

ABSTRACTS (MASTER THESIS)

Development of 24 GHz-Band Rectenna and Study on its MMIC Integration

**(Graduate School of Engineering,
Laboratory of Applied Radio Engineering for Humanosphere, RISH, Kyoto University)**

Ken Hatano

Microwave Power Transmission (MPT) in high frequency is essential to broaden a range of MPT applications. In higher frequency, however, the RF-dc conversion efficiency of rectennas decreases. Moreover, modeling errors of connectors, diodes, and propagation loss in a transmission line provide disagreement between simulated results and measured results. The objective of the present thesis is to design and develop highly-efficient 24 GHz-band rectennas with high accuracy. We adopted a microstrip line as a transmission line. We selected the Teflon substrate of 0.1mm thickness and set the width of the center conductor narrow in order to suppress the effect of the surface wave which causes a radiation loss. In a real microstrip line, a conductor loss increases because of the edge effect and the roughness of the center conductor. Thus, we estimated the conductor loss in the real microstrip line. Additionally, we modeled the end launch connector which was mounted to the rectifier. We also fabricated jig circuits for diode modeling, and fitted the simulated results to the measured results. We finally determined the elements of diode equivalent circuits which include parasitic elements. We developed a new-type rectifier which included the propagation loss in the real microstrip line, the connector equivalent circuit, and the diode equivalent circuit. The new-type rectifier achieved the efficiency of 56.0% in the simulation and 51.8 % in the measurement when the input power was 130 mW and the load resistance was 50 Ω . We obtained the highest efficiency of 57.4 % in the measurement at 297 mW and 60 Ω . We also succeeded to develop a monolithic microwave integrated circuit (MMIC) rectifier whose size was 1mm x 2.3 mm, as shown in Figure 1. The MMIC rectifier produced the efficiency of 48.0 % in the measurement at 194 mW and 120 Ω . We designed a patch antenna for the MMIC rectifier, and fabricated a MMIC mounted rectenna. We conducted a 24 GHz MPT experiment with the 2 x 2 MMIC mounted rectenna array, and succeeded motor drive by 24 GHz MPT.

References

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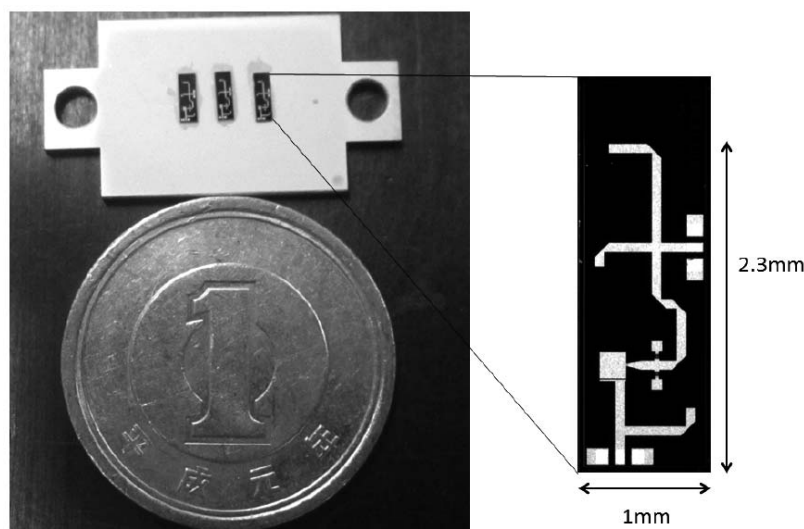


Figure 1. Photograph of a developed 24 GHz-band MMIC rectenna.