Paper ID: 40596
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SPACE POWER SYMPOSIUM (C3)
Advanced Space Power Technologies and Concepts (3)

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ENERGY TRANSMISSION ON A MODULAR SATELLITE

Abstract

A satellite design based on modular building blocks, connected with standardized interfaces is a novel approach in space engineering. Building blocks with a standardized form factor but individual functionality can be combined to a fully operational satellite according to custom needs. The satellite can be scaled and extended without additional development effort. With that, the modular, building block design approach can be cost and time saving. When combined with on-orbit servicing (OOS), a modular satellite can be maintained and upgraded in orbit, increasing the lifetime and contributing to reduce space debris. DLRs iBOSS (intelligent Building Blocks for On-Orbit Satellite Servicing and Assembly) and DARPAs Phoenix and RSGS (Robotic Servicing of Geosynchronous Satellites) program are current ongoing projects to address modular and serviceable satellite concept. Standardized interfaces connect the building blocks and distribute data, power, and heat through the satellite. However, the modular approach raises questions in terms of efficiency and reliability. Additional hardware is required to provide the modular structure and the additional interfaces add complexity and increase the power consumption.

This paper deals with the power distribution system of a modular satellite approach and focuses on the power transmission between the building blocks. Based on design criteria such as low cost, single-fault tolerance, modularity, and scalability, concepts of power distribution and design considerations are discussed that were taken into account to build a modular power distribution system.

A reduction of transmission losses at the interfaces between the building blocks is important to preserve the systems efficiency and to reduce additional loads. Still, the interfaces have to be switchable in order to allow for OOS, but also for influencing the current flow and to be able to deactivate faulty building blocks in satellite operation. Furthermore, a security mechanism, protecting neighboring building blocks from over-voltage and current peaks is desired.

This paper discusses the design options for reduction of the transmission losses between the building blocks, and for implementation of an efficient power path switching. An analog security and switching system with low transmission losses has already been accomplished and tested, and first measurement results will be presented.

With the technology presented in this paper it is possible to supply all building blocks of a modular satellite with power, protect the building blocks for malfunctioning, and influence the current flow, an important milestone towards a modular satellite design.