L-3 Fuzing & Ordnance Systems

Miniaturized Electronic Safe & Arm Device Development

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Presented By
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Agenda

- Need for smaller ESADs
- Example of size reduction realized to date
- Enabling Technologies
- What is necessary for further size reduction

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Need for smaller ESADs

- Customer Requirements
- Armed UAVs
- Better safety features for handheld weapons
- Further proliferation of ESADs into new areas

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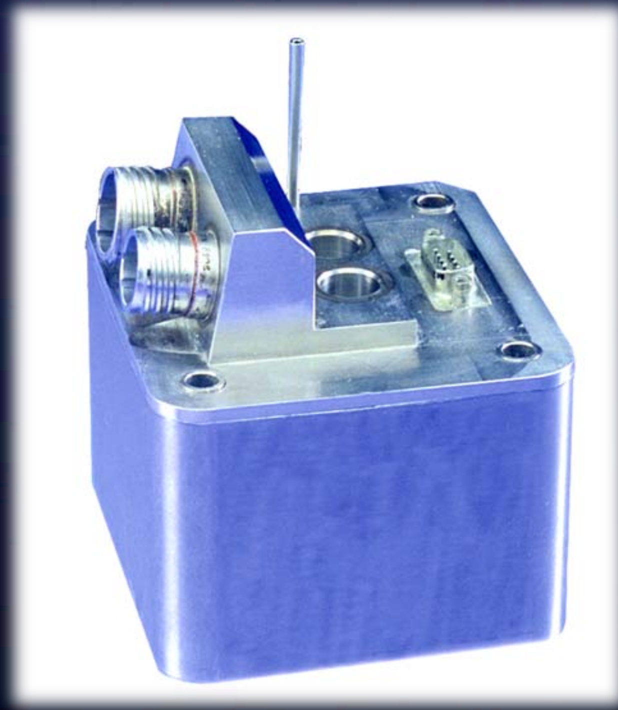
First ESAD (ATACMS)

- Volume: ~56 cubic inches



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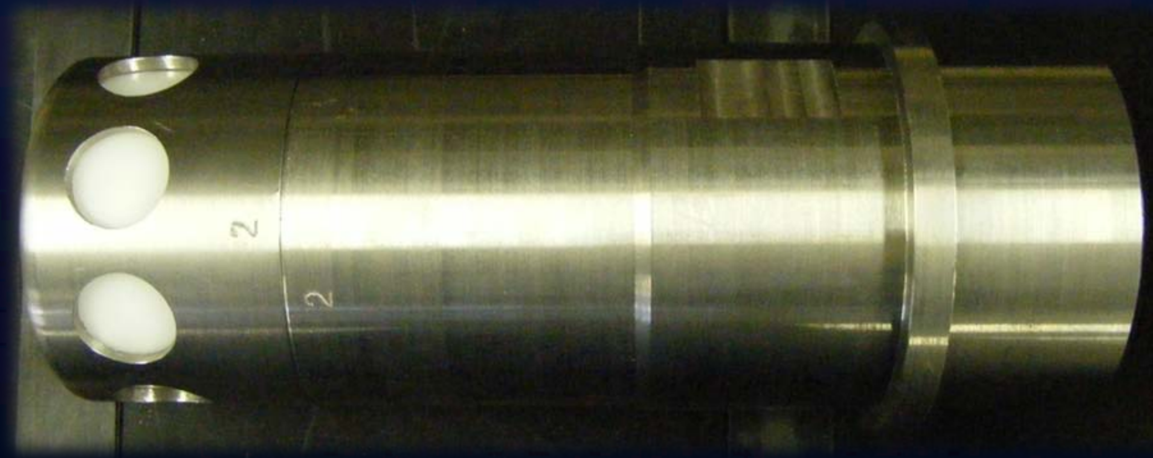
Typical 3” Bomb Fuze

- Volume: ~40 cubic inches (without booster)
- 29% smaller than ATACMS



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Fuzing & Ordnance Systems

Miniaturized ESAD

- Volume: 1.8 cubic inches
- 97 % smaller than ATACMS
- 96 % smaller than 3” bomb fuze

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Miniaturized ESAD

- Volume: 1.16 cubic inches
- 98 % smaller than ATACMS
- 97 % smaller than 3” bomb fuze

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Comparison to Computer Industry

- Computer industry has realized ~99.999998 % volume reduction (ENIAC to smart-phone)
  - *660,000 smart-phones needed to fill up volume of ENIAC*
  - *Due to tight integration of different parts and discrete part size reduction*
- L-3 FOS has realized ~98 % fuze volume reduction
  - *48 miniaturized ESADs needed to fill up volume of ATACMS*
  - *Driven by customer requirements, realized by smaller components*
  - *So far, not much integration of different parts for fuzing applications*
- Aggressive fuzing specific component integration needed to further drive down ESAD size.

