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THERMAL AND MECHANICAL DESIGN AND TEST CAMPAIGN RESULTS OF A SINGLE-PIECE STRUCTURE FOR THE URSA MAIOR NANOSATELLITE

Abstract

The Laboratory of Aerospace Systems of La Sapienza University of Rome is involved in the development and manufacturing of the nanosatellite URSA MAIOR (University of Rome la SApienza Micro Attitude In ORbit testing), a 3U CubeSat selected in the framework of QB50 mission, an FP7 project leaded by the Von Karman Institute of Fluid Dynamics with the aim to demonstrate the possibility of launching a network of 50 CubeSats intended for measuring and analyzing the lower thermosphere. The nanosatellite, scheduled for launch in January 2016, carries a multi Needle Langmuir Probe (mNLP) science unit, used to determine the electron temperature and density and the electric potential of plasma, an Attitude Determination and Control System (ADCS) realized at Surrey Space Center and two experiments: a polymeric drag sail for nanosatellites deorbiting and an innovative cold-gas MEMS (Micro Electro Mechanical System) micro-thruster for attitude control of nanosatellites, developed at La Sapienza University of Rome. Both the on-board computers and the structure have been designed, manufactured and tested at La Sapienza University of Rome. The structure subsystem is realized from a 100mm x 100mm square aluminum profile to enhance the thermal conductivity and the mechanical properties. The profile is properly machined to reduce the overall weight while preserving the thermal conductivity features and the structural stiffness. This paper outlines and compares the results from thermal and mechanical FEM analysis and test campaigns. In particular, a PSD (Power Spectral Density) frequency analysis, used to evaluate the stress suffered by the satellite during the launch, is performed. Furthermore, a (1g) sine sweep 5-400Hz test allows to evaluate the natural frequency of the structure and a random vibration test allows to compare real results to FEM analysis.