

PROPOSAL FOR A MODULAR ELECTRICAL POWER SYSTEM FOR NANOSATELLITES

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Abstract:

The Laboratory of Spacecraft Environment Interaction Engineering (LaSEINE) is developing several nanosatellite projects at the same time. A high percentage of the buses and payloads are designed, tested and integrated in-house. There has been a consistent effort to define the best standard design for the system bus.

Nowadays, most common Electrical Power System (EPS) designs for nanosatellites applications use the battery regulated bus architecture. This architecture requires one or more Battery Charge Regulators (BCRs) connected to the solar panels. If a standard design were to be developed using this same architecture, it must be able to manage the largest number of photovoltaic cells that can be installed. This means that if a mission does not use some BCRs inputs, the board area used by these converters will be unnecessary. The battery regulated bus architecture is suitable for worst-case design but not for modular design.

We can find this issue in most of the commercially available EPS units. Manufacturers offer extra battery daughterboards to avoid excessive energy storage capacity in low power missions but offer none solution to the excessive BCRs capacity.

A different power architecture is needed to develop a standard and modular design that suits the power needs of most of our projects. Board area, modularity and efficiency are the main requirements.

This work is a proposal for a modular EPS for its application in nanosatellites. The proposed architecture is developed around the Bus regulation and Energy storage Module (BEM). This module includes a single electrochemical cell connected to a bi-directional DC/DC converter called Battery Bus Regulator (BBR). The BEM charge and discharge the cell at the same time it regulates the bus voltage. Safety protections for the cell are included in this module. Two or more BEMs can be connected in parallel to meet the nanosatellite power needs.

Since the modules are linked to the electrochemical cells, the BBR will be designed tight to the cells characteristics.

The Interface and Protection Module (IPM) is the other main part of the EPS. This module includes the interfaces of EPS with solar panels and loads and the safety protections in such a configuration that can fulfill the requirements of any launcher.

An architecture description and a series of simulations under different illumination and load conditions are included in this work. These results will define the final architecture and devices for the first prototype of the system.