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RESULTS FROM THE FIRST TEST OF A CONVERSION MODULE FOR SPACE SOLAR IN ORBIT

Abstract

This paper reviews the results of the first space flight test of a Solar to RF conversion module. The module results inform future Space Solar satellite systems that are intended to collect solar energy in space, convert it to a RF transmission, and beam the energy to earth for terrestrial use. This effort is a continuation of previous research and testing performed on the ground, and this paper documents the transition of a RF power beaming module from Earth to Space and the flight data received. The previous research verifies the likely space-worthiness of the module for sunlight collection, power conversion, and wireless power beaming. The Photovoltaic Radiofrequency Antenna Module Flight Experiment (PRAM FX) was hosted on the X-37B orbital test vehicle and flew in space from May 2020 until November 2022. Herein, we review the results of on-orbit testing and operations under a variety of conditions meant to represent likely thermal and illumination environments where a solar power satellite would operate. Telemetry collection is at one second intervals measuring temperatures, voltages, currents, and a range of other quantities of interest. Results from analyzing the telemetry over the course of two and half years, show consistent temperature trends such as the efficiency and power decreasing as the temperature of the module increases. Also, there are strong indications that the module itself did not deteriorate in any significant performance parameter during on-orbit operations. This experiment successfully demonstrated, in orbit, a space solar conversion module able to collect sunlight and convert it to microwave energy for power beaming.