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LOW POWER HALL EFFECT THRUSTER FOR MICROSATS

Abstract

In recent years, cubesat have attracted increasing amount of interest, particularly among universities and research institutes due to their reduced cost and short development time. Within the design of cubesat it was was clearly been identified the need of micro electrical propulsion, where the high specific impulse and the relatively low electrical power consumption can lead to lower mass.

Kharkiv Aviation Institute (KhAI) is developing cubesat 2U with a volume of 2 liters. It is equipped with Hall thruster as its propulsion system and dedicated power processing unit. The series of low power Hall effect thrusters (LPHET) SPT 20M was developed and manufactured in Scientific and Technology center of Space Power and Engines of National Aerospace University "KhAI" from 2006. The experimental investigations showed that SPT 20M6 thruster can obtain thrust of 4 mN and specific impulse of 1000 S, under a 92 W power consumption. The estimated life-time is about 1400 h and power efficiency of 40%. This characteristics of the LPHET makes it suitable for cubesat's orbit control.

After analysing the possible option for battery suitable, the Lithium iron phosphate battery (LiFePO4) was selected. During normal operation, the LPHET is activated for 5 minutes a day for orbit maintenance, with the propellant system capable of sustaining a 3 years mission in LEO. Results of the experiment in vacuum chamber of KhAI are analysed and presented in this paper. Particularly, the temperature dynamic change in the LPHET during its orbit operations, the thermal state of the engine and battery are analysed. Furthermore, optimal battery location and needed SPT 20M characteristics are determined. Xenon propellant mass for designed mission is about 0.125 kg with titanium alloy propellant tank mass of 0.025 kg. Propellant supply system is designed, which includes three receiver with step-by-step pressure reduction.

Finally, a calculation is provided on the applicability of micro propulsion with reliable power system for the case of Low Earth Orbit cubesats.