High Voltage Fireset Component Behavior at Elevated Temperatures

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Overview

- Background
- High Voltage Firesets
  - Applications
  - Components
- Technical Survey
- Testing Methodology
  - MIL-STD 331D
  - Things to consider
- Path Forward

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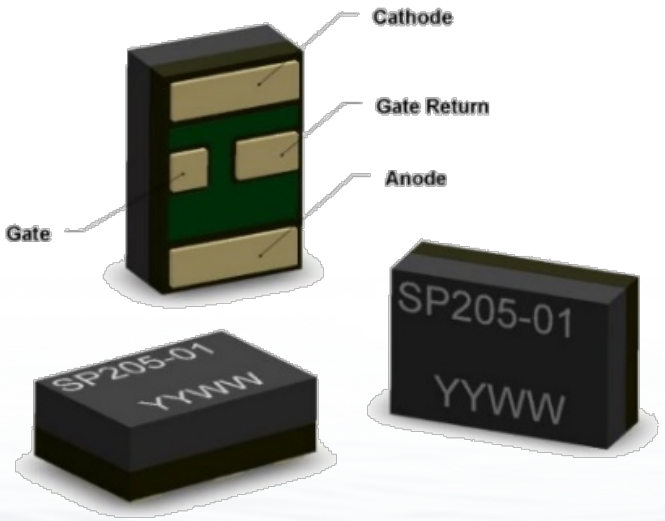
Background

- **Technology Goal:** Determine the margin of survivability of existing and mature high voltage fireset technologies at elevated temperatures.

Approach: Survey/consult, obtain/build and test mature fireset designs at temperatures greater than MIL-STD 331D (failure).



Current efforts funded through Joint Fuze Technology Program.

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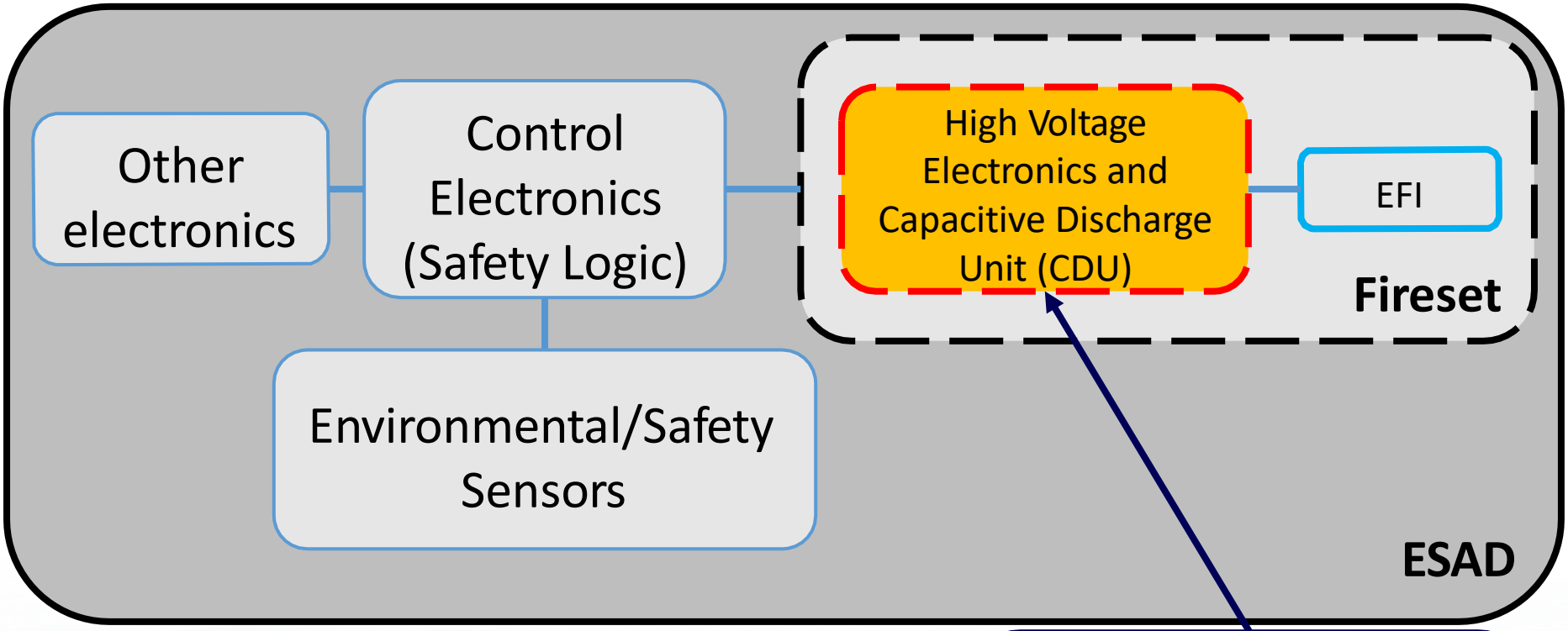
High Voltage Firesets



