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Design and Testing of the Electrical Power Subsystem for the SpudNik-1 CubeSat

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ABSTRACT

The University of Prince Edward Island is one of 15 universities taking part in the Canadian CubeSat Project funded by the Canadian Space Agency. The Faculty of Sustainable Design Engineering is designing and building a CubeSat that will carry an optical payload to capture soil and crop data of Prince Edward Island, called SpudNik-1. The data will be analyzed and shared with farmers on the island to improve their farming efficiency.

The Electrical Power Subsystem (EPS) will provide and manage the CubeSat's power during operation; it is divided into the power module, the battery module, and the solar module. The power module, the heart of the EPS, is composed of the inhibit circuit, buck-boost converter, battery charger, and monitor, and the power distribution system. The EPS is designed to handle operations in three different modes: active, standby, and a power-saving mode.

The EPS is designed to supply the required power with the three faces of the CubeSat, holding three solar cells each. Over the 16 orbits, the EPS should provide sufficient power to all parts of the CubeSat. With the CubeSat's current components, the average power consumption is 2.190W, and the average power generated is 2.977W. The EPS also needs to ensure that the battery does not fall under 80% charge throughout the mission to ensure the batteries' longevity and efficiency.

The EPS design will be tested on the subsystem level, followed by the module level, and finally, the system's overall functionality. The batteries are required to meet the standards of NanoRacks, the company launching the CubeSats through tests such as the charging and discharging cycles and vacuum testing. The maximum power point tracking will be tested by changing the incident angle of an artificial light source to the solar cells. The power module will be tested for its functionality within the requirements set by SpudNik-1. Next, all three modules will be tested together to ensure the system's overall functionality before testing it with the rest of the CubeSat in a FlatSat integration method. The FlatSat integration is where all CubeSat systems are laid out on a flat surface in a clean bench where it will undergo several tests to ensure that SpudNik-1 performs the desired task.

The presentation will include the design for the different modules and the testing procedures used to test the EPS with initial results.

Word Count: 390