Active Project (2016 - 2018)

Extreme Environment Compatible Ceramic Enhanced PEBB Devices (EE-PEBB), Phase II Project

SBIR/STTR Programs | Space Technology Mission Directorate (STMD)

ABSTRACT

A critical element in the NASA/NRC Technology Roadmap is to develop Power Electronic Building Block (PEBB) devices that can function in Extreme Environments. NASA?s stated aim is to use high power density/high efficiency PEBB devices to streamline design and introduce size, weight, cost and efficiency savings. The formidable challenge is to design such PEBB devices that use materials that can function in Extreme Environment conditions. The proposed high power density/high efficiency PEBB solution employs ceramics, striction materials and wide bandgap semiconductors as to meet these Extreme Environment operation challenges. This design eliminates transformer magnetics and opto-isolators (required for galvanic isolation) and eliminates external circuits and components as to provide lower complexity, enhanced performance, and much higher SWaP specifications than currently available. These ? smart? PEBBs incorporating new design and novel materials can now provide NASA design engineers with a whole new level of self-monitoring capabilities as to include voltage, current and temperature self-sensing at the device junction level. These will enable robust prognostics, power reconfiguration, and advanced control methods to be rapidly developed and tested.

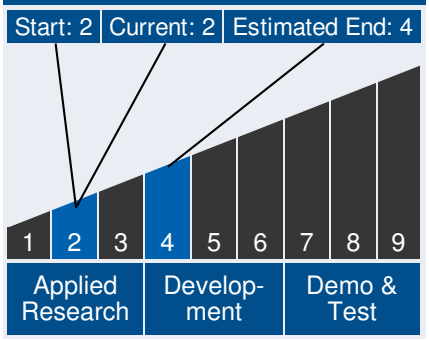
ANTICIPATED BENEFITS

To NASA funded missions:

Potential NASA Commercial Applications: Extreme Environment Power Electronic Building Block (EE-PEBB) devices are applicable to deep space applications such as orbiters, landers, Heliophysics and earth observation platforms. QorTek?s new integrated sensing EE-PEBB devices are also an ideal solution for NASA missions such as inter-planetary probes, outer planetary exploration and deep space probes for use potentially down to cryogenic temperatures, as well as high temperatures Venus Integrated Weather Sensor (VIWS) or high radiation environment Van Allen belts or Europa. The planned design

Table of Contents

Technology Maturity



Management Team

Program Executives:

- Joseph Grant
- Laguduva Kubendran

Program Manager:

- Carlos Torrez

Continued on following page.

incorporates packaging in a modular formfactor that lends itself to new and existing platforms with seamless integration. The inherently radhard nature of sensors and WBG switches introduces further advantages for such missions, as they will reduce risks associated with harsh space environment installations. It would directly impact the ability to reduce the requirements for radioisotope heating units (RHUs) to maintain higher operating temperatures of the electronics and radiation shielding for the current technology.

To the commercial space industry:

Potential Non-NASA Commercial Applications: Applications include ruggedized, high-temperature switching devices for electric vehicle (EV) applications and high temperature sustainable power electronics for down hole gas exploration. The EE-PEBB will be a smaller/less expensive solution than typical piecemeal power electronics circuits. All existing commercial applications would require external circuitry to condition both the input (gate drive) and output (sensor data) signals and in most cases isolate them. QorTek?s system will include all of the necessary circuitry in one modular package. QorTek plans to utilize its ongoing relationship with CREE to further facilitate commercializing a high temperature variant of the proposed technology specifically for emerging Green technology applications. EE-PEBBs can replace IGBTs and MOSTFETS in industrial communication applications including power conversion systems, inverter systems, power supplies, electric motor drive, and medical systems such as MRI machines are a few potential applications.

Management Team *(cont.)*

Principal Investigator:
- Ross Bird

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)

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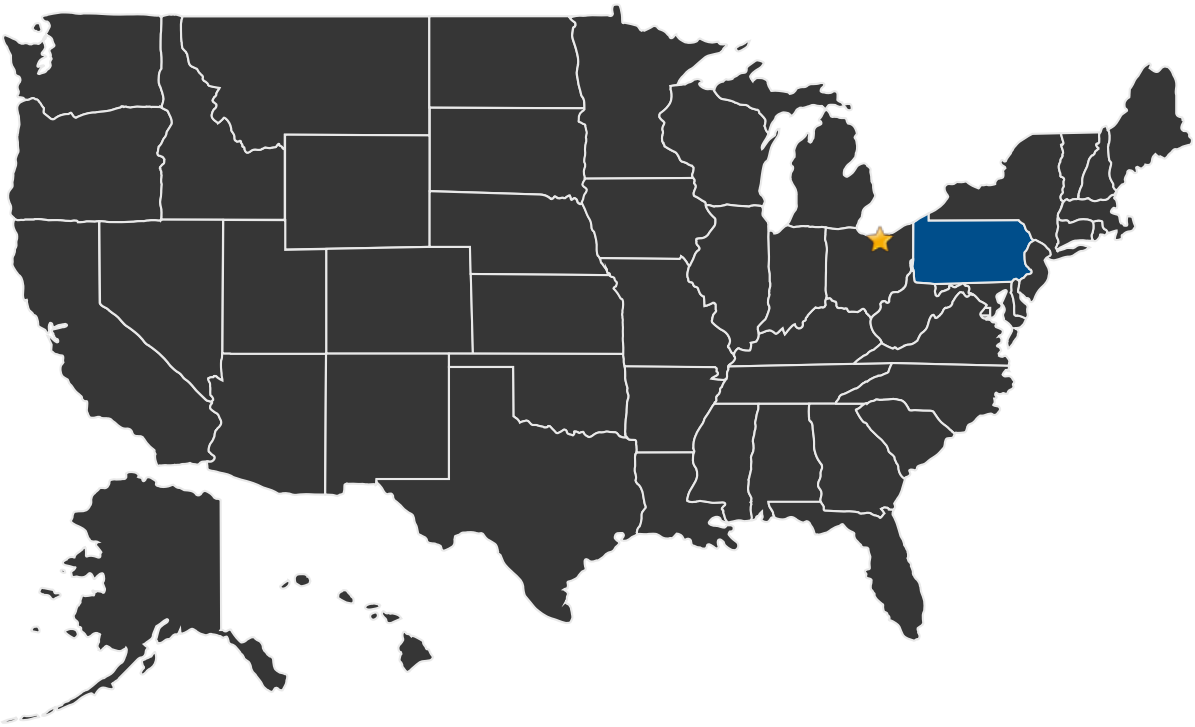
U.S. WORK LOCATIONS AND KEY PARTNERS



U.S. States With Work

Lead Center:
Glenn Research Center

Other Organizations Performing Work:

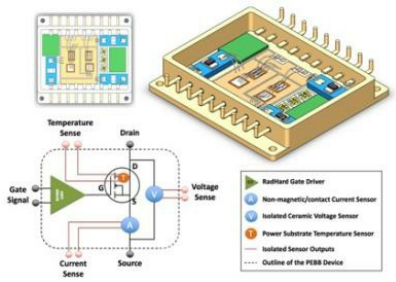
- QorTek, Inc. (Williamsport, PA)

PROJECT LIBRARY

Presentations

- Briefing Chart
  - (http://techport.nasa.gov:80/file/23404)

IMAGE GALLERY



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DETAILS FOR TECHNOLOGY 1

Technology Title

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