Department of the Navy SBIR/STTR Transition Program

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ONR Approval # 43-2203-16

Topic # N141-073

Multi-Stage, Multi-Phase, High Efficiency, Intelligent, Electrical Energy Conversion Unit for Navy and USMC

Global Technology Connection, Inc.

WHO

SYSCOM: ONR

Sponsoring Program: Marine Expeditionary Force

Transition Target: Future Naval Capability (FNC) for transition to PMS 320 Electric Ships Office and the U.S. Marine Corps (USMC) Expeditionary Forces.

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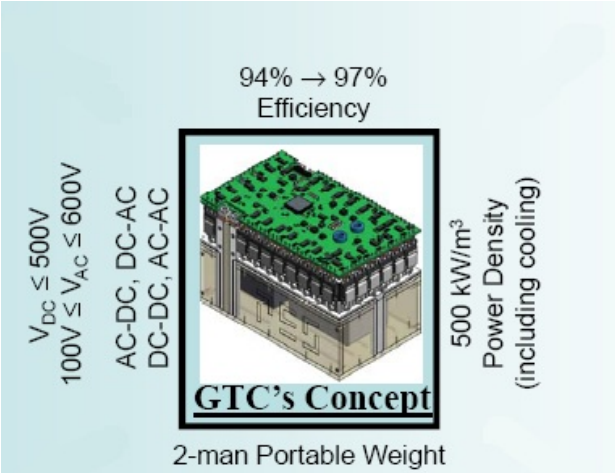
Other transition opportunities: The desired electrical power converter has direct applications in power conversion, machine drive, and transportation traction, making it broadly applicable to the commercial world.

Notes: Approach for High Efficiency Multipurpose Power Converter with High Power Density



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WHAT

Operational Need and Improvement: Motivated by the need to reduce shipboard space, weight or portability, the Navy and USMC require affordable, innovative technology solutions to increase electrical power/energy conversion efficiency and density reducing volume, weight, and cost.

Specifications Required: Specifications include the development of an electrical energy conversion unit for sea vehicles and expeditionary systems that has a volumetric power density of 500 kW/m^3 including cooling, a frequency up to 50-100 kHz, maximum 97% efficiency with a minimum efficiency of 94%, and is 2-man portable. Additional Requirements include:

1. Ability to convert AC-DC, DC-AC, DC-DC, AC-AC
2. An adjustable speed drive capability for different electric machine configurations/topologies
3. Multi-stage power electronic system with thermal management included and without external power source
4. Control of the electric machine forward and reverse without using external resistive loads
5. Real-time non-invasive prognostic/diagnostic capability of each phase of the electric machine and power electronics

Technology Developed: GTC is developing a high power density, high efficiency universal power converter based upon matrix converter concepts.The proven design will be optimized for high efficiency (94-97%), high power density (500kW/m^3), frequency (50-100kHz) and 2-man portable weight with universal power conversion at a wide range of input and output voltages, DC and/or AC for sea vehicles and expeditionary systems.

Warfighter Value: The proposed electrical energy conversion unit will provide rugged, reliable power in a variety of roles: reducing the burden of fuel storage, transport, and generator maintenance aids in streamlining operations, especially when Forces are deployed into remote or austere environments.The proposed solution will help in reducing demand, finding alternative energy sources and improving the energy security of military operations and will help towards meeting goals of the Defense Department's Operational Energy Strategy.

WHEN

Contract Number: N00014-15-C-5025 **Ending on:** January 30, 2017

Milestone	Risk Level	Measure of Success	Ending TRL	Date
Design of High Efficiency 15kW Base Unit	Low	Design review complete	2	September 2016
Implement Control, Diagnostic Algorithms and Thermal Management	Low	Design review complete	3	July 2016
Build and Characterize 15kW Prototype	Low	Prototype tested	4	January 2017
Build and Characterize 60kW Prototype	Med	Prototype tested	5	December 2017
Assemble and Test 240kW Prototype	Med	Prototype tested	6	June 2019

HOW

Projected Business Model: Projected Cost to manufacture base 15kW unit for initial article is $12,500 but learned cost for the 1000th built out cost will be $7500. Continued strong interest in green energy, power electronics for electricity conversion is experiencing important growth.According to estimate from "Yole Développement", the market size was almost $44 billion in 2012, and estimates that it should reach more than $55 billion by 2016. Yole anticipates the overall shipments of power converter for every power range should reach almost 28 million units. Photovoltaic Application: The use of Photovoltaic (PV) application has exponentially grown in the last decade. The total worldwide installed capacity of the photovoltaic application is approximately 9,000 MWh and is valued a $3.3 billion.

Company Objectives: GTC is a leading provider of Predictive Analytical Solutions for Equipment and Machinery Asset Management. This technology while reducing the operating and maintenance cost also increases reliability and its availability to operators. GTC is looking to meet government and prime contractors representatives looking to increase the reliability and availability of their systems.

Potential Commercial Applications: Starting with Ground and Sea Vehicles, this technology can be embedded in numerous other products that can make them fault tolerant, reliable and safe. Expeditionary Power and other uses include Photo-voltaic Application, Electric Vehicle, Grid Storage etc.The proposed device provides both charger and inverter functionality for stationary battery systems, eliminating separate charging and inverting systems.

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