- Found in ESADs (non-interrupted or in-line)
- High voltage (>500V)
- Used in Ordnance systems

Primary Focus:

~~Key Components~~

- HV Capacitor
- HV Switch
- HV Converter (Transformer)

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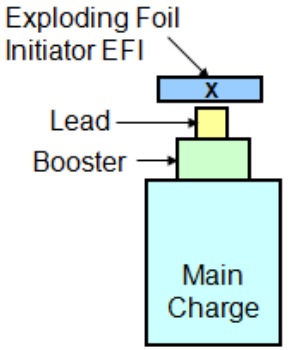
Typical Applications

- Precision guided munitions
- Air-to-Air Missile (AAM)
- Air-to-Ground Missile (AGM)
- Surface-to-Air Missile (SAM)
- Surface-to-Surface Missile (SSM)
- Light and Heavy Weight Torpedoes

Non-Interrupted

- "In-line" systems
- Electronic Safe Arm Device (ESAD)
- High voltage system



Electronic based system, no moving parts required

Example of AAM

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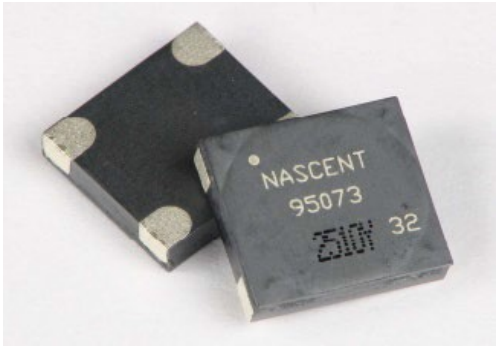
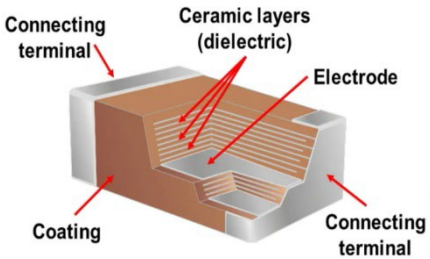
HV Fireset Major Components

- Flyback Transformer
  - HV generation
    - Wire wound
    - Multilayer/Monolithic Ceramic
- High Voltage Storage Capacitor
  - Responsible for energy storage until ready to fire
    - Multi-layer Ceramic (MLCC)
    - Polymer Multi-Layer (PML)
- High Voltage Switch
  - Triggering mechanism that completes circuit upon fire command

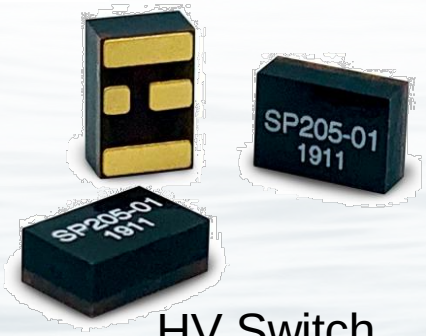


Flyback Transformer



MLCC

PML



HV Switch

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Other Key Subsystems

- Static Switches
  - Upper/lower
  - Prevents fireset from charging
- Dynamic Switch
  - Provides pulse signal for transformer
- High Voltage Feedback
  - Maintains high voltage threshold

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Technical Survey

- Surveyed/Received HV firesets from across the DoD/DoE agencies
  - Navy
  - Army
  - Air Force
- Key Components Analyzed/Compared
- MIL-STD 331 Requirements
- Temperature regimes
  - Note: Fuzes traditionally located along central may be less affected; however, it is important to understand the margin to which these HV firesets can survive

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MIL-STD 331D

- Appendix C
  - Requires a bare, unpackaged fuze and its components to be able to survive temperature extremes up to 160°F or 71°C for 28 days.

- Intend to test to failure

No Standard or Requirement above 160°F or 71°C

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Testing Methodology

- Variables to consider, included here but not limited to:
  - Potential cable failures at higher temperatures
  - Soak duration in order to thoroughly evaluate HV fireset performance
  - Isolation of non-key infrastructure
    - Conformal coat/potting
  - Potential redesign for instrumentation
  - Discrete vs. Non-discrete temperature testing
  - Avoid “re-inventing the wheel”

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Path Forward

- Continue to develop testing methodology for FY21
  - Temperatures and duration
  - Locations for evaluation (leakage current, etc.)
  - Perform INERT tests in thermal chamber(s)

Thermal Chamber

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Questions?