High-G Mortar Electronic S&A Demonstration

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Outline

- High-G ESAD Systems overview
- Project Team
- Technical Approach
- Design Details
- Testing and Results
- Current Status

Project Overview

- ARDEC ATO project to demonstrate high-g survivability of a potential low-cost electronic safety and arming device (ESAD) suitable for mortar and/or artillery fuzing.
- Both in-house and Kansas City Plant fireset designs to be evaluated as part of effort.
- Initial project to focus on demonstrating survivability for worst case mortar launch environment.
- Project to conclude with ballistic demonstration test at Yuma Proving Grounds on 81mm ammunition at Charge 4.

Project Team

Team Members

Stewart Genberg – Team Leader
ARDEC Fuze Division

Brian Mary – Lead Engineer
ARDEC Fuze Division

James Hartranft – Mechanical Engineer
ARDEC Fuze Division

Cuong Nguyen/ Calvin Cheung – Electronics Engineer
ARDEC Fuze Division

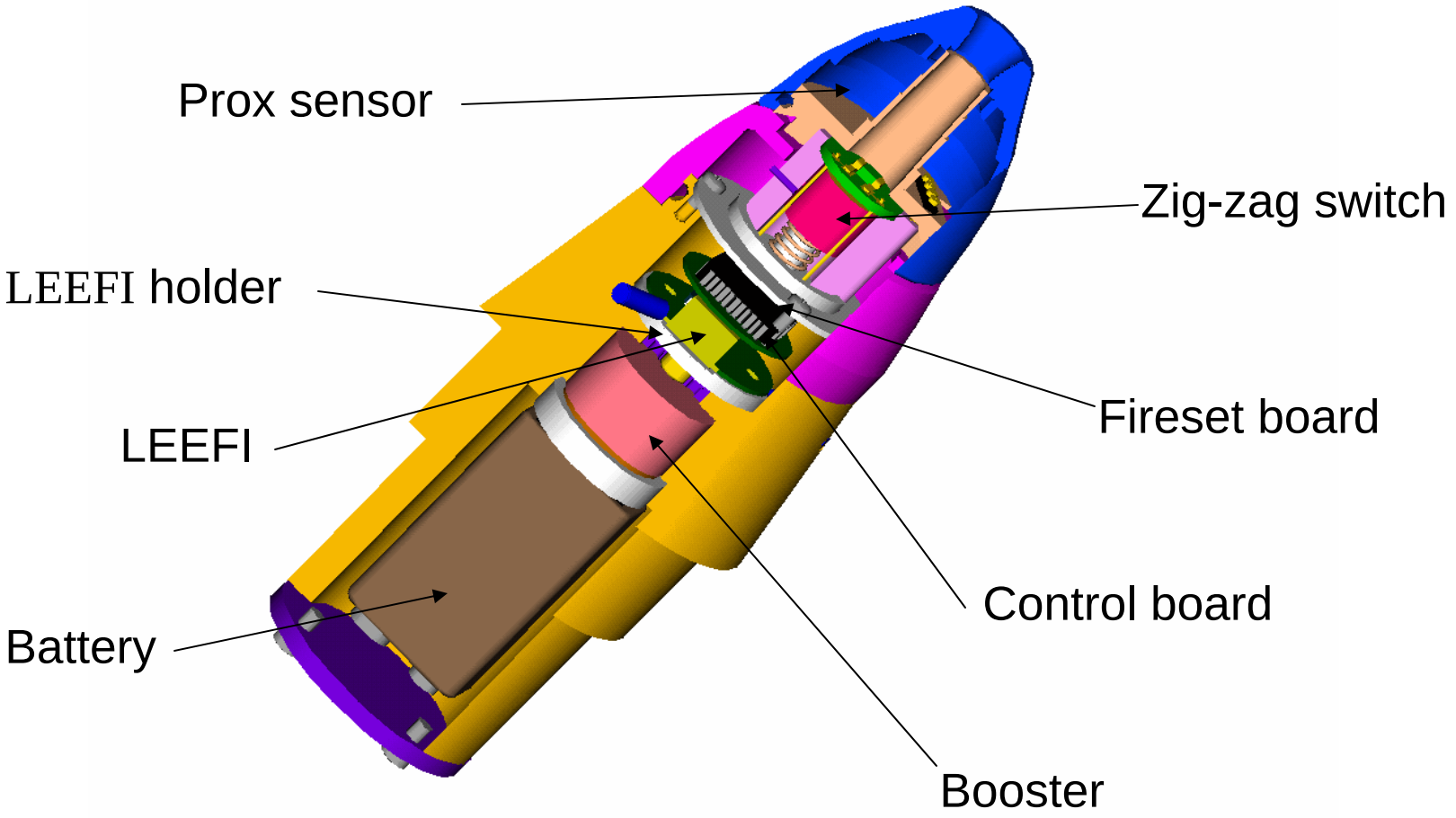
Technical Approach

- Microcontroller based Control Logic
- Standard ESAD architecture with two static arming switches and one dynamic arming switch.
- Custom zig-zag setback switch to sense first launch environment and act as one static arming switch.
- Second launch signature simulated with independent time-out circuit.
- Independent low energy fireset board assembly – two designs to be evaluated.

