

SPACE POWER SYMPOSIUM (C3)
Technologies and Experiments related to Wireless Power Transmission (2)

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MICROWAVE WIRELESS POWER TRANSMISSION DEMONSTRATION ON GROUND FOR SSPS

Abstract

Institute for Unmanned Space Experiment Free Flyer (USEF) has been studying wireless power transmission (WPT) from the beginning of 1990. In this study, we have focused on the microwave power transmission as a key technology for the realization of future Space Solar Power System (SSPS). The goal of SSPS is commercial energy plant which transmits 1GW level electric power from space. In 2009, Japanese New Space basic plan was issued, that selected SSPS as one of the research and development program to be promoted. Though SSPS was selected as an important project, Large Space System is not declared yet. It is limited to Ground level microwave WPT. USEF group is now conducting this project which includes ground WPT experiments with kW level electrical power, under the contract of Ministry of Economy, Trade and Industry (METI). For the final SSPS system, the lightest weight and highest performance transmission panel with accurate beam steering is required. In this program, we are seeking for the development and research of high effective and high performance technologies. We are developing thin phased array antenna by four subpanels. The total RF output power is designed to be 1.6kW. Highly effective GaN HEMT and class-F amplifier with more than 60% efficiency is used to produce the microwave power. Achieved figure is discussed in this paper. The received microwave at array of rectenna, antenna with rectifier, is converted into the electrical energy again with the distance of tens of meters. The rectenna will use existing Schottky Barrier Diode whose efficiency is about 65%. Also, the diode for rectenna rectifier with efficiency target 80% is developed in this program. Moreover, a software retrodirective technology is applied to the microwave beam direction control, and the microwave

is controlled in precisely and high accuracy to the direction of the pilot signal sent from the rectenna panel. Japan Aerospace Exploration Agency (JAXA) is responsible for the development of this precise beam direction Control in this program. We know it is necessary to apply a further technology to divert it for the space experiment. For instance, there are thermal and structural issues peculiar to space. However, this project is at an important position to proceed to the next development step aiming to the SSPS achievement. The experimental system's design and element development are carried out now. In this report, outline of the project is explained.