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

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A POTENT AND ENDURING ELECTRICAL POWER SYSTEM FOR A NANOSATELLITE

Abstract

This paper describes the enhanced design and implementation of the modules of electrical power subsystem(EPS) of COEPSAT-2. The scientific objective of COEPSAT-2 is to demonstrate the novel technique of propulsion using solar sail where, it will characterize the charged particle4 environment with respect to altitude. A comparison between energy harvested through 'maximum power point tracking' and 'direct energy transfer' is done and a more power efficient and reliable system has been implemented by exploiting the characteristics of the solar cells. The optimum number and configuration of the batteries has been chosen based on energy calculations. The battery pack will experience high current surges owing to subsequent deployments in the initial phase of the satellite after ejection from the launch vehicle and will have to withstand eclipse phase with high power consumption. On the basis of system efficiency, robustness and energy margins, an innovative battery and solar cell configuration has been compared with '1SNP' battery configuration. The major loads on the EPS consist of high power consuming magnetorquers, reaction wheel and power amplifiers for communication. The charged particle monitoring unit requires a high voltage bus of 28V while the controllers require the 3.3V bus. There is also a requirement of a -5V, 5V, 3.6 and 10V buses for communication loads and analogue wave shaper circuit. Thus the EPS needs to implement various converters as the battery voltage needs to be stepped up and down to various levels. In order to improve the overall system's efficiency, some loads like high power amplifiers have been given dedicated voltage buses citing their better performance at those voltages. The EPS is responsible for the implementation of the driving circuitry of actuators like BLDC motor, stepper motor and magnetorquers.

After analysing the performance of different commercially available devices, the designs of converters have been improvised on, such as boost converters have been cascaded to obtain a higher voltage bus with improved efficiency. A charge pump topology has been implemented to generate a negative voltage, citing the low current requirement. A generic, customizable and resilient load protection system has been implemented.