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THERMAL CONTROL FOR SPACE MICROELECTRONIC EQUIPMENT VIA PYROELECTRIC MATERIAL: DESIGN, CHARACTERISATION AND EXPERIMENTAL CAMPAIGN.

Abstract

In last decades the development of new satellite platforms from smaller to bigger size goes in parallel with the development of the microelectronics equipment boarded on. Avionics, control systems and payloads equipment exploit the microelectronics in order to reduce the overall dimensions and masses and to increase the performances of each units in order to improve the achievement of goals of each missions. A larger use of electronics elements with the relevant components increases the importance of a carefully equipment design under different points of view. One of these is the thermal management. It well known that the Joule effect causes the heat overstocking which on turn reduces the efficiency of the electronic devices and increases the difficulties to manage the thermal power budget on board. A new design philosophy sees on the use of the pyroelectric materials a possibility for a simpler and a more efficient thermal control. Pyroelectrics are a "special" class of materials that demonstrates a spontaneous capacity to convert thermal fluxes in electrical charge and if applied on a "passive" structure they can "actively" reduce the heat overstocking. The electrical charge could be eventually stored for different purposes such as for instance the auto-feeding , or better the energy harvesting. With the reduction of the temperature of each components, and consequently with the reduction of the heat flux that flows through microelectronics a better efficiency and a better performance are ensured. In this way the reliability is increased and the goals of the mission could be achieved easier and easier. In this paper the design of a thermal rig made up of pyroelectric devices and dummy electronics components in order to verify the thermo-electric conversion is presented. Furthermore an experimental campaign has been performed to validate the technology here introduced and the relevant results will be presented. In particular the characterisation of a typical aerospace pyroelectric material via scanning electron microscope (SEM) and a semi-quantitative analysis will be discussed. In order to verify the trustworthiness of the experimental campaign the results will be compared whit those coming from an in-house-developed numerical code.