Miniaturization of 920-MHz Differential Rectennas Using Shorted-Microstrip Antennas

Takahiro Suenaga* Eisuke Nishiyama* Akira Morita** Takahiro Kudo** Ichihiko Toyoda *
(*Dept, of Electrical and Electronic Engineering, Saga University) (**Fuji Electric Co. Ltd.)
suenaga41@ceng.ec.saga-u.ac.jp

1 Introduction

In wireless sensor networks, wireless power transfer using rectennas has been attracted much attention. In this paper, miniaturization of differential rectennas employing shorted-microstrip antennas (shorted-MSA) is proposed and discussed.

2 Structure

Fig. 1 shows the structures of the conventional differential rectenna and the proposed shorted-MSA differential rectenna. The conventional differential rectenna consists of two microstrip antennas, a diode, a capacitor and two λ/4 shorted stubs. On the other hand, the microstrip antennas are replaced by two shorted-MSAs in the proposed rectenna. Copper foil tapes are used to short-circuit each antenna element to the ground plane. As the size of shorted-MSAs is half of the conventional microstrip antennas, miniaturization of differential rectennas can be achieved.

3 Experimental Results

Fig. 2 compares the measured output DC power of the rectennas. Each maximum output powers of the conventional and proposed rectennas is 8.7 mW and 3.9 mW, respectively, where the respective optimum loads are 270 Ω and 300 Ω. The output power of the conventional rectenna is almost double of the proposed rectenna's. This is because the antenna gains of shorted-MSAs are less than those of microstrip antennas. According to the simulation results, the antenna gains of the microstrip antenna and shorted-MSA are 10.6 dBi and 6.8 dBi, respectively.

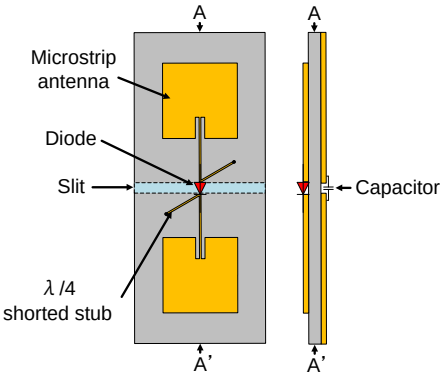
Fig. 3 compares the measured conversion efficiency defined by the ratio of output DC power and received RF power [1]. The maximum conversion efficiencies of the rectennas are 27.7 % and 29.9 %, respectively. Almost the same conversion efficiency is obtained.

4 Conclusion

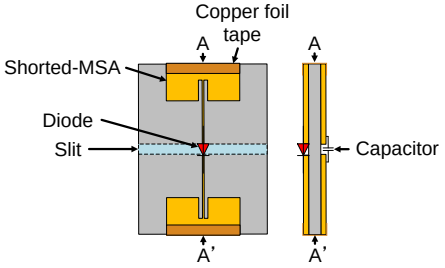
A new miniature differential rectenna using shorted-MSA has been proposed and its performance has been also experimentally compared with a conventional differential rectenna. The output power of the proposed rectenna is lower than that of conventional one, but conversion efficiency is still maintained.

References

[1] J. Takahashi, E. Nishiyama, I. Toyoda, "Experimental Study on Load Resistance Design of a Differential Rectenna," Proc. 2015 Int'l. Symp. on Antennas and Propag. (ISAP2015), pp. 223-225, Nov. 2015.



(a) Conventional differential rectenna



(b) Proposed shorted-MSA differential rectenna

Fig. 1 Structures of differential rectennas.

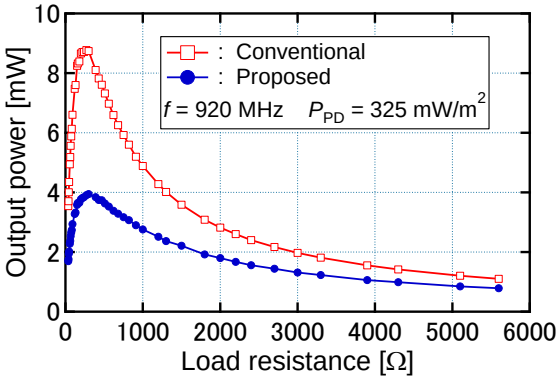


Fig. 2 Measured output power vs. load resistance.

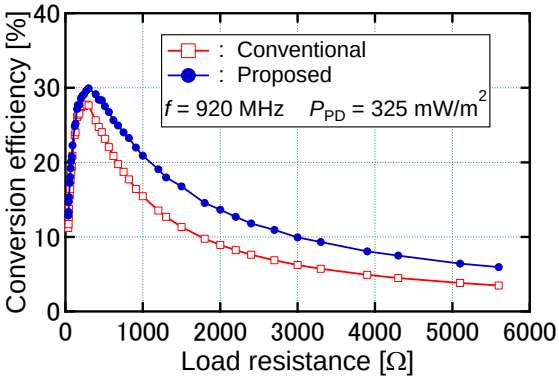


Fig. 3 Measured conversion efficiency vs. load resistance.