. This expertise is additionally renowned as power harvesting and energy scavenging [1, 2]. In present era, energy harvesting at radio frequency (RF) has been a fast increasing topic. As the most significant wireless energy transmission was considered and renowned in the 1890's by Nikola Tesla through the electromagnetic wave propagation technique of Hienrich Hertz [3]. The field is stretched and correlated to a number of uses such as microwave-powered helicopter prototype, solar power satellite system (SPSS), microwave power transmission in space and radio-frequency identification (RFID) [4-7]. As a result, the most essential cause of the RF energy harvesting is the rectenna that recognizes the ambient RF energy by the antenna and amend the conventional energy to the DC power with the help of rectifier circuit. A rectifier, as well acknowledged voltage multiplier or charge pump, converts the RF signal into a DC signal out of the AC signal and has been generally utilized in radio frequency identification (RFID) and several applications. A rectifier can typically be well-known as DC-DC and AC-DC types and this paper predominantly centers on the next. Wireless sensor networks (WSN) have built up in modern period as constructive equipment for a wide sort of utilizes, in company with smart homes and cities, health of Advance Design System (ADS).

and fitness, amusement, structural health examination. RF energy harvesting influences a outlook for generating a minute amount of electrical power for electronics devices. Such harvesters employ a battery-less function and develop noticeably the functioning period of the Wireless Sensor Networks (WSNs). This paper contemplates on the RF to DC conversion element of a RF energy harvesting method which employs radio frequency waves as the input resource. A matching network is employed to equal the input impedance of the rectifier with that of the antenna's output impedance with the purpose of reduce power loss. In this paper a RF energy harvesting scheme for the 2.45 GHz band is illustrated, which can be operated to build up low power devices, e.g. wireless sensor systems

II. RECTIFIER DESIGN

The purpose of the rectifier is to straightforwardly change microwave RF energy into DC electrical energy. Schottky Diodes are selected as if possible low forward bias voltage of 0.15 V with fast switching at high frequencies which is mainly suitable for particularly low RF input power uses. Here we have designed the rectifier circuit with matching network operated at 2.45 GHz shown in Figure 1. DC output voltages of rectifiers depend on special parameters like width, length of layer etc. The circuit is imprinted on the substrate having Dielectric constant = 4.34 and h = 1.5 mm. The circuit was considered and also optimized with the help

