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DEVELOPMENT OF A RADIO-FREQUENCY RESONANT-SWITCH POWER SUPPLY FOR RF ION THRUSTERS FOR SMALL SATELLITES

Abstract

As satellite systems tend to commercialize, it imposes a new approach to the design of their propulsion systems. The main goal now is its cost-efficiency and reliability. It is known that as spacecraft size decreases, so does its power supply capacity, therefore an efficient propulsion system is needed with low power consumption. The most popular types of electric propulsion systems nowadays include Hall thrusters, electrostatic gridded ion thrusters and radio-frequency (RF) thrusters. All those thruster types are known to lose efficiency and lifetime when the power consumption is reduced. Developing an RF ion thruster with low power consumption and high specific impulse is one of the main challenges of today's aerospace industry. The mass of a thruster and its subsystems is one of the crucial parameters mainly considered while studying a possibility of equipping a space mission with propulsion system. That is why the problem of reducing the mass of thrusters and propulsion control systems is of great importance. This paper describes the first prototype of an RF generator with 300 W output power for the RF ion thruster currently being developed by Avant-Space Systems. The generator works as a resonance pulse power source with automatic frequency control, which leads to several advantages compared to classical solutions. Control system layout and algorithms developed made it possible to significantly reduce losses in the converter, while using Gallium-Nitride field transistors allows higher switch rate. The automatic frequency control allowed achieving higher efficiency of up to 95