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ENERGY DISTRIBUTION SYSTEM ON A MODULAR SATELLITE

Abstract

A novel approach in space engineering is the modular approach for satellite design. Building blocks with a standardized form factor but individual functionality can be combined via standardized interfaces to a fully operational satellite according to custom needs. Modular satellites can be scaled and extended without additional development effort. With that, costs and time can be saved during the satellite design and development process. 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, leading to a more sustainability following a green space policy. There are several approaches to address this concept, like DLRs iBOSS (intelligent Building Blocks for On-Orbit Satellite Servicing and Assembly), DARPA's Phoenix and RSGS (Robotic Servicing of Geosynchronous Satellites) program, or the EU funded SIROM interface. Standardized interfaces connect the building blocks and distribute data, power, and heat through the satellite. Additional building block electronics distribute the power to the consumers and acquire monitoring data.

In this paper we will present the electrical power system (EPS) concept that was developed in the iBOSS project. The satellite wide EPS consists of power generation units, power storage batteries, power transmission and interface control units, and power distribution in the building blocks. Modular satellites come with the potential of scaling power generation and storage according to the individual needs of the satellite without additional development costs. Further, modular satellites capable of OOS can be upgraded with new technologies, such as more efficient solar cells or new batteries after some years in orbit. With this capability lifetime limitations due to EPS degradation can be overcome. Beside that, modularity enables the use of alternative design concepts compared to the traditional monolith satellites. This includes decentralized batteries and energy flow control. In addition to considerations on satellite level, the EPS will be broken down to EPS infrastructure components on building block level. In the iBOSS project we designed a scalable power distribution unit (PDU), controlling the payload and subsystem power supply, gathering housekeeping data, and allowing for extension of individual needs of the building block, such as multiple high voltage and low voltage supplies. The PDU hardware was designed, tested, and subjected to a total ionizing dose equivalent to a LEO mission with two years mission time. Test results and test setups of the PDU will be presented and discussed in this paper.