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RESULTS OF THE OPERATION OF THE PETRUS 1J PULSED PLASMA THRUSTER UNIT ON GREENCUBE

Abstract

This paper presents the results of the in-orbit test of the PETURS 1J propulsion module on board GreenCube as well as results of ground tests. GreenCube is a 3U CubeSat build and operated by the Sapienza University of Rome with an internal pressure vessel in which plants are cultivated and observed. GreenCube will fly onboard the maiden flight of Vega C that is scheduled to launch in the summer of 2021. PETRUS 1J is a secondary payload and besides demonstrating its functionality it offers attitude control and propulsion capabilities to the CubeSat. This mission is the first in orbit test of the PETRUS family thrusters. For operating PETRUS onboard GreenCube the original 5J device is further scaled down to a 1J design. The PETRUS 1J module is a propulsion unit for multi-unit CubeSats consisting of a cluster of four coaxial pulsed plasma thrusters (PPT). Due to the use of both, thermal as well as MPD effects, PETRUS is a hybrid PPT. Being implemented in a tuna can with an additional 20 mm CubeSat section, the propulsion system weights 400 g at a total volume of 335 cm. PETRUS 1J is a technology demonstrator and will be the basis for further developments of easy to use and low-cost propulsion systems for CubeSats. The power processing unit (PPU) for the thrusters is build using solely commercial-of-the-shelf components and therefore very cost effective as well. Besides charging and igniting the thrusters it also fully monitors their operation, the thruster's reliability, and lifetime The PPU is controlled by a separate microcontroller and communicates with the main computer of GreenCube over a SPI connection. The thrusters' in orbit performance is determined by disabling the attitude control system of the satellite and measuring the

influence of the thrusters' torque using the attitude determination system. For investigating PETRUS' in-space operation various test scenarios, such as single pulses, regular series of pulses or cyclic operation of all four thrusters. are foreseen. Based on the determined torque, the in-orbit performance of PETRUS is compared to measurements taken on ground at IRS and ESA ESTEC. Moreover, the in-space results can be used to compare and optimize the in-house Hardware-in-the-Loop testbed. The findings of PETRUS 1J will contribute to the further development of the whole PETRUS family covering thrusters with pulse energies 1J to 68J.