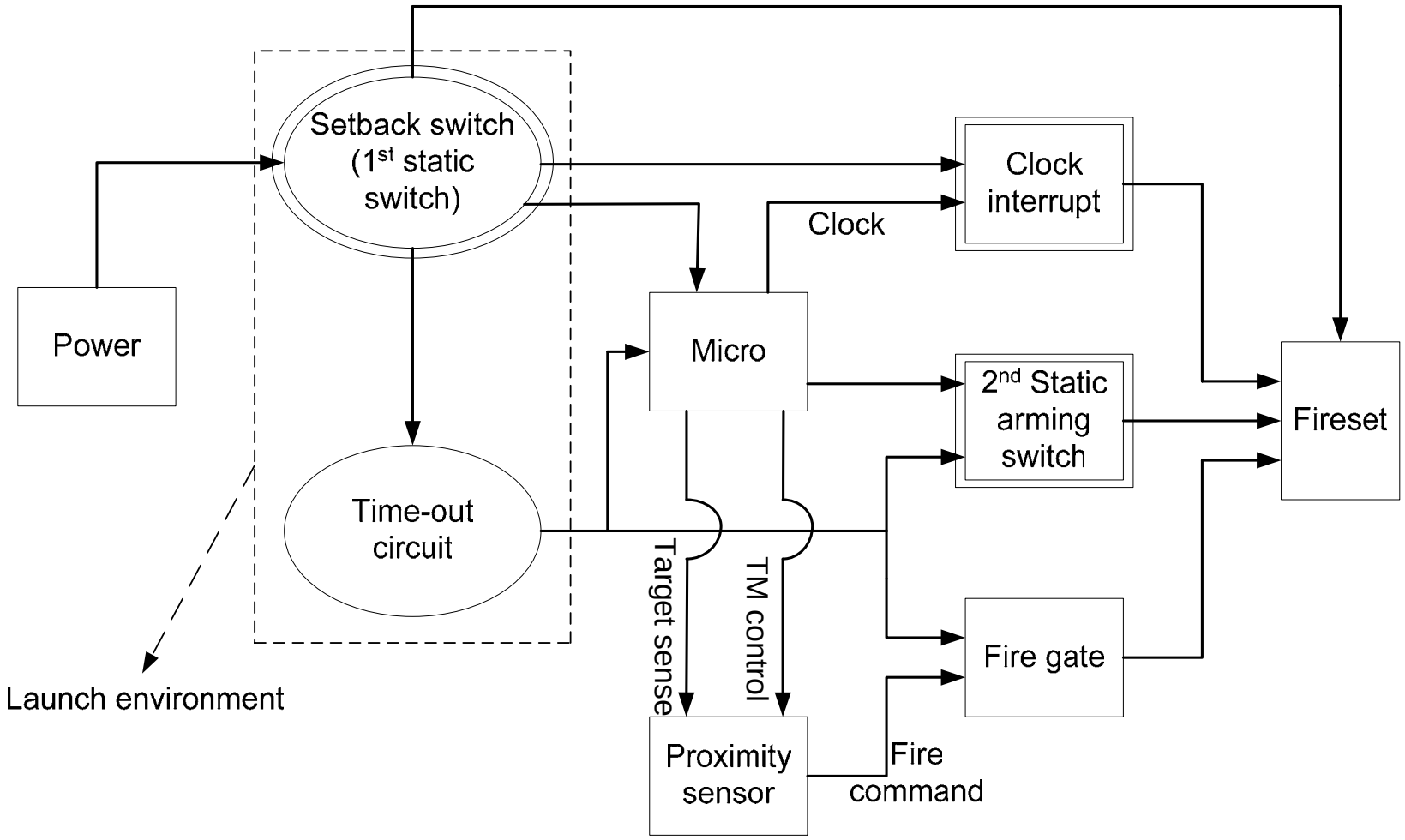
Technical Approach

- Modified M734A1 mortar fuze prox electronics for target detection.
- Standard LEEFI slapper detonator with RSI-007 output.
- M734A1 PBXN-5 Booster to be used in ballistic demonstration test for function signature.
- Repackaged off-the-shelf alkaline battery power supply

Device Drawing



Control Logic Block Diagram



Control Algorithm

- Pre-flight
  - Screw inserted in custom power switch to connect battery power
  - The micro will initialize and run a self-test to verify safe startup conditions
  - If all safety conditions are satisfied, the prox sensor transmits a code to indicate fuze is safe to fire.
  - If all safety conditions are not satisfied, the prox sensor will transmit fault codes signaling the error condition

