Paper ID: 53330
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IAF SPACE POWER SYMPOSIUM (C3)
Advanced Space Power Technologies (3)

Author: Mr. Ananth Gargeswari Seshasayee
R V College of Engineering, Bengaluru, India

Mr. Shrikrishna Hebbar
R V College of Engineering, Bengaluru, India
Mr. Abhishek Kyathasandra Manjunath
R V College of Engineering, Bengaluru, India
Mr. Anish Mitra
R.V.College of Engineering, India

DESIGN OF AN AUTONOMOUS ONLINE POWER DISTRIBUTION ARCHITECTURE BASED ON REAL-TIME LOAD TRAFFIC ANALYSIS IN A NANOSATELLITE

Abstract

Numerous power systems in satellites have failed due to the malfunctioning of their switching converters. Switching converters are essentially used for the creation of a constant voltage bus. These converters fail mainly because of excessive heat dissipation due to their continuous usage and constant voltage spikes. Considering the cost and space effective protocols which are to be followed in a nanosatellite, it is not viable to have cooling mechanisms. It is better instead to have an alternative system to overcome this drawback.

The system proposed to be used in RVSAT-1 has been designed taking into consideration high reliability and redundancy as prime factors. This involves an online load allocation system in which sets of loads are not hardwired to particular converters. Instead, the loads which are supposed to be powered at any point of time during the satellite's mission will be allocated to the converters such that the load on any specific converter is the least. Real time data will be continually obtained from sensors and will be used to quantize the loading effect on each converter. Algorithms have been developed such that each succeeding load to be powered will be assigned to the buck converter which has been loaded the least. The system has been realized by developing a digital hardware, which has complete autonomy from other subsystems, through Verilog HDL. Autonomy of the system is very important here because failure of a certain load should not affect the functioning of the control unit.

The primary advantage of this system is that the necessity for redundancies is completely removed and the dependence of the distribution system on other subsystems has also been entirely eliminated. This system effectively reduces the risk of failure of the distribution system and thereby the malfunctioning of the satellite.