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

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INNOVATIVE ELECTRIC POWER SUPPLY SYSTEM FOR NANOSATELLITES

Abstract

Electric Power Supply system is the most important system for any aerospace mission. It has power generation, conversion, distribution, storage and control sections. Aerospace systems need a very reliable and efficient power supply system. Defective power supply system means the failure of aerospace mission. So realizing the importance of this subsystem for any aerospace mission, we designed and implemented power management tile for CubeSats, but can be used for other NanoSatellites also. In space missions, actual satellite technology results to high costs. The goal of this work is to reduce the overall cost, size, weight and increase the power conversion efficiency of the power management system. To achieve this goal, first of all COTS (Commercial of the Shelf) components were used for the implementation of the power system. They are low cost and easily available from the market. Secondly, modular architecture helps to share costs among multiple missions and reduce development time. The modularity concept is applied to the power supply system of CubePMT. Use of COTS components, design modularity and reuse keeps low overall cost, size, weight and increase power efficiency. The responsibility of this system is to get power from the solar cells, convert it to the power distribution bus (PDB) voltage level and then down convert from the PDB to different voltage levels required in the system. Two series connected solar cells generate 4.2V, up converted by a boost converter with more than 90% efficiency to power distribution bus level (18V) and then down converted by switching and linear regulator to different voltage levels (3V, 3.3V and 5V). To get maximum power from solar cells they are operated at maximum power point by hysteretic boost driver. This hysteretic boost converter reduced current stress to solar panels and especially it is realized without using CMOS integrated circuits which are prone to latch-up in space environment. Temperature, voltage and current sensors are mounted on different positions in order to monitor the operation of the system. Overvoltage protections circuits are also implemented at different points to keep the system within operation limits. Load switches are employed at the input of each subsystem which are enabled and disable from the on-board processor. PSpice OrCAD, Mentor Graphics and UML were used for simulation, PCB design and documentation. After having the desired results from simulations the actual system was implemented and tested.