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DESIGN OF AN ELECTRIC POWER SYSTEM WITH EMBEDDED BATTERY MANAGEMENT SYSTEMS AND CHARGERS FOR THE ILR-33 AMBER ROCKET AND MICRO LAUNCHER APPLICATIONS

Abstract

This paper presents a tradeoff analysis of selected power systems architectures and a test results of the chosen solution for the AMBER suborbital rocket. Applicability of this power design method for future launchers is also discussed.

The rocket's electronics are composed of many subsystems characterized by different power needs. Having a dedicated battery for each system to accommodate different voltages is not an option due to mass and volume constraints. Independent power supply structure is allowed for mission-critical subsystems, such as the one responsible for the rocket's (payload) recovery.

In the development of the ILR-33 AMBER suborbital rocket, the latest achievement of Warsaw Institute of Aviation, a different configuration of batteries and power converters has been applied. This was done by means of the trade-off analysis between amounts of batteries and power converters, keeping in mind the efficiency and the generated electrical noise by power converters as well as the overall safety of the system, the mass and volume budget and also comfort of use.

A dedicated charger and the battery management system also enable constant battery protection and charging in a "wait-for-launch" state. This contributes to operating ergonomics, as batteries do not need to be pulled out from the rocket in order to be recharged.

The prototype of the system was assembled and tested using a dedicated test stand with spring loaded pins, National Instrument PXI for data acquisition and test control with use of an infrared vision camera to monitor the heat dissipation. Many different loads on each of 6 power lines with a different input voltage from batteries have been simulated. The performed analyses resulted in a full assessment of the system's efficiencies and thermal characteristics.

An optimal solution for this problem can reduce development and operation costs of the system, mostly by reducing the duration of prelaunch preparation and enlarging launch vehicle lifting capabilities.

The result and planned future improvements are summarized and discussed with design guidelines suggested based on the development and testing of the created system.