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# ELECTRICAL POWER SYSTEM FOR ESTCUBE-1 NANOSATELLITE: LESSONS LEARNED FROM IN-ORBIT OPERATIONS

**Abstract**

The Electrical Power System (EPS) for ESTCube-1 nanosatellite was assembled from non-radiation hardened commercial components from ground up, including commercial maximum power point trackers, power regulation, control, and memory integrated circuits. The satellite was deployed on 7th of May 2013 to a 670 km polar Earth orbit and has been operating since. The EPS was fitted with a detailed monitoring system and performance data of different components has been regularly collected since deployment. In this paper we will present the data collected this far and lessons learned both about the components used and the general design of the subsystem.

ESTCube-1 is the first satellite in a series of nanosatellites made to test technologies for the electric solar wind sail, a novel propulsion technology that relies on generating an electric field to deflect charged particles in order to achieve thrust or drag, depending on the relative movement in respect to the charged particles. The mission required a system that would be reliable and be able to produce peak loads up to 10 W. At the same time, the system had to be constructible from non-radiation hardened commercial components in a fixed hard deadline environment; therefore, many easily available commercial solutions had to be used, including integrated maximum power point tracking chips, voltage regulators, current-limited power switches, and microcontrollers. For higher reliability, critical components were duplicated.

The data collected this far shows that all of the solutions used have been reliable and no irregularities in the system's electronics have been detected. The only problem observed has been a rapid degradation of the solar panels, but the power production has since leveled off, and the high configurability of the system allows the satellite to be operated without loss of functionality. In this paper we will assess the applicability of both the components and general approaches used onboard the satellite, based on the data obtained. The results show that many commercially available non-radiation hardened solutions can be used directly in nanosatellite designs for missions with the required lifetime of a year and in-house development of systems with similar functionality, such as maximum power point trackers, is no longer required. This should both help to reduce the costs and development times of future nanosatellites.