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# THERMAL SYSTEM DESIGN AND ORBITAL ANALYSIS OF SWAYAM: AN OVERVIEW OF THE DESIGN PRINCIPLES AND TECHNICAL CONSIDERATIONS

**Abstract**

Designing and validating the thermals system for a CubeSat imposes inherent challenges and restrictions. Pico-satellites having form factors like 1-U and 2-U, have limited power and space available for incorporating a reliable and flexible thermals system. Swayam, a 1-U Pico-satellite, is designed and developed by the students of College of Engineering, Pune to demonstrate a passive attitude control system. The satellite, to be injected into a polar low-Earth orbit, employs a passive thermal system that has been optimized for various conditions in the destined orbit. The satellite system has been modeled and analysed for the orbit using Siemens UG-NX software. The optimum insulation area and the type of insulation are decided based on the results obtained from simulations. Simulations are run considering the factors which influence the on orbit temperatures such as solar radiation, albedo, planet flux, internally generated heat and heat emission from the satellite. Further, the system performance has been validated and qualified for space conditions through a thermal vacuum and hot-cold cycle test. Simulations are performed by applying orbital heating, thermal loads, thermal coupling and radiation to a finite element model of the satellite. Probable orbits have been simulated to test the reliability of the passive thermals system. Thorough analysis of the simulation results show that the temperatures of all the components are within the specified operating ranges and display a repeating trend. Temperature changes have been found to be a function of the orbit under question, therefore varied from one orbit to another. Based on these results, it has been concluded that the thermal system used for Swayam is fit to serve its purpose. This paper details the design principles and various considerations that have been employed while developing the system.