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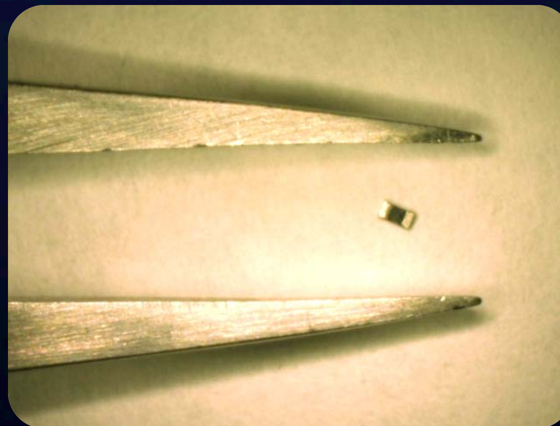
Small Passive Components

- Passives take up significant percentage of board space.
  - *Smaller passives have been facilitator of size reduction in the past.*
- Passives are about as small as they can get
  - *Smallest readily available passives are 0201 size*
  - *Approximately 20 mil length x 10 mil width x 9 mil height*



Tweezers and 0402 size resistor

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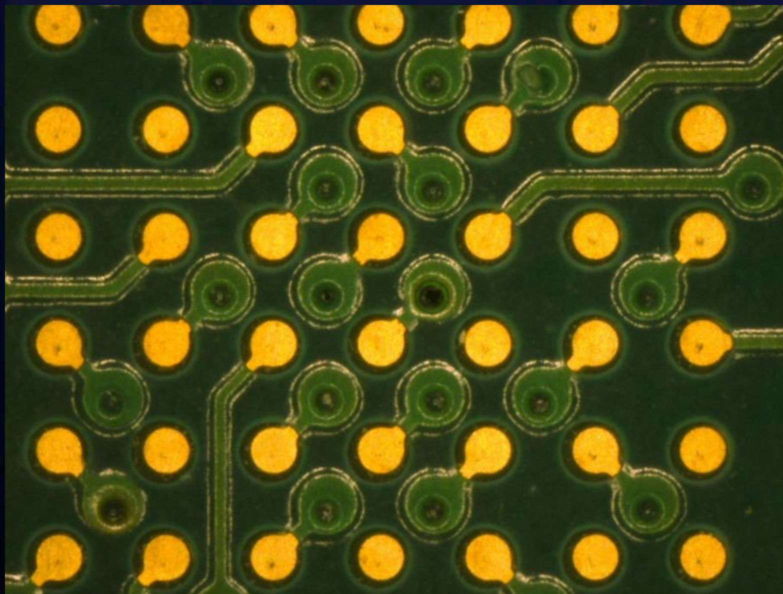
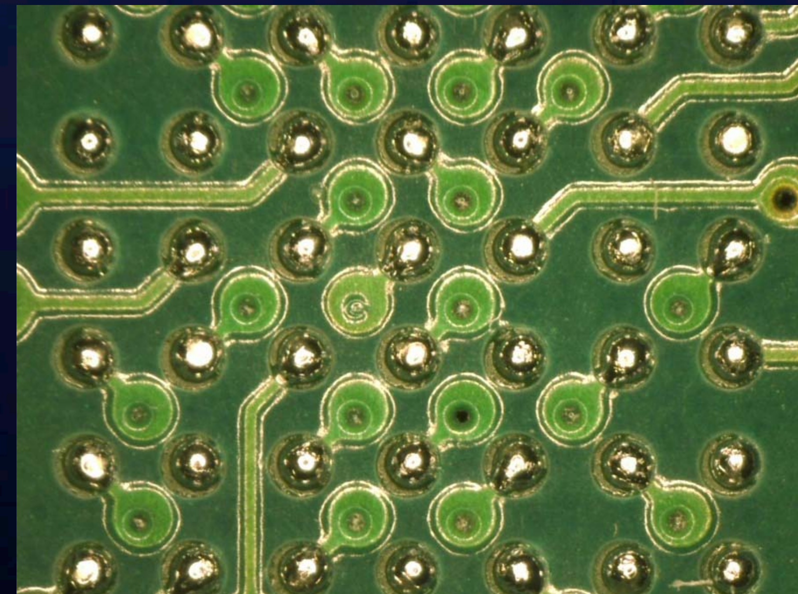
Printed Circuit Board Finish

- ENIG boards offer very flat surface
  - *Flat surface required to reliably solder small components*
  - *Left: ENIG (electroless nickel immersion gold)*
  - *Right: HASL (hot-air solder level)*





