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EXAMINING 300 W HALL EFFECT THRUSTER WITH DIFFERENT POWERS

Abstract

Electric propulsion (EP) systems have become preferable technologies over the conventional propulsion systems in space systems. Currently, the main emphasis on the satellites/spacecraft is the cost reduction and downsizing the structure resulting an important effect on the mass of the overall system. Nowadays, especially for small satellites below 500 kg equipped with EP systems are very advantageous since the higher fuel efficiency results in less propellant storage, has high specific impulse, less compact design. Collision avoidance, orbit transfers, station keeping maneuvers, orbit maintenance are achieved with EP systems. Generally, in EP systems, Arcjets, Pulsed Plasma Thrusters, Ion Thrusters and Hall Effect Thrusters (HETs) are used. Analyses show that the integration of propulsion systems with the mentioned thrusters enhances the small satellite missions.

In this research, the behavior of Hall Effect Thruster (HET) is examined. Briefly, the propellant which is Xenon gas in our tests is ionized and then accelerated by an axial electrostatic field which is formed by radial magnetic field which results the electron flow from cathode to anode. The tests are carried out inside a vacuum chamber with a pressure level of 10^-7–$10^-8 Torr$.

Thrust measurements are performed by using an inverted pendulum type thrust stand which is integrated inside the vacuum chamber. Moreover, Xenon gas is released to the systems with different flow rates with the help of computer controlled flow control devices. In the test sequence, in order to make the calibration and also confirm the calibration of the thrust stand during the tests, on each voltage value, measurements were taken.

Different voltages ranging from 250 V to 150 V at a decreasing trend of 10 V with a variable anode flow rates from 9 sccm to 5 sccm and a fixed cathode flow rates are applied to the HET and the measurements are obtained. By using these measurements, thrust, specific impulse, efficiency and the power consumption are calculated and compared with different voltage levels. Moreover, this wide range of scanning different voltages levels with varying anode flow rates will be the basis of understanding the behavior and the stability of the thruster. Finally, this study shows the potential benefits of using the electric propulsion systems with low power thrusters on small satellites.