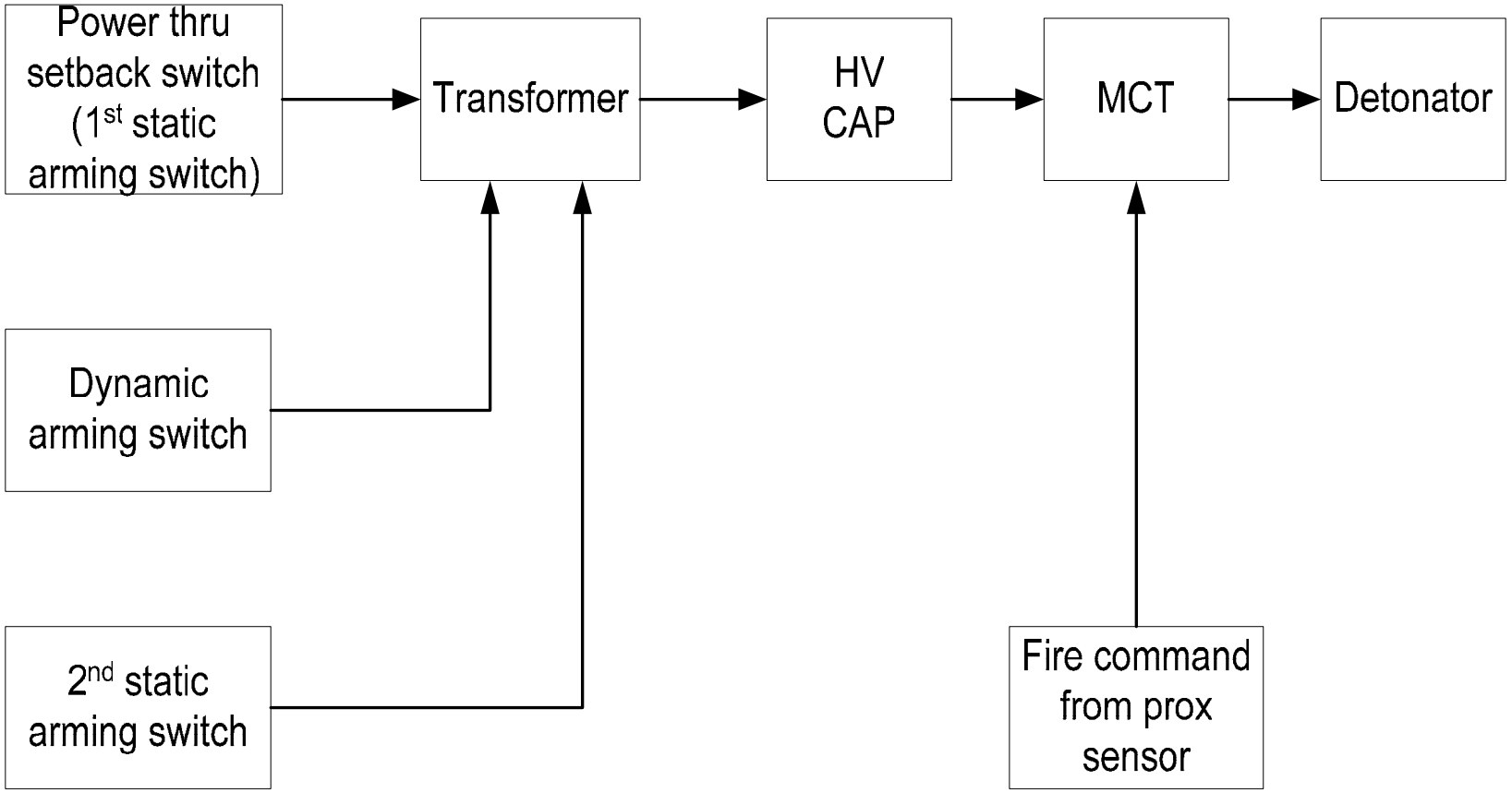
Control Algorithm

- Launch and Flight
  - The micro remains in waiting state until zig-zag setback switch closes at gun launch
  - During flight, the fuze transmits self telemetry data
    - zig-zag closure
    - Time out delay completion
    - High voltage charge detection on fire capacitor
  - Self Telemetry data is transmitted on the down-leg of flight
