IAF SPACE POWER SYMPOSIUM (C3)
Advanced Space Power Technologies (3)

Author: Mr. Brent Gardner
National Aeronautics and Space Administration (NASA)/Glenn Research Center, United States

MODULAR STANDARDS FOR SPACE POWER SYSTEMS

Abstract

With ambitions to return to the moon and to enable human exploration beyond low earth orbit, the National Aeronautics and Space Administration is developing advanced exploration system technologies. One such technology seeks to transform the future of space electrical power systems by applying a modular approach. The modular power system development approach offers significant benefits over a traditional power system development approach, including promoting power system commonality across interconnecting or docking spacecraft elements, which thus simplifies the integration and verification testing of the end-to-end power system. Additionally, a modular power system offers the potential to reduce future spacecraft power system development costs by developing common power electronics hardware modules that can be integrated into multiple spacecraft architectures, such as utilization and habitation systems for lunar exploration. The modular power approach also improves the sparing and logistics up-mass by making the power modules interchangeable across docked vehicles, thus enabling the sharing of spares across an exploration campaign which would reduce the stowage volume needed for on-orbit spares.

This paper presents an approach to provide commonality for future space power systems through a set of modular power standards. The approach presented breaks down the electrical power conversion and distribution system into the lowest level functions, which are represented by power electronics modules, and serve as the foundational building blocks of the system. A series of Modular Power Standards has been developed to define the functions and interfaces of the lowest level of the electrical power system, or for each type of power electronics module. The power electronics modules, when integrated with a common chassis and backplane, can then be built up into modular electronics assemblies, which have been demonstrated and characterized in a relevant ground test environment. These modular electronics assemblies include Battery Charge-Discharge Units, DC-DC Converter Units, Main Bus Switch Units, and Power Distribution Units. The modular electronics assemblies can then be integrated together into an end-to-end modular power architecture, thus realizing the benefits of power system commonality for future lunar and deep space exploration missions.