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THERMAL SYSTEM MODEL AND DESIGN OF THE CONTROL OF A 3U CUBESAT

Abstract

Commercial-off-the-shelf (COTS) electronic components, which have very narrow operating temperature ranges, are commonly mounted on CubeSats. Designing the thermal control system to meet these narrow ranges in the harsh space environment can prove to be a very challenging task. This paper explains the design of the thermal system of a 3U CubeSat designed by the students of Team Anant, BITS Pilani to ensure the successful operation of all on-board components for the required operation time. The satellite employs passive and active thermal control techniques finalized after considering the various conditions the CubeSat can face in orbit. The satellite system has been modelled and analyzed for the mission orbit using commercially available software. The solid model was defeatured to optimize the running time for the simulations. We analyzed two cases that are the worst hot case and the worst cold case considering orbital modes as a function of time in the orbit. Radiation from different sources and the heat dissipated by various components was taken into consideration. Thermal contact conductances were considered between different contact pairs to get precise results. The possible options for thermal controls with their dependence on the other subsystems were evaluated. A thorough analysis of the results obtained from the simulations suggests that the temperatures of all components are within their operating temperature ranges for the modelled orbits after implementation of the thermal control.