**Department of the Navy SBIR/STTR Transition Program**

**DISTRIBUTION STATEMENT A. Approved for public release. Distribution is unlimited.**

ONR Approval #43-4388-18

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**WHO**

**SYSCOM:** ONR  
**Sponsoring Program:** Code 35 - Hypervelocity Projectile  
**Transition Target:** Hyper Velocity Projectile, SHD FY15-17, for PEO IWS 3C Surface Gunnery Program  
**TPOC:** Victoria Snyder  
**victoria.snyder1@navy.mil**  
**Other transition opportunities:** Next generation clock references, timing circuits, and navigation systems  
**Notes:** Image Description: Proposed concept of operations of the Ferroelectric Resonator Oscillator (FEROS) integrated within the guidance system of the Hypervelocity projectile.

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**WHAT**

**Operational Need and Improvement:** The Global Positioning System (GPS) receiver in the Hyper Velocity Projectile utilizes oscillators as timing references to provide positional accuracy. Current quartz temperature-compensated crystal oscillators (TXCO) cannot withstand the harsh environment of a high-velocity, gun-launched guided projectile. There is need for a high-G mechanical shock - and temperature-shock tolerant oscillator as a replacement for TXCOs.

**Specifications Required:** Specifications include: frequency stability <10 ppm, phase noise <-120 dBc/Hz @ 1kHz, mechanical shock >50,000 g, temperature fluctuation withstand 10C/min, and operating temperature range of -31C to +85C.

**Technology Developed:** Development of ferroelectric-based (barium strontium titanate) resonator circuit integrated with oscillator circuit in a compact form factor to withstand the harsh environment of a high-velocity, gun-launched guided projectile.

**Warfighter Value:** Integration of the FEROS technology within a miniaturized GPS receiver will help to improve accuracy of precision guided munitions operating under harsh operational conditions and adverse weather limitations.

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**WHEN**

**Contract Number:** N68335-17-C-0155  
**Ending on:** June 11, 2019

<table>
<thead>
<tr>
<th>Milestone</th>
<th>Risk Level</th>
<th>Measure of Success</th>
<th>Ending TRL</th>
<th>Date</th>
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<td>Completion of Phase II prototype and initial testing</td>
<td>Low</td>
<td>Prototype measured in laboratory environment</td>
<td>5</td>
<td>2nd QTR FY19</td>
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<tr>
<td>Completion of prototype demonstration</td>
<td>Med</td>
<td>Prototype measured in relevant environment</td>
<td>6</td>
<td>3rd QTR FY19</td>
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**HOW**

**Projected Business Model:** During Phase III, the FEROS technology can begin low rate initial production (LRIP) within three months with a plan for full rate production (FRP) (50 units/month) within 6 months.

**Company Objectives:** The goal is to work with a prime contractor for the GPS receiver integration and transition this technology to the targeted platform.

**Potential Commercial Applications:** As a high-precision oscillator, it can provide a clock reference, clock generator, or timing circuit for the processor, memory functions, communication ports, analog-to-digital (A/D) and digital-to-analog (D/A) converters, and many other functions. In RF applications, the demands on the timing function are especially challenging, where the oscillator is not just a clock reference. In RF, it establishes basic carrier/channel tuning at frequencies in the hundreds of MHz and into the GHz range to ensure proper clocking of the A/D and D/A converters.

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