Low-Cost, Open-Source Customizable CubeSat Solar Panels

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CubeSat solar panels are typically purchased as commercial off-the-shelf (COTS) product for student space missions due to a high learning curve and lack of available open-source alternatives. When purchasing COTS components for CubeSat projects, solar panel costs are high, typically in the range of $25000 for a 3U CubeSat [1]. The work presented aims to establish a solar panel fabrication procedure manageable for undergraduate and graduate students that minimizes cost while maximizing power generation on the satellite.

In industry, technicians spend months training on procedures in order to create a quality product. Without adequate documentation and readily available procedures, a student team would struggle to re-create solar panels with the same quality. As an added convenience, COTS solar panels are built to adhere to CubeSat industry standards. Alternative options, such as custom-made solar panels are available, however, the cost of such options tend to be significantly higher than COTS. This leaves the option of making solar panels in-house as a more financially realistic option for student satellite missions.

After the successful launch of Alberta's first satellite, Ex-Alta 1, we have been designing its successor, Ex- Alta 2. As a lack of available power is a common problem on CubeSats, we seek to use this customize in-house solar panel design to better utilize the available space on a CubeSat. By doing so, we can increase power generation without the use of deployable solar panels. This approach involves combining the solar and interstage panels found on the faces of a CubeSat into one continuous body. With this design, instruments, instrument standoffs, as well as deployment mechanisms can be placed in any location (between solar cells) along the panel. If a team were to design their own printed circuit boards (PCBs) along with this open source solar panel design, the would be able to reduce the cost of customizing their satellite by building components in-house instead of using COTS panels. In addition to the flexibility that in-house solar panels add in terms of customizability, these panels should provide more structural integrity than a COTS product by using one continuous panel, rather than having several 1U panels with interstage panels between them. Full-face-length solar panels increases the structural strength and rigidity, decreases satellite mass, and re- duces the number of ribs required in the structure.

A mechanical representative of these in-house made solar panels recently underwent vibration testing at the Canadian Space Agency's David Florida Laboratory in Ottawa as part of the Canadian Satellite Design Challenge. The objective of this vibration testing was verifying that the mounting procedure would with- stand vibrations of the launch vehicle. The panels were tested for 120 seconds in all three satellite axes with a random vibration profile between 20 Hz and 2000 Hz having a maximum flight envelope of $0.055g^2$/Hz. None of the solar cells mounted according to the open-source procedure showed any signs of damage after this test, verifying the mechanical integrity of the cells mounted with this procedure.

The combination of the customizability, increased spatial efficiency, and low cost makes these open-source solar panels a logical addition to our Open CubeSat Platform and a meaningful step towards lowering the entry cost for student space mission projects.

References: [1] Nokes, Charles.Engineering Student Project Fund Proposal Summary 2015-2016. 2015. University of Alberta, Edmonton.