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OPTIMIZED THERMAL DESIGN OF THE GAMMA RAY BURST DETECTOR

Abstract

The Gamma Ray Burst (GRB) is a kind of phenomena that the directional universal gamma-ray boosts its magnitude in an extremely short time and then fades away quickly. The GRB will last for short 0.1-1000 seconds, with the radiation mainly concentrated in the energy range of 0.1-100 MeV. The GRB is presently one of the most active fields for the astronomical research, and some payload experiments have been designed for the GRB detection. We make an apparatus named the Gamma Ray Burst Detector (GRBD) for the GRB exploration, which belongs to the scientific application system of a manned spacecraft. However, the GRBD generates a lot of waste heat during its mission time, so that the problem of heat dissipations influences the performance and reliability of the GRBD seriously. In the original thermal design scheme, there are only multi-layer insulations (MLIs) coated around the outside surface of the GRBD. The emitted heat will make the components (e.g. the FEE chip) inside the GRBD suffering an undesired profile of high temperature environment. Therefore the GRBD cannot work normally during the required life time. With the comprehensive consideration of the external space heat flux, the internal heat loads and the apparatus working mode, we optimized the thermal design of the GRBD with a modified scheme that utilizes both the MLIs and the Optical Solar Reflectors (OSRs) on the grids of the GRBD. And then we carried out the simulation and analysis tasks for the two schemes. As the results of the simulation and analysis reveal, when the two GRBDs are working in the hot mode, the temperatures of the modified GRBD tend to be brought down by 2-3 compared with the original GRBD at almost all the temperature testing points. What creates the most compelling effects is that the peak temperature dropped about 8 at the hottest point (i.e. the FEE chip). It follows that the safety margin for the working temperature of the internal components can be increased obviously. The optimized solution proved to be effective to maintain the working temperature in an appropriate level for the internal components of the GRDB. The targets of the system performance and the design life can be guaranteed consequently.