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ELECTRICAL POWER SYSTEM FOR SRMSAT-3: AN AUTONOMOUS RENDEZVOUS AND DOCKING MISSION

Abstract

Autonomous rendezvous and docking of Nano-satellites opens up a wide scope of opportunities for space exploration in future, such as in-orbit servicing, scientific and technological experiments and collaborative building of space stations using small modules. Maximum power will be consumed in this mission by Attitude Determination and Control System, Propulsion System, Autonomous Guidance and Navigation, Inter-satellite Communication, all bounded within the Mechanical and Structural constraints. Electrical Power System (EPS) for SRMSAT-3 plays an important role primarily to fulfil the power requirements for reaction wheels and secondary thrusters to control orientation and position during the Docking phase and for inter-satellite communication when in close proximity, while also fulfilling the basic electrical requirements of the satellite. The Mission SRMSAT-3 intends to Autonomously dock a Chaser satellite with the Target satellite in the near-earth circular orbit at approximately 500 Km (LEO) altitude.

The EPS is required to generate, store and distribute large amounts of power by design and incorporation of efficient solar panels and battery units to meet the estimated power budget which is around 40 Watts for the Chaser Satellite, whereas the Target Satellite requires much lower power. The usage of highly efficient Multi-junction solar cells is employed, in different configurations in the two satellites. It was estimated that power stored in the Battery Pack from solar panels would not be sufficient to perform both the on-board tasks and docking simultaneously. Hence, to compensate this, extra battery capacity was added which will be charged to its maximum during additional orbits just before the Docking phase. Thus an appropriate Li-ion battery module was designed for this purpose. The battery configuration meets the power demand for Docking and On-board tasks during eclipse without the need to add excessive solar panels on the Chaser due to size and mass constraints. The architecture includes Maximum Power Point Trackers to draw out maximum power from solar panels to the power bus for further distribution. The Protection unit performs its tasks by using switchable components, providing over-voltage protection and limiting excess current to avoid damages and to increase the efficiency of the bus. Moreover, it is tailored in such a way that it can perform essential on-board tasks systematically even in extreme conditions by entering a safe mode and not shut down completely. The proposed paper presents the preliminary design of a reliable power system for SRMSAT-3.