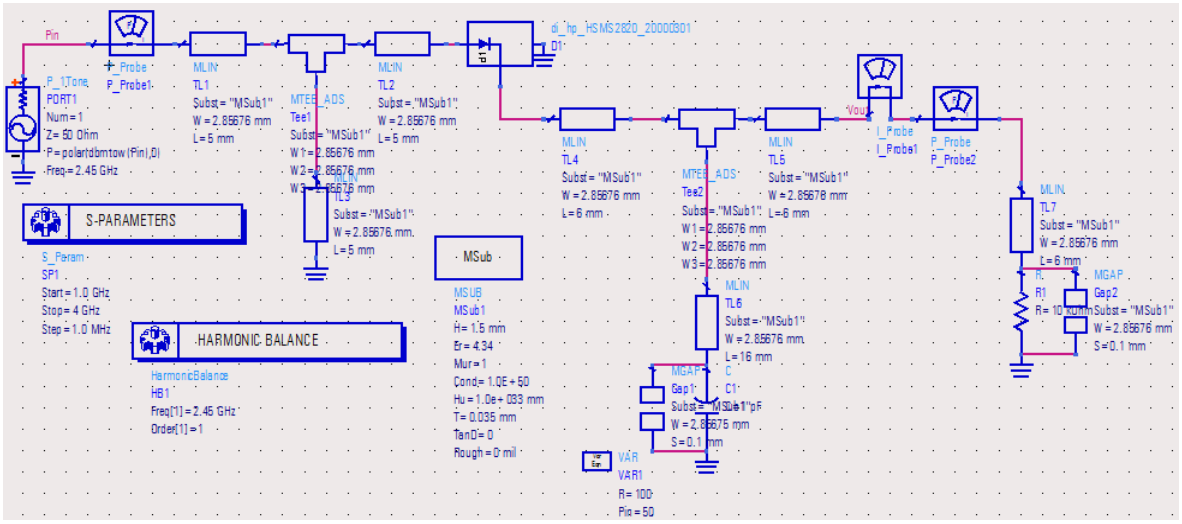

Figure 1. Schematic diagram of the rectifier circuit at 2.45 GHz

III. RESULTS AND DISCUSSION

The Rectifier circuit with matching circuit is simulated by using Harmonic Balance (HB) Simulation method of ADS-2009. The simulated DC output voltage are acquired for different input RF power with respect to the 10 kΩ load is illustrated in Figure 2. Figure 3 signifies the variation of output DC current with respect to Input power. Figure 4 shows the alteration of reflection coefficient ($S_{1,1}$) of the rectifier with respect to frequency at 2.45GHz .For the deviation of $S_{1,1}$ with respect to frequency, it has been observed that this 2.45 GHz resonant frequency is altered to 1.918 GHz. For 1.918 GHz, we obtained return loss -13.507. The rectifier circuit resonates at 1.918GHz for a 50Ω input source. Figure 5 illustrates the smith chart at 2.45 GHz frequency. Input and also the output voltage can be achieved with the help of HB simulation and $S_{1,1}$ parameter can be acquired by using S-parameter simulation