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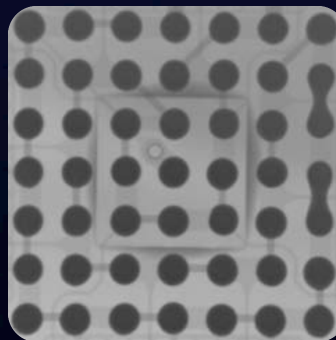
Useful Equipment

- Surface mount assembly line
  - *Solder paste masking*
  - *Pick & place*
  - *Reflow oven*

- Semi-automated re-work equipment
  - *Camera assisted part placement*
  - *Localized IR reflow*

- X-Ray BGA Inspection



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Enabling Technologies

- Smaller Components
  - *Ball Grid Array (BGA) IC packages*
  - *Surface-mount transformers*
  - *Very small passive components*
- ENIG Printed Circuit Boards
  - *Electroless Nickel Immersion Gold*
  - *Flatter surface required for small components*
- Automated assembly equipment
  - *Higher reliability assembly for small components*

} Commercial industry driven

- Fuze-specific component integration
  - *Fire cap with integrated bleed resistors*

} Fuze industry driven

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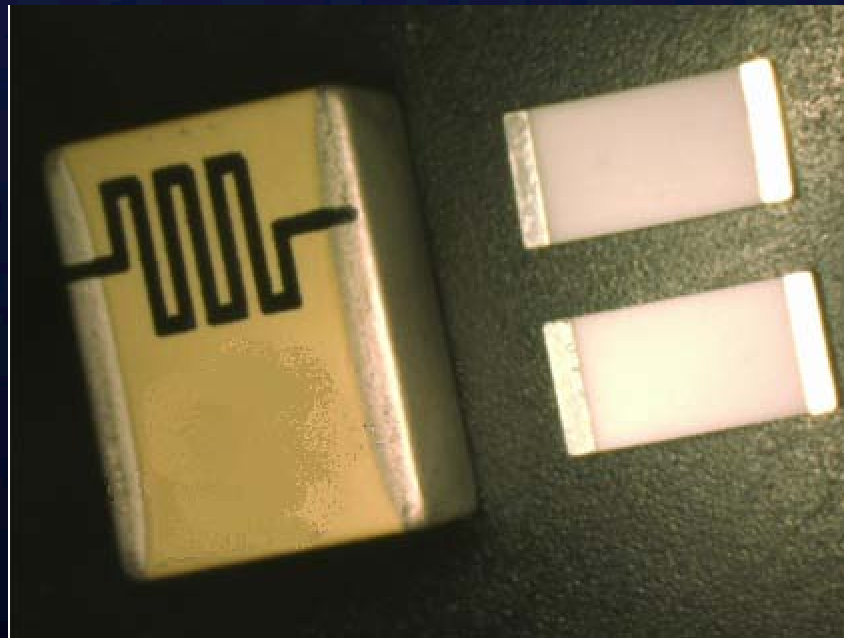
Fuze-Specific Component Integration

- Capacitor with integrated bleed resistors
  - *Approximately 50% of the area of a layout with discrete bleed resistors*
  - *Equivalent bleed resistors shown at right*



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Fuze-Specific Component Integration

- This is where future space savings will be realized

Large Components	Integrated?
Bleed Resistors	✓
High voltage capacitor	✓
Fire Switch	
Safety Logic	
Voltage Regulators	
Transformer	
Small Passive Components	
Environment Sensors	

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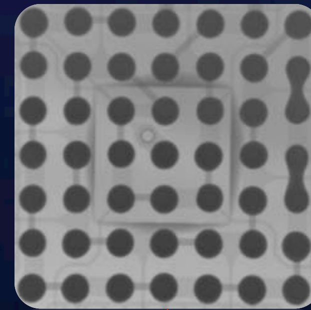
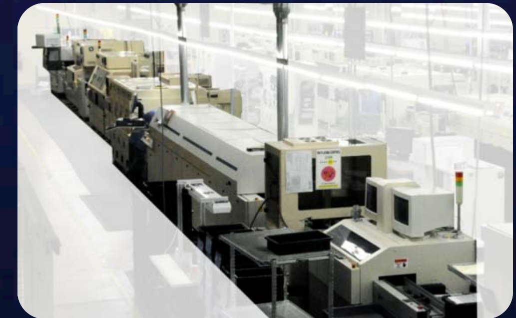
L-3 FOS Capabilities

- L-3 FOS has invested in necessary equipment and has the experience needed to produce state-of-the-art miniature ESADs





Two miniature ESADs in development/DVT

X-Ray BGA solder inspection

Surface-mount prototyping & assembly

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