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AN INVESTIGATION OF THE SYSTEM ARCHITECTURE OF HIGH POWER DENSITY 3U CUBESATS CAPABLE OF SUPPORTING HIGH IMPULSE MISSIONS

Abstract

This study examines the system architecture of high power density 3U CubeSats capable of supporting high impulse missions. Under analysis is the ALBus CubeSat, a 3U High Power Density CubeSat at the National Aeronautics and Space Administration's Glenn Research Center in Cleveland, Ohio. The mission is a technology demonstration of a 100-Watt power management and distribution system aboard a small volume CubeSat and serves as evidence of CubeSats being able to provide high power to the subsystems necessary to support high impulse missions. This study mainly explores the thermal behavior of a CubeSat subjected to substantial waste heat due to extra power generation. It was found through a thermal vacuum test that, despite 100-Watts of waste heat being deposited into the system, the thermal limits of the electrical components were not exceeded and remained at steady-state operable temperatures. The thermal vacuum test proved the ALBus CubeSat was able to provide enough power without overheating to the point of detriment to its electrical components. A propulsion system is a fundamental necessity for any high impulse mission so a practical option for 3U CubeSats was explored to solidify the viability of such a spacecraft. The Miniature Xenon Ion Thruster, or MiXI, being researched and developed at NASA's Jet Propulsion Laboratory, is proven to be a desirable propulsion system for small satellites due to its high efficiency, low contamination, and precise thrust and impulse bits. It also is only 3 inches in diameter and can be operated on less than 100-Watts of power. This study is intended to help solidify the feasibility assessment of a high-power density CubeSat capable high-impulse missions.