  - Prox sensor provides fire command to fireset electronics at proper burst height.

Firesets

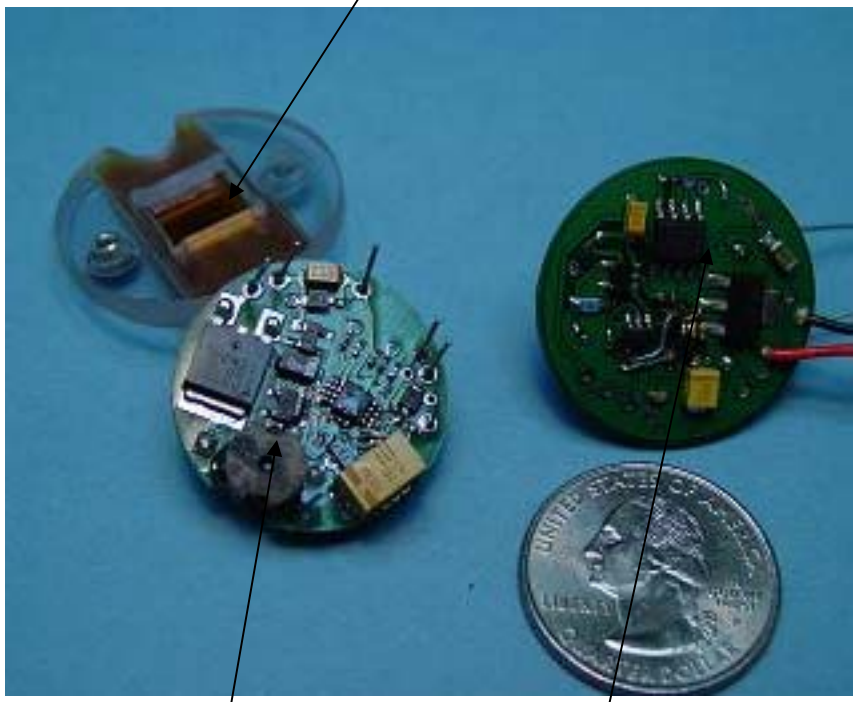
- In-house fireset
  - Freq: 50KHz, 25% duty cycle
  - Charges 0.1µF capacitor to 1000V
  - Custom transformer winding
- Kansas City Plant MIF
  - Freq: 30KHz, 50% duty cycle
  - Charges 0.2µF capacitor to 1000V
- Same interconnection configuration

