ABSTRACTS (MASTER THESIS)

Development of a compact microwave rectifier with the multilayer substrate filter

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These days, Internet of Things (IoT) is the focus of attention for the realization of more convenient world. Microwave power transfer (MPT) is expected to be a method of power supply to the IoT devices. In order to apply MPT techniques to the IoT devices, microwave receiving components are required. Hence, the size of the components for MPT should be reduced because of limited size of IoT devices. The objective of the present study is to develop more compact microwave rectifier. In the previous study, the multilayer substrate filters have been proposed as a new compact microwave filter and demonstrates its effectiveness for circuit size reduction. However, their proper operation principle have not been studied.

At first, the principle of the multilayer substrate filter (Fig.1) is analyzed so as to provide a more simple and flexible method for filter design. With the equivalent circuit and electromagnetic analysis the filter operation is clarified. In addition, a four-layer substrate filter for the microwave rectifier is designed by electromagnetic simulation. A single shunt class-F load-type rectifier is generally chosen as a microwave rectifier. It requires input and output filters (Fig.2) in order to obtain high rf-dc conversion efficiency. Hence, the multilayer substrate filter is designed, fabricated and measured to satisfy the required characteristic for the rectifier's filters. The good measurement results are obtained compared with the simulation results. Finally, a multilayer substrate rectifier with the multilayer substrate filter is designed by circuit simulation. As a result of the simulations, higher efficiency and more compact circuit size of the rectifier with the multilayer substrate filter are achieved than one with the conventional filter. Additionally, the designed rectifier is fabricated (Fig.3) . However, its measured rf-dc conversion efficiency is low, compared with simulated results (Fig.4). The efficiency reduction of the fabricated multilayer rectifier is discussed.

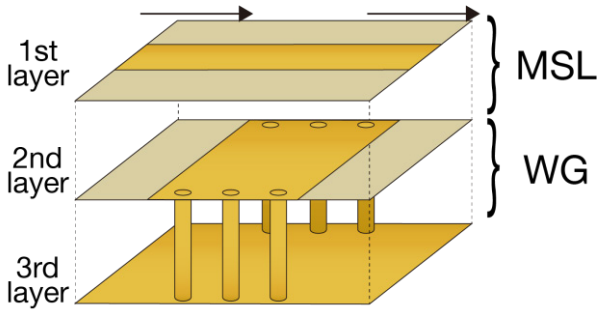

Fig. 1 Proposed new microwave filter (MSL : Microstrip antenna, WG : Waveguide)

Fig. 2 Developed output filter

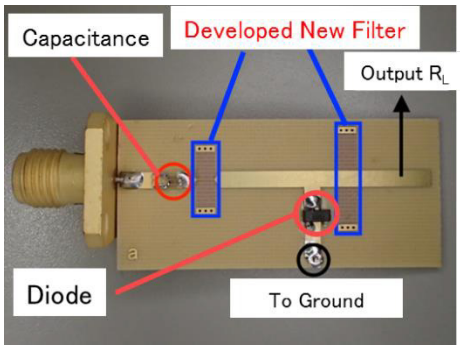

Fig. 3 Developed rectifier

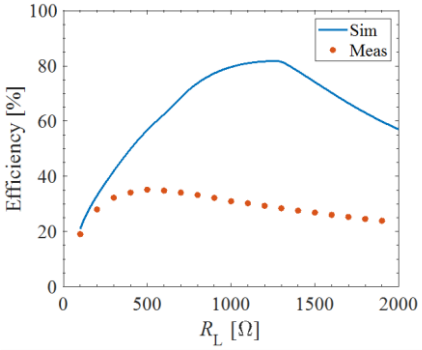

Fig.4 rf-dc conversion efficiency