

# Department of the Navy SBIR/STTR Transition Program

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NAVSEA #2020-0355

Topic # N181-048

Ultra-Low Ripple 1000 Volt Direct Current Battery Charger

Galley Power LLC

## WHO

**SYSCOM:** NAVSEA

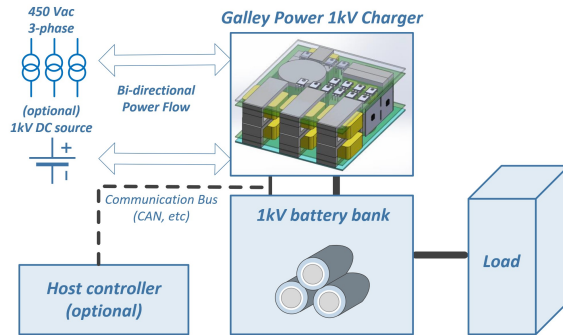
**Sponsoring Program:**

**Transition Target:**

**TPOC:**

(215)897-1722

**Other transition opportunities:**



## WHAT

**Operational Need and Improvement:** High power 1KV Lithium-ion battery charger extends battery bank service life time with ultra-low charging ripple that reduces the heat generation from battery internal resistance. The charger is designed for high efficiency and high-power-density to substantially improve the Space, Weight, Power and Cost (SWaP-C). The charger also supports high control bandwidth with optimized charging profile.

**Specifications Required:** A 33kW 1kV charger achieves 96.5% efficiency with 3MW per cubic meter power density. The battery charging ripple is below 0.25%. The charging profile supports constant voltage, current and power. The charger input is standard 3-phase 450Vac with a power factor control that is compliant with MILSTD1399 300B. The AC input to the battery bank is galvanically isolated. Complete protection designs support output over/under voltage, output short circuit, over temperature, Input over voltage, power foldback and AC brown-out. All the controls are software programmable. The system can be controlled remotely through CAN bus. The charger module is designed for a 19" rack form-factor with a 33kW rating per 4U standard rack height (7"). The module has the capability to provide higher increments of charging power.

**Technology Developed:** Galley Power's high power high voltage solution fully transitions to SiC based high frequency power devices with soft-switching techniques. The advanced charging control is capable of supporting various battery chemistry including Lithium-ion, LiFePO4 or Lead-acid. The charger is a modular design with real-time synchronization capability which allows interleaving operation, significantly reduces the charging ripple, and allows variable switching frequency. The bi-directional 3-phase power inversion technology supports both battery charging and state-of-charge (SOC) adjustment.

**Warfighter Value:** TBD

## WHEN

Contract Number: N68335-20-C-0154

Milestone	Risk Level	Measure of Success	Ending TRL	Date
Lab prototype of 6kW 1kV low ripple charging module	Med	Satisfactory functions and charging profile	4	October 2020
Lab prototype of interleaved 13.2kW 1kV low ripple charging modules	Med	Satisfactory performance to meet module level specification	4	August 2021
Lab prototype of 33kW 1kV high efficiency and high-power-density low ripple charger	High	Satisfactory performance to meet system level specification	6	June 2022

## HOW

**Projected Business Model:** Galley Power business model for 1kV Lithium-ion battery charger is primarily targeting to sell as a fully functional charging module for system integration. Galley Power also sells the charger as customized product based on the requested power level, input power source, battery bank voltage and capacity.

**Company Objectives:** We anticipate that the navy SBIR/STTR Transition Program (STP) forum will facilitate connections with Navy system integrators to explore the opportunities for high power high voltage Lithium-ion battery bank charging needs. Galley Power can customize the charger's functions, form-factors and control protocols to accommodate the feasible redesign into the targeting systems.

**Potential Commercial Applications:** This technology can be applicable to high voltage grid energy storage systems. This technology can also be applicable to the fast charging of electrical vehicle batteries.

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