

Energy Storage Manufacturing– High Energy Density (HED) Capacitors

Establish domestic pulse power capacitor manufacturing capabilities for achieving greater energy density, increased direct current hold time, increased shot life, decreased current rise times, and reduced manufacturing costs.

OBJECTIVE / SOLUTION

There is a need to establish domestic manufacturing capabilities for pulse power capacitors for achieving energy density of over 3.0 J/cc, which is greater than the currently available 1.0 J/cc in state-of-the-art capacitors. In addition to an increase in energy density, this ATO-M is also designed to increase direct current hold time, pulse shot life, decrease current rise times, increase operating voltages, and reduce manufacturing costs. It will also leverage on-going capacitor technology development within the Army and other Services; develop advanced dielectric thin film manufacturing capabilities that do not currently exist; develop metallization/end connection processes for high current discharge capabilities, and develop thin film manufacturing process technology to improve dielectric film breakdown strengths. This project aims to realize technology and manufacturing improvements to TRL 7 and MRL 7 over a period of 6 years from a baseline of TRL 5 and MRL 3.

ACHIEVEMENTS

This program was started in FY04. A contract was awarded in May 2004 to vertically integrate various parts of capacitor manufacturing, including dielectric film manufacturing, film conversions, and capacitor manufacturing and testing. A roadmap for achieving the integration resulting in cost reduction and performance improvement has been laid out.

Technology investments in joint TARDEC/ARL ATO (III.LG.2004.02) for developing new dielectrics, new processes, and new designs will be executed in parallel to this ATO-M and technology will be transferred into the ManTech development when sufficiently matured.

BENEFITS

- Provides affordable, high energy density, fast rise time capacitors for compact pulse power sources.
- Provides advanced large-size capacitor manufacturing capabilities.
- Accelerates the manufacturing processes for fast HED capacitors in parallel with pulse power technology development.

STATUS

- Developed and demonstrated 6.5kV ¼MJ millisecond discharge capacitors with an energy density of 2.6J/cc.
- Developed 10kV 12.5kJ microsecond discharge capacitors with an energy density of 1.3J/cc and DC life of over 800 hours at 10kV; understood the controlling parameters for producing such capacitors.
- Procurement and development of key items for manufacturing process improvements are in progress.
- Successfully produced 3-5 µm biaxially oriented polypropylene and 4-5µ high temperature poly (etherether ketone) dielectric films for capacitors in pilot scale film processing equipment.

WEAPON SYSTEMS / SECONDARY ITEMS IMPACTED

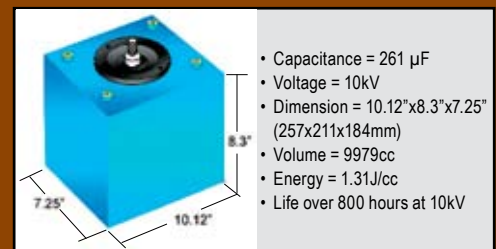
- Combat vehicles—electromagnetic armor (for survivability) and electrothermal chemical guns, electrothermal ignitions, high power microwaves, and direct energy components (for lethality)
- High power electronics

POTENTIAL COST AVOIDANCE

- Estimated \$40 to \$60 cost savings per kJ for pulse power capacitors.



Bradley M2A3 Infantry Fighting Vehicle



- Capacitance = 261 µF
- Voltage = 10kV
- Dimension = 10.12"x8.3"x7.25" (257x211x184mm)
- Volume = 9979cc
- Energy = 1.31J/cc
- Life over 800 hours at 10kV

HED Microsecond Discharge Capacitor

High Energy Density (HED) Capacitor



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