SPACE POWER SYMPOSIUM (C3)
Small and Very Small Advanced Space Power Systems (4)

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SOLAR EMULATOR AND SIMULATOR DESIGN FOR CUBESATS

Abstract

A highly efficient and long life electrical power system is developed by Space Systems Design and Testing Laboratory (SSDTL) of Istanbul Technical University for TURKSAT3USAT, which is a 3U student satellite funded by Turkish satellite corporation Turksat. This paper presents designed test system in detail both in hardware and software level. The aim of the project is to test MPPT tracking capability and sun vector measurement accuracy of any CubeSat from one to four units. The system consists of simulation software, a solar panel emulator and an interface to connect those two systems. The software part contains an orbit propagator, a thermal model and solar panel models of the satellite. Orbit propagator of software can determine the orbital position, while the attitude determination software calculates the attitude vectors. Depending on the orbit and attitude the solar radiation, Earth IR and Earth albedo radiation power can be determined for each side and solar panel of satellite. Solar cell performance depends on irradiance, temperature and radiation. Depending on thermal model of the satellite heat-flow and temperature are determined. For given temperature and irradiance values solar panel model returns the voltage and current characteristics of solar panel output. An interface between software and hardware ensures continuous hardware simulation of the solar panels. Hardware part of the test system generates required power with accurate voltage and current values. Temperature sensor output values are generated for electrical power system (EPS) for measurements. Satellite EPS is connected to test system for validating parameters and characteristics, thus developers can follow the efficiency and MPPT tracking capabilities of their power systems. The system is designed in such a way that it can be attached to the TVAC facility of SSDTL so that total power cycle can be simulated for CubeSats. Power and energy systems can be tested comprehensively. The system will correspondingly be used to test the accuracy of sun vector measurement accuracy. For solar panel testing and validation a solar simulator is designed. The light source is a xenon lamp with constant 1400W/m2 power density. Lamp is designed in order to irradiate solar panels from every possible angle.