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DESIGN AND IMPLEMENTATION OF A RESILIENT LOAD PROTECTION SYSTEM OF A NANO SATELLITE

Abstract

This paper elaborates the enhanced design and implementation of the load protection of the nano satellite, COEPSAT-2. The paper also aims to highlight the lessons learnt from the previous satellite mission, Swayam. A failure in the Electrical Power System can have damaging consequences on the entire satellite. Load Protection (LP) needs to be integrated with the system such that the system will be resilient to any obtainable contingencies like undervoltage, overvoltage and overcurrent. In low earth orbit satellite missions, electrical loads are subject to single event latch-ups (SEL) frequently. The system must be able to revive from such SELs. As the mission objective of the satellite includes orbit maneuvering and charged particle environment monitoring, the satellite is expected to enter the 'Lower Van Allen Belt' where it will be exposed to hard radiations. This heightens the possibility of an SEL. Programmable over current and under/over voltage limits has been proposed enhancing the capabilities of LP and enabling it to be used according to load requirements. The proposed design resets the load in case an SEL arises, resuming its normal operation.The drawbacks of the LP system of the Swayam satellite have been analysed and a robust system having added redundancies has been proposed and tested to its limits. In COEPSAT-2, the EPS is responsible for the protection of all of the loads including the On-Board Computer(OC) and Terminal Node Controller(TNC) through a load protection module. OC and TNC have control over the LP modules of various other loads and can reset them in case a fault arises. A logic has been developed to protect the controllers from any fault by implementing a system that enables them to control their own LPs.The salient feature of this load protection unit is its ability to give Power-on Reset (PoR) to the whole electrical power system and hence, all its loads in the satellite. An autonomous analogue counter gives a periodic PoR through a series of combinational circuits. A feature of giving a PoR through an uplink from the Ground Station has been introduced for redundancy. Possibilities of SELs has been exploited and a countermeasure for protection against a permanent latch-up has been introduced into the system.