IAF SPACE POWER SYMPOSIUM (C3)
Space Power System for Ambitious Missions (4)

Author: Mr. Siyue Jiang
China Academy of Space Technology (CAST), China, jiangsiyue2008abc@163.com

Mr. Kang LI
China Academy of Space Technology (CAST), China, 453381469@qq.com
Mr. Zhi Huang
China Academy of Space Technology (CAST), China, hzbuaa@163.com
Mr. Pingxin Ma
China Academy of Space Technology (CAST), China, mpx321@Sina.com
Mr. Tian Zhao
China Academy of Space Technology (CAST), China, 601098560@qq.com
Mrs. Jiajia Si
China Academy of Space Technology (CAST), China, hahasijiajia@163.com
Ms. Xuan Zhang
China Academy of Space Technology (CAST), China, pihaihappy@163.com

A NOVEL HIGH VOLTAGE CONVERSION MODULE FOR DIRECT-DRIVING ELECTRIC PROPULSION IN SATELLITES

Abstract

With the development of aerospace technology, the power demand for satellites is increasing. At the same time, high-voltage and high-power devices such as electric propulsion are widely used in satellites, which puts forward higher requirements for satellite electric power systems. The use of a high voltage bus can reduce wire loss and meet the demand for high power. The bus can also be used to directly drive Hall electric propulsion devices, significantly reducing the weight of the electric propulsion system. Therefore, the introduction of a high voltage bus is necessary for future satellites.

Considering the direct drive of Hall electric propulsion devices or some specific payload in future communication satellites, a two-stage converter is proposed in this thesis for a high voltage bus of 300V. The first stage is an interleaved boost circuit: a solar array is the input, and the output is connected to a battery. Maximum Power Point Tracking(MPPT)is realized by adjusting the duty cycle of the switch by the disturbance observation method. The second stage is a full bridge circuit in which the battery is the input, and a high voltage bus is the output, performing the conversion of high voltage ratio and high voltage isolation between power supplies and loads. The phase shifting of the primary side is adopted to ensure the stability of the output bus.

Compared with the current communication satellite power system, this circuit has two main advantages: first, it realizes the MPPT of the solar array, improves the efficiency, and reduces the redundancy design; second, it realizes the high-voltage bus without using the high power wide-band-gap switch, which is still in the research stage, that means the switches with flying experiences can be chosen to ensure the reliability.

In this paper, the main technical specifications of the circuit have been defined and the parameters of passive components in the circuit have been designed. A control strategy has been proposed to satisfy the requirement for a high voltage bus during the sunlight and eclipse period, which has been proved by simulation.