Low Power Hall Thruster Development for TechSat 21

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The Technology Satellite for the 21st Century (TechSat 21) is an Air Force Research Laboratory (AFRL) technology demonstration mission from the Space Vehicles Directorate in Kirtland AFB, NM.[1-3] The TechSat 21 mission will demonstrate space-based, sparse aperture sensing and formation flying, in conjunction with key microsatellite technologies. As much of the mission success is driven by the on-orbit formation flying, a critical part of the demonstration is a propulsion subsystem to perform the cluster reconfiguration and maintenance. Busek's low power Hall thruster system is attractive for TechSat 21 for several reasons. Aside from the low system wet mass, the system is self-contained, relatively compact, and does not require significant interface engineering. Furthermore, the high specific impulse (I_{sp}) adds flexibility to the system particularly if the required ΔV increases to accommodate new requirements such as orbit raising, additional maneuvers, or de-orbit. The Hall thruster will be operated in a steady state firing mode as well as in a pulsed mode to satisfy the minimum impulse bit (I_{BIT}) requirement, further enhancing the system capabilities by providing a wide range of throttleable performance.

This paper will summarize the flight qualification status and performance characteristics of Busek's low power Hall thruster and low flow cathode including mission applications, steady state and pulsed mode performance, and a design overview of major system components.

A flight design of the Hall thruster and cathode, designated BHT-200 and BHC-1500, respectively, has been completed and several engineering models built and tested. Performance characterization of the flight-like components has been completed. Following qualification level vibration and shock testing, the thruster/cathode assembly were successfully integrated with an engineering model power processor unit and system controller and a xenon flow control system. This paper describes the flight-like thruster and cathode design and extensive testing conducted to date. Preliminary data from our planed mission simulation and life test are also presented. In addition, system level integration and test results are provided.