Fireset Block Diagram



Electronics Hardware

LEEFI holder

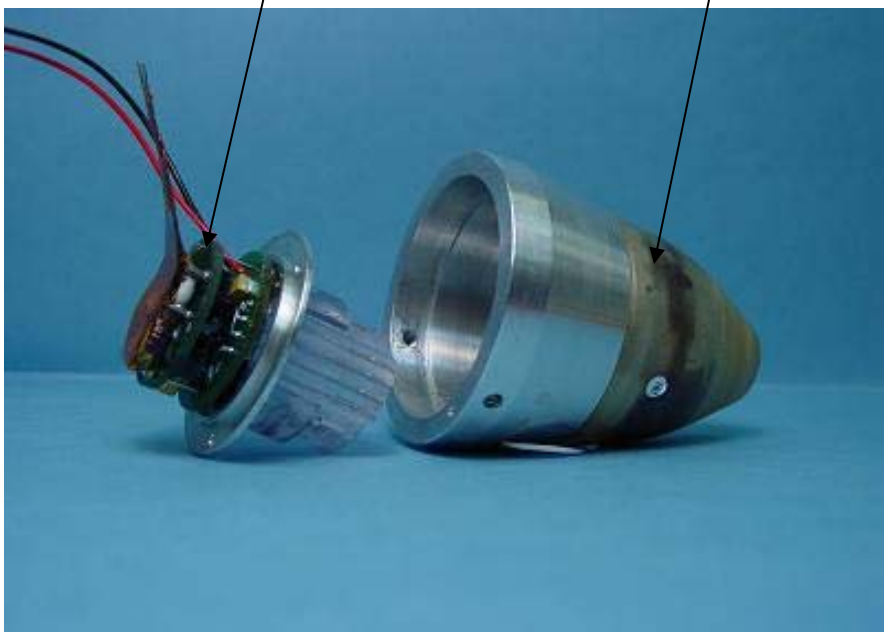


In-house fireset

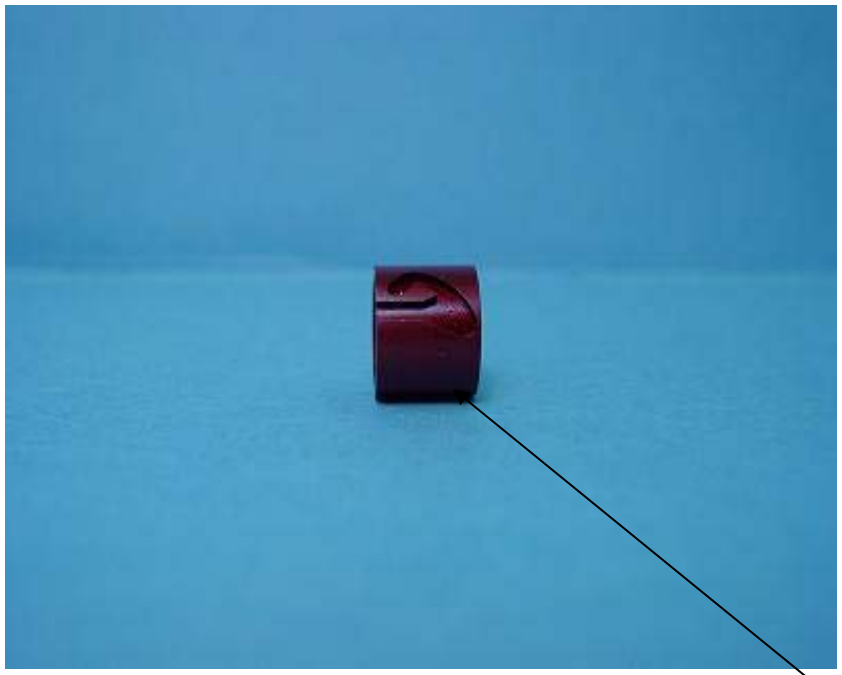
Micro board

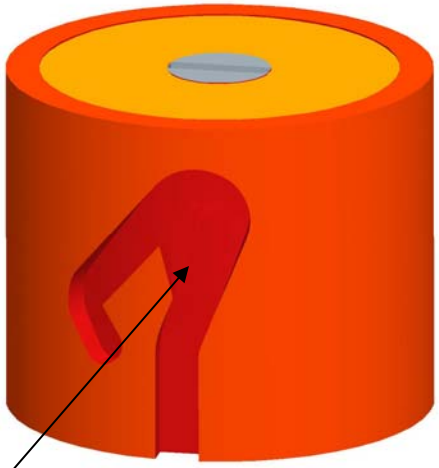
Fireset board mated with Micro board

Prox sensor



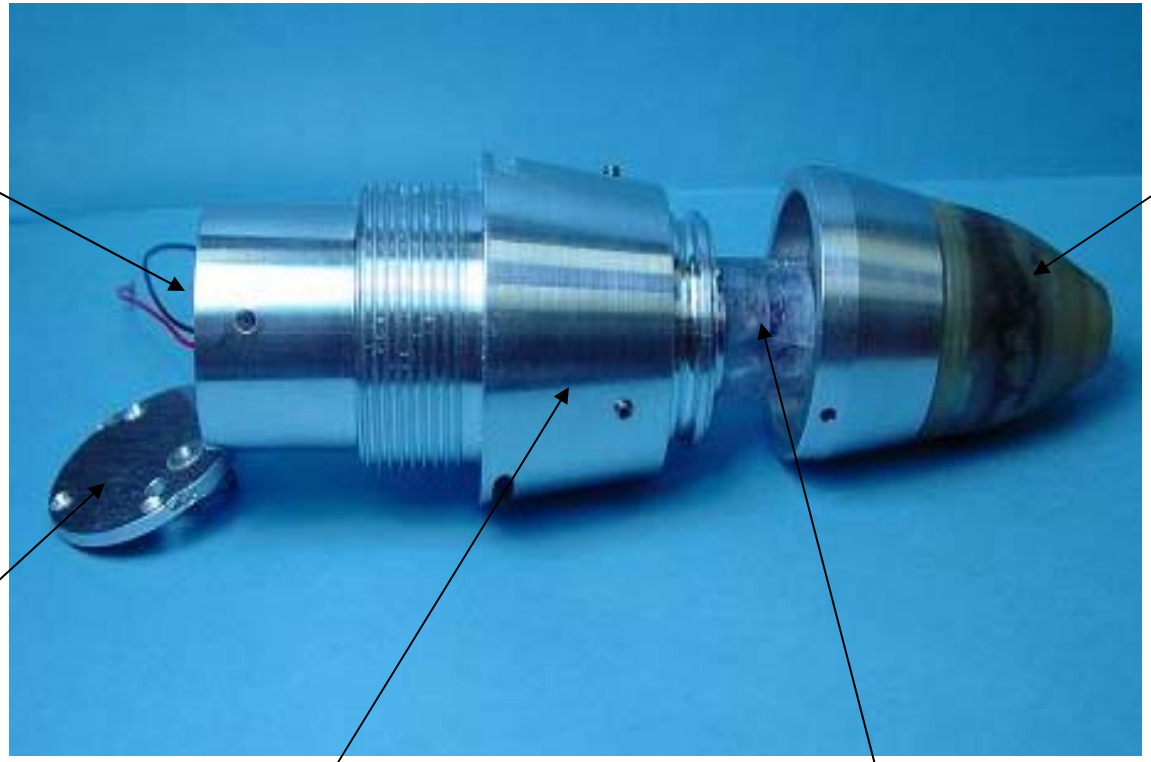
