

SPACE PROPULSION SYMPOSIUM (C4)
Electric Propulsion (4)

Author: Dr. Hiroyuki Osuga
Mitsubishi Electric Corporation, Japan

Prof. Fjio Kurokawa
Nagasaki University, Japan
Dr. Taichiro Tamida
Mitsubishi Electric Corporation, Japan
Prof. Naoji Yamamoto
Kyushu University, Japan

A NEW POWER CONTROL METHOD FOR HALL THRUSTER USING OSCILLATION-MODE-MAP

Abstract

If an effective electric propulsion system can be successfully developed satellite use in the super low orbit of around 250km is possible. For the satellite, which is equipped with the synthetic aperture radar, performance improvement and reduction of the electricity consumption are possible at the same time by lowering satellite altitude. The Hall thruster is considered one of the most promising electric propulsion systems. In the future, super low orbit satellites will be required to be designed as small as possible because of installation limitations on the rocket payload. These limitations influence the power generation for the Hall thruster operation. Due to these limitations, the electrical propulsion system is designed to be smaller size and lighter weight, low power consumption operation and have quick response of plasma ignition for drag compensation. In addition, the performances of the Power Conditioners (PCs) are compatible with the satellite bus system as mentioned below and to control wider thrust range. Many studies on Hall thrusters have been conducted, but most of them have discussed only the stationary operation, and do not mention about the low power consumption operation. Furthermore few of them mentioned the effect of power supply, and the practical application. The purpose of this paper is to clarify the conditions for a low power consumption operation, and realize stable operation over a wide operating range for the Hall thruster. We discuss how to control the power conditioners (PCs) to suppress the power consumption, especially when the operation or thruster conditions changes temporally in the practical application. We think that low frequency oscillation can be essentially suppressed using the method of controlling the PCs. The method will be a very important guideline for Hall thruster design and operation in particular making it easy to manage the power consumption in a satellite, using the PCs control. In this paper, we present the preliminary performance test results of 20mN-class Hall thruster and propose a stable control method for power conditioner within a high thrust operation zone on the performance maps. As a result of performance experiments for 20mN-class Hall thruster, over 30 percent thrust efficiency of the Hall thruster was found to be sensitive to the anode voltage and applied magnetic flux density. We propose the stable control method for power conditioner within a high thrust operation zone on the oscillation-mode map.