

Miniaturized Power Processing Unit Study: A Cubesat Electric Propulsion Technology Enabler Project

Center Innovation Fund: ARC CIF Program

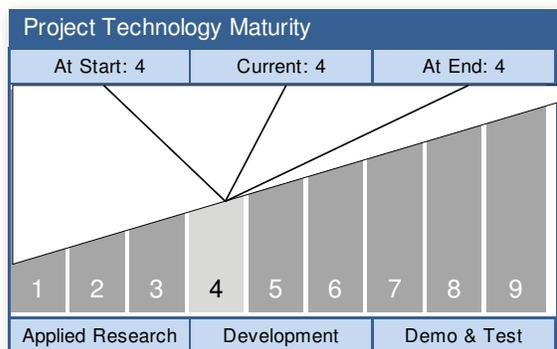
Space Technology Mission Directorate (STMD)

National Aeronautics and Space Administration



ABSTRACT

This study evaluates High Voltage Power Processing Unit (PPU) technology and driving requirements necessary to enable the Microfluidic Electric Propulsion technology research and development by NASA and university partners. This study provides an overview of the state of the art PPU technology with recommendations for technology demonstration projects and missions for NASA to pursue.



Technology Area: In-Space Propulsion Technologies TA02 (Primary)
Space Power & Energy Storage TA03 (Secondary)

ANTICIPATED BENEFITS

To NASA funded missions:

These missions will be proposed under the OCT's programs: - Franklin and Edison Technology Development Program - Game Changing Technology Division (OCT/GCT) NASA Broad Agency Announcement (BAA) Unique and Innovative Space Technology NNM11ZUA001K - Crosscutting Capability Demonstrations (OCT/CCD) NASA Broad Agency Announcement (BAA) Technology Demonstration Missions (TDM) program NNM11ZDA001K

Read more on the last page.



DETAILED DESCRIPTION

This study investigates the technical requirements and potential solutions for miniaturized High Voltage Power Processing Units with the objective of enabling Microfluidic Electric Propulsion (MEP) thrusters for cubesats and large missions.

For the long term evolvement of Electric Propulsion thrusters, Power Processing Units need to significantly reduce the mass, volume, and thermal properties. This will allow for usage of these thrusters from the micro down to pico-sized satellites, and enable long duration missions. Enabling the thruster technology will increase mission capabilities requiring orbital maneuvers including attitude control, spin, orbital inclination changes, de-orbiting, orbital transfers, swarm and formation flying.

The study focuses on the trade space to develop the Key Performance Requirements (KPRs) for the Power Processing Units and evaluates them against the current state of the art for technical feasibility. Topics investigated ...

MANAGEMENT

Program Executive:
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Program Manager:
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Project Manager:
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Principal Investigator:
Shakib Ghassemieh

DETAILED DESCRIPTION (CONT'D)

include:

- Mass
- Volume
- High Voltage parts evaluation
- Power Budget
- Output Power
- Number of control channels
- Modularity
- Scalability
- Operational modes
- Reliability
- Radiation Tolerance
- Power Efficiency
- Interfaces
- Cost
- Vendor Parts Availability

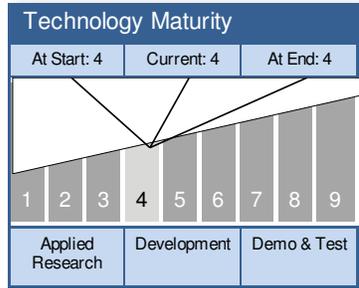
ADDITIONAL AND DETAILED TECHNOLOGY AREAS

- TA04: Robotics, Tele-Robotics & Autonomous Systems



TECHNOLOGY DETAILS

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TECHNOLOGY DESCRIPTION

For the long term evolvement of the EP thrusters it is prudent to significantly reduce the mass, volume, and thermal properties of the PPU. Creating a high fidelity, efficient, and miniaturized PPU is a game-changing technology enabler because it will allow for usage of these thrusters from the micro down to pico sized satellites, and enable long duration missions. This technology will not only benefit nanosatellites, but all space applications that require high voltage power including and not limited to: the International Space Station (ISS), launch vehicles, satellites and spacecraft, as well as payload instrumentation. Enabling the thruster technology is important because it will enable a large range of 6 DOF orbital maneuvers including attitude control, spin, orbital inclination changes, de-orbiting, orbital transfers, swarm and formation flying. The study proposed here would focus on the trade space to develop the Key Performance Requirements (KPRs) for the PPU and evaluate them against the current state of the art for technical feasibility. The study will include lab environment candidate-component testing and evaluation.

- Technology Area
 - TA02 In-Space Propulsion Technologies (Primary)
 - TA03 Space Power & Energy Storage (Secondary)
 - TA04 Robotics, Tele-Robotics & Autonomous Systems (Additional)

This technology will provide not only advancement in electric propulsion, but could also be used on CubeSats to demonstrate other capabilities that current CubeSats cannot.