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DEVELOPMENT OF A SCALABLE COTS-BASED LITHIUM-ION BATTERY MANAGEMENT  
SYSTEM FOR SATELLITES IN LOW EARTH ORBIT

**Abstract**

This paper introduces a COTS-based (Commercial of-the-shelf) lithium-ion battery management system for satellites in LEO (low earth orbit). The COTS battery system is developed to reduce the price of future satellites. Development and testing of the battery system is supported by fundamental knowledge of Lithium-ion batteries. The approach of using only or mostly COTS components including the battery cells influences the system's architecture, electronic design, software and the qualification process. In this paper the development of the battery system with its functions to measure temperature, voltage and current of the battery cells and the entire system is described. Further functions involve cell balancing, state of charge and state of health estimation. Moreover, the aspect of scalability is outlined. The scalability will allow usage of one battery system and its functionality in several satellites with different power needs. One main management module is designed to control multiple cell modules. During the development various commercial battery cells were investigated and tested for reliability and life expectancy. A crucial part of the success of the battery system is the durability of the battery cells. Studies of the influences of temperature, current, SOC (state of charge) and DOD (depth of discharge) on cell durability were conducted. Furthermore, a qualification plan for the finalized battery system was defined to verify that all components are able to withstand the space conditions and to stay operable during a LEO mission.