Miniaturized Electronic Safe & Arm Device Development

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This presentation consists of L-3 Corporation general capabilities information that does not contain controlled technical data as defined within the International Traffic in Arms (ITAR) Part 120.10 or Export Administration Regulations (EAR) Part 734.7-11.
Agenda

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

• Customer Requirements
• Armed UAVs
• Better safety features for handheld weapons
• Further proliferation of ESADs into new areas
First ESAD (ATACMS)

- Volume: ~56 cubic inches
Typical 3” Bomb Fuze

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

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

- Volume: 1.16 cubic inches
- 98 % smaller than ATACMS
- 97 % smaller than 3" bomb fuze
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 fusing applications

- Aggressive fuzing specific component integration needed to further drive down ESAD size.

The information in this presentation is of general capabilities and open for public release.
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)
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

• Fuze-specific component integration
  – Fire cap with integrated bleed resistors

Commercial industry driven

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

Source: NOVACAP
Fuze-Specific Component Integration

• This is where future space savings will be realized

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<th>Integrated?</th>
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<td>High voltage capacitor</td>
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<td>Fire Switch</td>
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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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