High Temperature PPU Project

Game Changing Development Program | Space Technology Mission Directorate (STMD)

ANTICIPATED BENEFITS

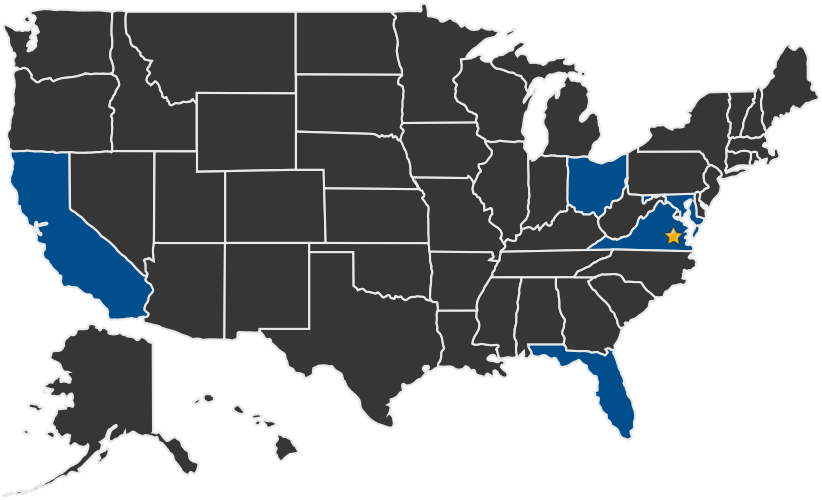
To NASA funded missions:

5-10X reduction in PPU specific mass and volume for a 300kW-class September mission. 80% total PPU and PPU thermal management system mass savings for a 300kW-class September mission

DETAILED DESCRIPTION

Develop, demonstrate and deliver a new technology to enable a modular and power-scalable 10-80kW electric propulsion power processing unit capable of operating at temperatures 2X state of the art. The new silicon carbide based components will lead to a 5X-10X reduction in specific mass and volume of the propulsion system per kW of spacecraft power

U.S. WORK LOCATIONS AND KEY PARTNERS



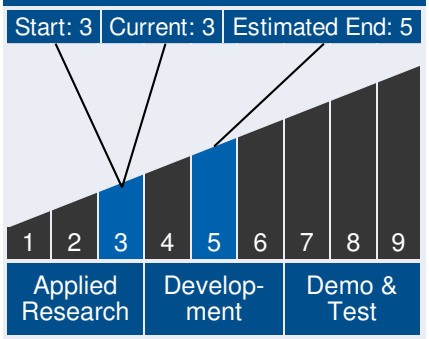
U.S. States With Work

Lead Center:
Langley Research Center

Table of Contents

Anticipated Benefits 1
Detailed Description 1
U.S. Work Locations and Key Partners 1
Technology Maturity 1
Management Team 1
Technology Areas 2
Details for Technology 1 3

Technology Maturity



Management Team

Program Executive:
- Lanetra Tate

Program Manager:
- Mary Wusk

Continued on following page.

Other Organizations Performing Work:

- Texas A&M

Management Team *(cont.)*

Project Manager:

- Timothy Smith

Principal Investigator:

- Charles Taylor

Co-Investigator:

- Yuan Chen

Technology Areas

Primary Technology Area:

Space Power and Energy Storage (TA 3)
└ Power Management and Distribution (TA 3.3)
  └ Conversion and Regulation (TA 3.3.5)
    └ Advanced Power Processing Units (TA 3.3.5.4)
    └ Advanced Power Processing Units (TA 3.3.5.4)

Secondary Technology Area:

In-Space Propulsion Technologies (TA 2)
└ Non-Chemical Propulsion (TA 2.2)
  └ Electric Propulsion (TA 2.2.1)

DETAILS FOR TECHNOLOGY 1

Technology Title

Advanced In-Space Propulsion: High Temperature Boost Power Processing Unit (PPU)

Technology Description

This technology is categorized as a hardware assembly for unmanned spaceflight

The task is to investigate the technology path to develop a 10kW modular Silicon Carbide (SiC) based power processing unit (PPU). The PPU utilizes the high temperature SiC device technology and multi-chip packaging technology enabling the PPU operating at high junction temperatures to reduce the thermal mass for in-space propulsion applications, focusing on a Hall thruster propulsion system. The comparison of the topologies for the Hall thruster PPU has been on-going, and the current design is a non-isolated straight boost topology for the discharge supply, with the trades of the detail design features of the topology being investigated. PPU packaging scheme is also being developed to provide a thermal distribution on the PPU board to optimize the topology and packaging design from the thermal perspective through an iterative process. The goal is that no additional thermal management mass will be added to the 10kW PPU module. Both SiC and high temperature silicon-on-insulator (SOI) technologies are investigated for the control circuit scheme as variable options, along with passive technologies and path to space qualification methodology.

Capabilities Provided

Technology is targeted to support the development of electric propulsion systems for 300kW-class space exploration vehicles

Potential Applications

High efficiency electric propulsion systems for space exploration