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HIGH ENERGY DENSITY BATTERY ARRAY FOR CUBESAT MISSIONS

Abstract

During the development of the first Ecuadorian satellite, once mission objectives and payload design was complete, the power budget calculations indicated that we will need a large amount of energy to run the main payload, which was a real time video transmission system, our system design guidelines dictated that such power matrix should be robust, redundant and would need a backup system in order to ensure a continuous operation over the longest period of time possible, considering that our solar arrays were composed of solar cells with an efficiency of only 19 percent.

We needed a power supply of at least 26.64 Watts per bank, and as per our system safety design guidelines the power matrix turned into 4 of this banks, giving a total of 106.56 Watts, the challenge was to pack this much power into an space reduced enough to fit into a 1U structure.

The benefits of having this much power available for the spacecraft became obvious as we calculated the expected life of the power matrix and simulated and tested the sun illumination-eclipse cycle, charge-discharge periods, thus reducing the load on each cell and maximizing the expected battery life, each array was composed of 16 cells each, and our spacecrafts carry 2 of this arrays on board, also each array uses the waste heat of the spacecraft electronics to warm itself by the use of a carbon nanotubes based thermal transfer system and a micro MLI layer that allows the arrays to avoid radiating this heat back into the neighboring internal electronics.

Now after more than 3 years operating in space in 2 spacecrafts, NEE-01 PEGASUS and NEE-02 KRYSAOR, this battery array design has been demonstrated to exceed the expectations of the system design guidelines. This paper will describe the system, discuss testing and operation data as well as a new thin design to be flown in one upcoming U.S. cubesat mission next year and more follow-up missions of this program.