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Author: Dr. Jianbin Han
Beihang University, China, hanjianbin1208@sa.buaa.edu.cn

Mr. Xinsheng Wang
Beihang University, China, xswang@buaa.edu.cn
Mr. bo lee
Beihang University, China, liboy@sa.buaa.edu.cn
Mr. Kaixing Zhou
Beihang University, China, kxing@sa.buaa.edu.cn
Mr. Ma Haibo
Beihang University, China, mahaibo@sa.buaa.edu.cn
Mr. Yongchao Dai
Beihang University, China, kuang_dyc@163.com

THERMAL CONTROL DESIGN AND VERIFICATION OF BUAA-SAT

Abstract

The BUAA-SAT is a micro-satellite mainly developed by graduate student of Beihang University with the purpose of space technology test and education. The satellite's volume is 300×300×500mm, with mass of 30kg and power of 11W. This paper describes the design of the thermal control system, and in addition, the analysis of thermal model and thermal balance test is introduced. The thermal control design of the satellite uses passive thermal control method completely. Generally, micro-satellite has small power and volume, so the temperature will always be too low. In our thermal design, there is no heat dissipation surface. Except for the solar array and some antenna, all the equipment and structure are covered by MLI (multi-layer insulation) blankets. In addition, apart from the solar array, all the outside surfaces are designed as high absorptivity and low emissivity. Inside of the satellite, all the parts are designed to have higher heat exchange rate, so they can exchange energy to keep an approximate temperature. The thermal model was constructed in the environment of Ansys, software of FEM. To simplify the model, some methods were used with precondition of changeless mass and specific heat. The elements including Solid70 and Link33 were employed to simulate the heat conduction. The heat radiation was simulated with a matrix, which includes radiation angle factor of face to face. Referring to the heat flux of 600km sun-synchronous orbit, the thermal balance temperature can be obtained. Finally, the thermal balance test is described to verify the thermal design and the result of the thermal model. The satellite was placed in a vacuum container; in the meanwhile, there was a thermal sink and an infrared heating cage around the satellite. Adjusting the voltage of the heating cage to get the average heat flux of the orbit, the changing temperature curve of the satellite will be obtained after about 7 hours. Then, with some mathematic method, the thermal balance temperature can be computed. Then, it was compared with the result of the thermal model in Ansys.