Electronic Hardware





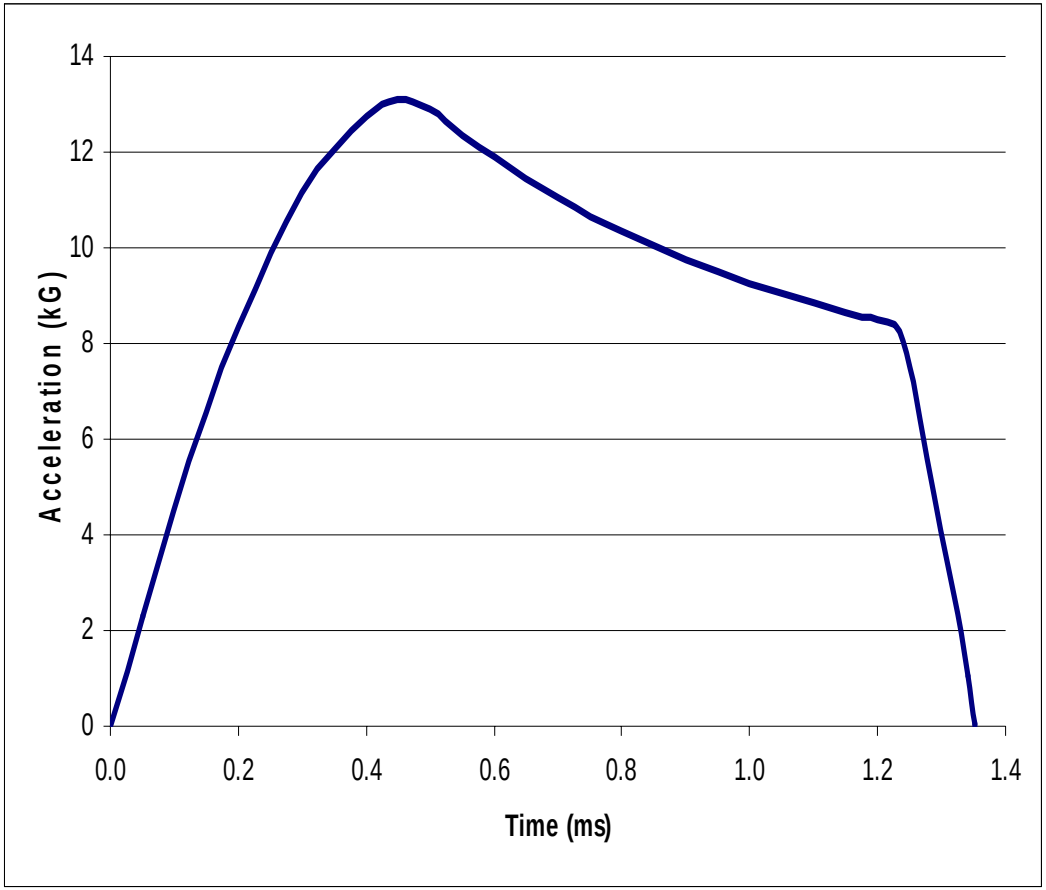
Zig-zag setback switch

High-G ESAD Hardware



Air Gun Shock Pulse

All system components have been demonstrated to survive high-G air gun shock testing.



Current Status

- Initial design for mortar fuze application completed
- Fabricated 10 full-up assemblies.
- Explosive train reliability testing finished for fuze booster.
- Air gun shock testing completed on two units
- Ballistic test planned for remaining 8 units
  - 4 units with in house fireset
  - 4 units with Kansas City Plant fireset
- Awaiting field test Summer 2006