

SPACE PROPULSION SYMPOSIUM (C4)
Electric Propulsion (4)

A NEW DESIGN OF POWER PROCESSING UNIT FOR HALL THRUSTERS

Abstract

Hall Thrusters, which are characterized by high thrust density and relatively simple structure, are considered as the most promising electric propulsion system for the next generation spacecraft and the orbit transfer vehicle. The most important problems for the practical applications of Hall thruster systems are the way to reduce power consumption, total mass and volume of the Power Processing Unit (PPU). We are developing a new Power Processing Unit (PPU) for the 1.4N-class Hall Thrusters. The PPU consists of the four power supplies including an auxiliary power converter, a signal interface circuit and a primary power sources interface. The PPU contains the shunt regulator which until now has been a separate component in the conversional electric propulsion system. This enables a reduction in the total mass, volume and cost of the PPU. We discuss this promising electric propulsion system and the anode power supply of a 1.4N-class Hall thruster, which needs a lot of power resources. 1.4N class Hall thrusters require 23 kW(200V, 115A) class anode power supply. This electric propulsion system requires high performance power efficiency and steady operating points between the 100V and 115V input voltages. In the first step of the development, we compared the converter technologies of the anode power supply, calculated the performance and results of using a scale down experimental model. This paper presents a new high efficiency boost converter with voltage clamp function. In the converter, a theoretical analysis and a simulation were performed and an experimental model (200V, 13A output) was evaluated. Especially, the ripple current characteristic equation to the input voltage variation was derived. And the design method of the inductance was clarified in the coupled inductor. The maximum high efficiency of 97.5