

## DESIGN AND IMPLEMENTATION OF A HIGH EFFICIENCY 5.8 GHz SINGLE BAND RF RECTIFIER FOR IOT ENERGY HARVESTING APPLICATIONS

Naimul Hasan<sup>1</sup>, Mousam Halder<sup>1</sup>, Subhadip Das<sup>2</sup>, Sudipta Chattopadhyay<sup>3</sup>, and Kousik Roy<sup>2\*</sup>

<sup>1</sup> Department of Electronics & Communication Engineering, Sanaka Educational Trust's Group of Institutions, Durgapur, West Bengal-713212, India

<sup>2</sup>Department of Computer Science and Engineering, Bengal College of Engineering and Technology, Durgapur- 713212, West Bengal

<sup>3</sup>Department of Electronics and Telecommunication Engineering, Jadavpur University, West Bengal -700032, India

\*Corresponding Author Email ID: kousikroy002@gmail.com

### ABSTRACT

Emerging IoT networks demand continuous power support in environments where battery replacement is difficult. Radio frequency energy harvesting offers a steady way to recover useful energy from surrounding electromagnetic fields. In this work a compact single band rectifier is presented for the 5.8 GHz ISM region. The design employs a voltage doubler circuit with a low barrier Schottky diode SMS7630 079LF which allows efficient rectification even at low excitation levels. A matching section is added to guarantee the precise transfer of power incident on the nonlinear core. The rectifier is fabricated on RO4003C material that has a permittivity of 3.55, a loss tangent of 0.0027 and a thickness of 0.813 mm so that stable microwave operation could be supported. Simulation studies along with measurement results yield a significant return loss of -32.440 dB at the frequency of interest. The circuit gives a voltage output that rises with improved load conditions and has a power conversion efficiency at about 47.336 percent for a 1 k $\Omega$  load and zero dBm input. This work proves a reliable power module that could be applied to energy-driven IoT networks with the requirement of being continuous and maintenance-free operation.

**Keywords:** RF energy harvesting, IoT energy harvesting, High efficiency rectifier, Single band RF rectifier

### 1. INTRODUCTION

IoT networks have developed at such a fast rate that the demand for power sources that are stable and at the same time maintenance-free has been raised [1]. Nodes operating on batteries are limited in their lifetime and require frequent changes, which hinders their use in large or far-off places [1]. RF energy harvesting is a good alternative since it not only scavenges the ambient electromagnetic energy but also powers the self-sufficient devices [2]. The 5.8 GHz ISM band is an appealing source because of the considerable engagement in contemporary communication links [3]. Rectifier circuits are central to this process because their design determines the power conversion efficiency and the ability of the system to supply low power IoT units [4]. Recent work has improved voltage doubler structures advanced impedance matching and reduced parasitic effects to enhance microwave performance [5]. Challenges remain in maintaining high efficiency under weak input levels and ensuring circuit stability in varied environments [6]. Enhanced matching networks and harmonic suppression techniques show improved output voltage and efficiency and support practical IoT harvesting systems [7]. Prior studies have examined rectifiers at 2.45 GHz and 5.8 GHz using minus ten dBm input and reported trends in DC voltage return loss and output power [8]. Related work at 1.9 GHz has shown changes in efficiency and output voltage across loads and input levels and has demonstrated the impact of matching networks built with HSMS diode families [9–12]. This work introduces a single band rectifier at 5.8 GHz that uses refined circuit methods and careful device selection to improve output voltage and conversion efficiency which contributes to the development of reliable and sustainable IoT systems.