SPACE POWER SYMPOSIUM (C3)
Small and Very Small Advanced Space Power Systems (4)

Author: Mr. Trevor Kwan
The University of Sydney, Australia

Mr. EuGene Kim
The University of Sydney, Australia
Dr. Xiaofeng Wu
The University of Sydney, Australia

DESIGN AND IMPLEMENTATION OF AN ELECTRICAL POWER SUBSYSTEM FOR A HYPERSPECTRAL IMAGING MICROSATELLITE

Abstract

The electrical power subsystem (EPS) is a very critical component of a satellite where the voltage requirements of the various subsystem components are generally different to that of the battery and solar panel. Moreover, as sunlight is generally the main source of energy in outer space, maximizing the efficiency of the solar panel is also an important factor. A common method to achieve this is the usage of maximum power point tracking (MPPT) algorithms where the algorithm ensures the solar panel is always operating at the peak of its P-V curve.

The University of Sydney is building a microsatellite for hyperspectral imaging for Australia. In this paper we present an EPS that will be utilized on-board the satellite. The EPS architecture will involve a DC micro-grid where the battery is used to provide the passive common DC bus voltage. The battery is charged by solar panels via a DC-DC converter that is operated in either the MPPT mode or constant voltage mode (in the event that the battery's state of charge is full and the load demand is low). A series of DC-DC converters are then used to interface the satellite load components to the battery where each DC-DC converter provides a unique voltage level that meets the load's requirements.

PV Panels are connected to the battery through Non-Inverting Buck Boost (NIBB) converters where the NIBB are operated with MPPT tracking. NIBBs were chosen over buck and boost converters because it allows the output voltage to be higher or lower than the input. This feature is important because of the stochastic nature of the solar panel's input. It is assumed that the satellite will contain components that have voltage requirements of 15V, 12V, 5V and 3.3V and that the EPS will be designed to provide voltages at these levels.

In this design all the load DC-DC converters will be composed of Buck converters. In this case, the battery voltage will be set to a value higher than 15V to ensure that the Buck converters can provide the aforementioned required voltage levels.