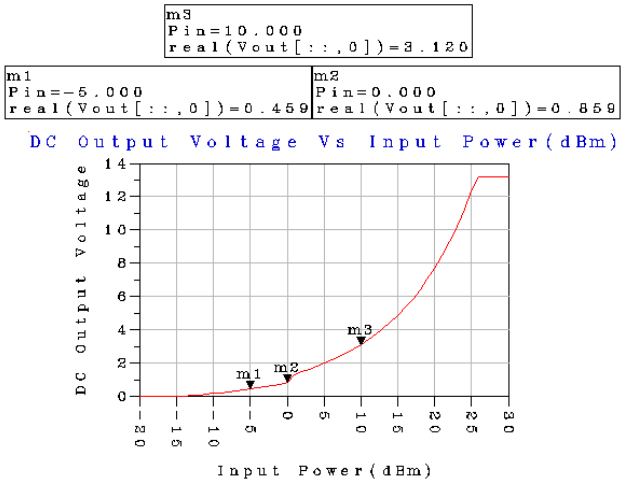

Figure 2. Variation of DC output voltage with respect to input power

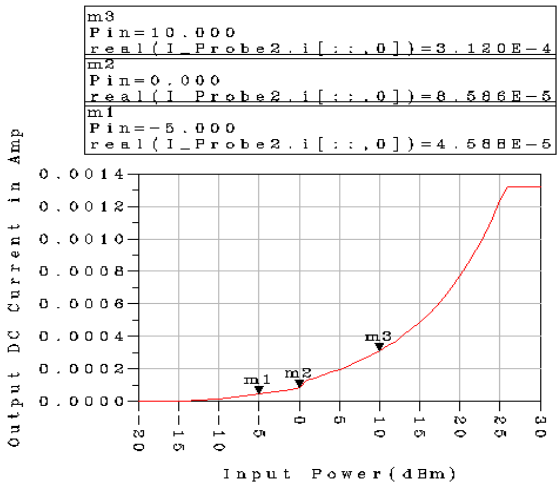

Figure 3.Variation output DC current with respect to input power

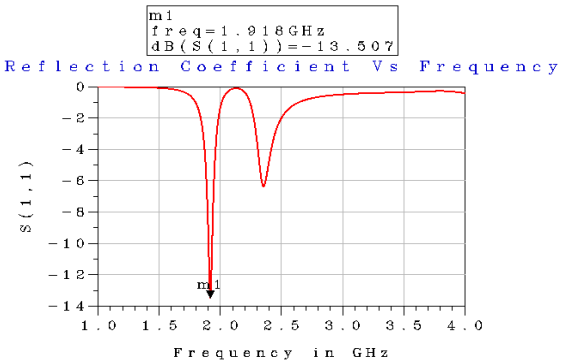

Figure 4. Variation of S(1,1) with respect to frequency

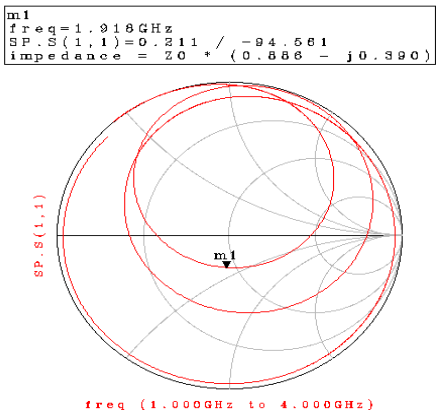

Figure 5. Illustration of smith chart at 2.45 GHz frequency

IV. CONCLUSION

RF power harvesting technology depicts a bright prospect in small power consumer electronics and wireless sensor arrangement. With growing the working frequency of rectifier circuits it has been perceived that DC output voltage is significantly reduced when the length and width of rectifier circuits alter. This paper focuses on the RF to DC conversion constituent of a RF energy harvesting construction which operates radio frequency waves as the input source. The RF energy restrained by the receiving antenna is provided for into the rectifier. The rectifier alters the constant RF input signal to output DC voltage. The rectifier is the principal noteworthy structure of the energy harvesting scheme as it removes the input radio frequency power into DC. In this paper a novel design of RF energy harvesting scheme for the 2.45 GHz is presented, which can be employed to make stronger minute power devices for instance wireless sensor arrangement.

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Authors Profile

Dr. Kousik Roy obtained his M.Tech from Burdwan University, West Bengal, India in RF & Microwave Engineering and Ph.D (Engineering) from Kalyani University, West Bengal, India in the area of solar radio astronomy. Presently he is doing as an assistant professor in the Department of Electronics & Communication Engineering at Asansol Engineering College, Asansol, West Bengal; India. He has more than 15 years of teaching and about 8 years of research experience. He has published more than 50 research papers in reputed journals, national and international conferences. His research interest includes Astronomy, Astrophysics, Atmospheric physics, Microstrip Antenna and Computational Electromagnetics.

Dr. Chiranjib Goswami received his B.Tech and M.Tech (Microwaves) degree from West Bengal University of Technology and the University of Burdwan in 2006 and 2009, respectively. He has completed his Ph.D in the area of metamaterial and its application in microwave circuits and antenna. He is currently working as an Assistant Professor in Asonsol Engineering College, Burdwan. Hisresearch interests are microwave antenna and metamaterial.

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Mr. Naimul Hasan was born in Bonha, West Bengal, India in 1984. He received the Diploma in Electronics and Telecommunication Engineering from ,Jalpaiguri Polytechnic Institute, India, in 2006, and the B.Tech in. and M.Tech degrees in Electronics and Communication Engineering from the West Bengal University of Technology, India, in 2009 and 2011, respectively. In 2012, he joined the Department of Electronics and Communication Engineering, Sanaka Educational Trusts Group of Institutions (SETGOI) as an Assistant Professor, His current research interests include RF Energy harvesting, micro strip antenna

Rasmi Priya is presently studying M.Tech degree in Electronics and Communication Engineering from the West Bengal University of Technology. Her current research interests include RF Energy harvesting, micro strip antenna

Dr. Saswata Chakraborty has done his Phd. from NIT, Durgapur in 2016 and M.Tech from the same institute in 2008. His research interests are Solid State Devices and Antenna. He is currently working as an Assistant Professor in Asansol Engineering College.

