Concept development to IP to prototyping to production:
- Smart munitions (sensors, actuators, initiators, high-g hardening, internal communication, power source, …);
- Weapon platforms (high-speed turrets, pointing sensors, passive and active vibration control, lightweight structure design, recoil reduction,…);
- Novel mechanical devices (vibration dampers, vibration isolators, general mechanisms, tools, …);
- Medical devices, surgical tools, safety devices;
- Runway and highway safety devices;
- Homeland Security related perimeter safety devices, …;
- Over 190 patents issued and over 80 pending since 2000.

In business since 1993 and as Omnitek Partners, LLC since 2000.
Small Business: Currently 14 full-time and part-time people.
Mechanical Inertial Igniters
and
Self-Powered Inertial Electrical Initiators with
All-Fire/No-Fire Detection and Safety Logic
Inertia Igniters for Munitions

- Provides inertial igniters for thermal batteries for the full range of gun-fired munitions, mortars and rockets.
- Fully qualified per MIL standards, including for no-fire safety.
- Reliability of over 99.9% with 95% confidence level tests underway for gun-fired munitions and mortars.
- Have been designed for all fire range of 15 G to over 50,000 G.
- The patented classes of inertial igniters were developed from concept to prototyping, testing and production at Omnitek Partners.
- Can be converted to all-fire triggered “G” switch.
- V2 models for 5,000 G and above are manufactured with M42C1 primer and for lower G levels with PA101 or equivalent.
- Omnitek has also developed numerous custom designed inertial igniter variations for thermal battery and initiation train ignition.
Inertial Igniters for Thermal Batteries

U.S. Army Armament Research, Development and Engineering Center

Thermal batteries have long been used in munitions and similar applications to provide large amounts of power during a relatively short period of time, mainly during the munitions flight. There is a need to develop highly reliable and miniaturized inertial igniters for thermal batteries that satisfy the strictest safety requirements, and can cover almost any off-line and no-fire conditions for the entire range of artillery, mortars and medium caliber rounds and small rockets.

Omnitek Partners has developed novel miniature igniters which are simple in design and manufacture, highly reliable, occupy very small volume, and are purely mechanical. They contain no damping elements to ensure consistent operation and have a shelf life of over 20 years. These miniaturized mechanical igniters have made it possible to fabricate thermal batteries for applications that require very small sizes and where previously only electrical igniters could be used, which require other sources of power and sensory information for safe operation. The breakthrough technologies for the design of highly reliable, miniature inertial igniters is based on the development of mechanical mechanisms and components that make it possible to accurately predict the dynamic behavior of the various components of the igniter and almost entirely eliminate the possibility of jamming and other events that would otherwise reduce the operational reliability of the device.

Technology Transition
This technology has received four patents with several pending for thermal battery and other similar military and commercial applications. Under a $580K U.S. Army’s Commercialization Pilot Program (CPP) award, Omnitek has performed reliability tests of one of its inertial igniters, demonstrating a reliability level of 99% at 95% confidence level. Omnitek’s inertial igniters have been purchased by two defense contractors for thermal batteries to be used in Army and Navy munitions. Omnitek igniters are also being considered for integration into thermal batteries for at least four other Army and Navy munitions by defense contractors with sales value of up to $2 million per year.

1910 U.S. Army SBIR success story.
Omnitek Programmable Electrically Initiated Inertia Igniter and its Operation

Piezoelectric Element energy output

Logic Based Event Detection Circuitry

Programming Step: Set the (all-fire) event threshold level. Set the ignition delay time (optional)

Safety electronic circuitry and logic

Safety Mode: Detect and differentiate all no-fire events from all-fire events.

Trigger Initiation

Proprietary Information Omnitek Partners, LLC
**KEY PLAYERS:** ARL – ARDEC – SBIR (Omnitek)

**ARL** - On-chip nanoporous silicon research

**ARDEC** – SBIR Phase I, II, plus, III - DAA30-03-C-1077
  Phase I, II W15QKN-08-C0503
  (SBIR contractor Omnitek Partners LLC)

**GOAL:**
Provide capability/process to manufacture highly reliable self-powered electronic initiators that are programmable to all-fire/no-fire levels, and meet safety and reliability requirements with no external sensors or batteries.

**PRODUCTS:**
- Manufacturing process for integration of ultra-low-power nanoporous silicon initiators with on-chip electronics
- Development of self-powered electronic initiators with programmable all fire detection functionality, handling & packaging processes and machinery.
- Transfer of manufacturing processes to manufacturing partner

**PAYOFF:**
- Reduce cost, size and complexity to integrate reserve power source into munitions. Reduce EMI and EMP vulnerabilities, improve safety.
Piezoelectric-Based Energy Harvesting from Impulse Loading in Gun-Fired Munitions

Piezoelectric element / stack

Projectile structure

Electrical model of a piezoelectric element
Safety and All-Fire Detection Circuitry of the Self-powered Initiation Device
Safety and All-Fire Detection Circuitry of the Self-powered Initiation Device

Proprietary Information
Omnitek Partners, LLC
Safety and All-Fire Detection Circuitry of the Self-powered Initiation Device

- Piezoelectric Element
- Bridge Wire
- Output Voltage Threshold Detection and Switching Element

Proprietary Information
Omnitek Partners, LLC
Safety and All-Fire Detection Circuitry of the Self-powered Initiation Device

Proprietary Information
Omnitek Partners, LLC
Safety and All-Fire Detection Circuitry of the Self-powered Initiation Device

With the charging voltage limiting Zener diode Z2 – trigger time at 5V threshold 3 msec
Piezoelectric-Based Energy Harvesting from Impulse Loading in Gun-Fired Munitions
Electronic Piezoelectric charge generation simulator
Energy Harvesting Power Sources and Sensors
Electric Power Generation Using Firing Acceleration and Vibration

Basic Power Generation Concept

- Firing acceleration $a$ displaces mass $m$ a distance $d$.
- Potential energy $\frac{1}{2} k d^2$ is stored in the spring $k$.
- Energy is then harvested from the vibrating mass-spring system using certain mechanical to electrical generator system.

Piezoelectric element
Electric Power Generation Using Firing Acceleration and Vibration
Integration into Gun-Fired Rounds and Field Testing Expertise

Round #1

Picture of a fully instrumented M830A1-HEAT round before and upon barrel exit. The round was used to test several Omnitek Developed energy harvesting power sources (piezoelectric-based and TPV based for supersonic rounds)

TPV energy harvesting for supersonic rounds