An Advanced Packaging Approach for a High Performance Deployable Photovoltaic System rHaWK

ABSTRACT

This presentation introduces an innovative deployable solar array power system architecture for small satellites. A system is presented that utilizes existing commercial technologies in space photovoltaics and structurally efficient material systems to realize a deployable power system. This innovation will address the need for improved stowed power density (kW/m^3) and specific power (W/kg) over state-of-the-art (SOA) systems without sacrificing the structural shielding necessary for end-of-life (EOL) performance. The foundation of the innovation is a highly modular and scalable platform that combines the packaging-efficiency benefits of a blanket array with the radiation-shielding benefits of a rigid-panel array. The modular construction enables the use of automated assembly methods to reduce cost and accelerate delivery. This presentation will demonstrate the feasibly of this system to improved stowed power density and EOL performance by way of unique packaging using common aerospace qualified materials and designs.

High stowed-power-density space photovoltaic systems are key technologies for enabling current and future small satellite missions. The mission scope for small satellites continues to expand beyond low earth orbit to GEO, interplanetary, and deep-space exploratory applications. The expanding spectrum of mission requirements demands a robust, reliable, and scalable power solution capable of surviving launch and high radiation environments while minimizing stowed volume. The rHaWK architecture addresses these key requirements, specifically stowed power density (kW/m^3), specific power (W/kg) and deployed stiffness (first fundamental mode frequency). The works shown herein will demonstrate a novel path towards a next generation solar array system.

Defining a complete system is key to comparing solar array performance metrics across the multitude of array providers. The rHaWK deployable system contains three subsystems with several components borrowed from innovations in MMA Design's deployable antenna systems and CubeSat deployable solar arrays. The individual systems include: a) a canister-free, linearly deployable boom system with exceptional packaging efficiency to deploy and support the blanket array, b) rigid composite solar array blanket system to provide superior panel stiffness and radiation shielding, and c) existing solar cell technology. Critical features of each of these components have been proven successful independently or as a subsystem, with the next major step being a conjoined system. This presentation will cover the results of rHaWK trade studies performed for a range of small satellite missions up to 6 kW and compare performance with SOA solar array systems.