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2019 Fuze Conference

Providing for Continued DSU-33D/B Viability

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DSU-33 Overview

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Doppler Radar Proximity Sensor

- Detects one factory-preset Height of Burst (HOB) and provides fire pulse signal to FMU-139 series and FMU-152 fuzes
- Compatible with M117 & Mk80-series general-purpose warheads, including JDAM variants

Performance Parameters

- Height of Burst: 14-26 feet AGL
- Operational Life: 200 sec, min
- Storage Life: 13 years
- Service Life: 5 years outside storage container
- Multiple weapon release: salvo: 6, ripple: 24

DSU-33 Weapon Configuration (Typical)

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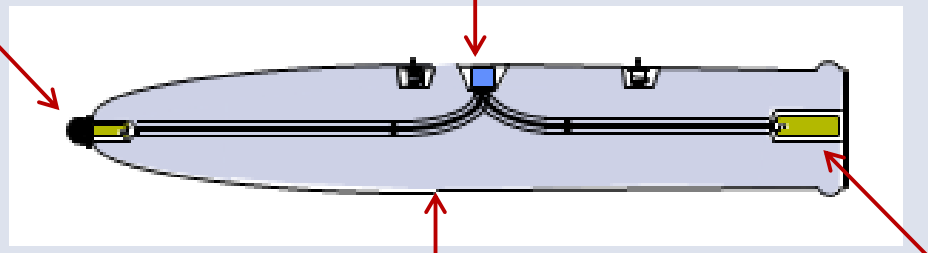
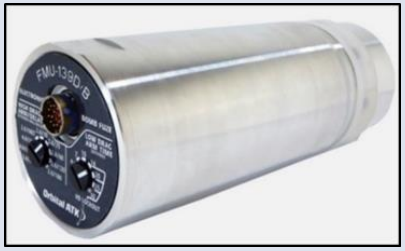
DSU-33 Sensor

FZU-48/55/63 Initiator or MK122 Switch





FMU-139 or FMU-152 Fuze

Mk-80 Series or M117 GP Bomb

DSU-33 History

- 1970's: Desire to improve performance of Mk 20/Mk 43 Target Detectors
- 1980's: Motorola develops DSU-33A/B
- 1990-1995: Motorola manufactures DSU-33A/B for USAF
- 1998: DSU-33D/B JDAM-compatible design upgrade is completed
- 2000: ATK begins DSU-33B/B production
- 2006: DSU-33C/B producibility upgrade completed & production begins
- 2008: DSU-33D/B qualified and production begins
- 2018: 200,000th DSU-33 Sensor delivered by Northrop Grumman

The Challenge: Maintaining Viability Over A Long Production Run

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- DSU-33D/B is a mature product in the sustainment phase of it's overall life cycle
  - Both the design and the manufacturing process are well understood
  - C/B and D/B are virtually identical, with > 150,000 produced since 2008
- However, over time multiple factors converge to require changes; even on a stable and successful program like DSU-33:
  - **Obsolescence:** Suppliers drop products & exit markets altogether
  - **Economics:** Increasing costs force changes to maintain profitability
  - **Failures:** A long production run will promote failure mechanisms that likely would never occur during a short program life

Examples: Obsolescence

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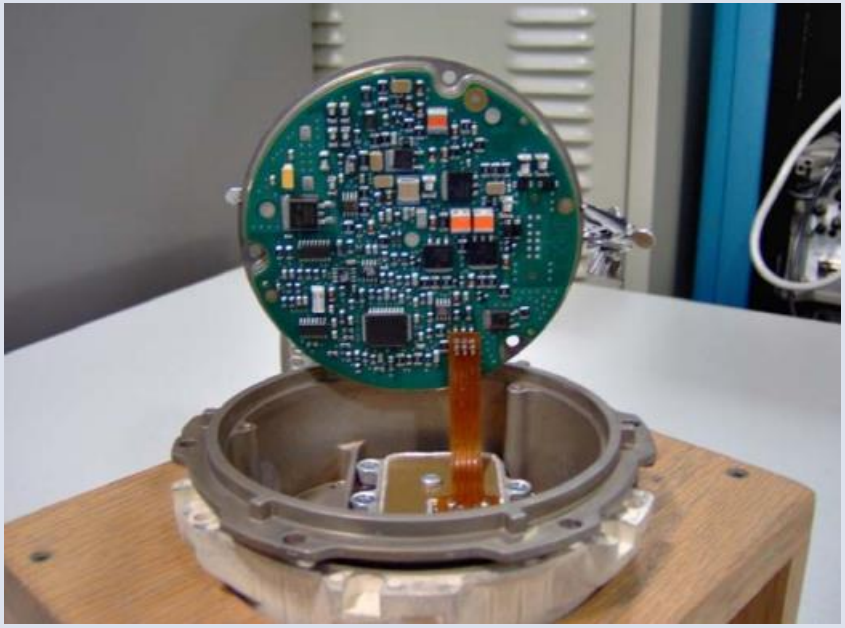
- The commercial electronics industry continues to evolve rapidly
- Specific parts become scarce or obsolete; or entire product lines are discontinued
- Situations Northrop Grumman has successfully managed include:
  - Obsolescence of 2 Transistors
  - Obsolescence of 3 Thermistors
- Mitigation strategies included:
  - Monitoring upcoming obsolescence via tools like Part Miner
  - Supplier dialogue
  - End of Life (EOL) buys
  - Selection of alternative parts
  - Qualification of alternatives via Component and Sensor-level testing, and analysis



Examples: Economics

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- Suppliers may increase pricing to the point where a legacy part no longer is affordable
- Supplier quality may deteriorate to the point where their continued use is no longer affordable (e.g. unacceptable costs of nonconformance)
- Situations Northrop Grumman has successfully managed include:
  - Desiccant capsule pricing and quality
  - Pricing of a custom Transistor
- Mitigation strategies included:
  - Selecting and qualifying a COTS Transistor
  - Developing and qualifying a custom desiccant pack (shown at right)

Examples: Failure Mitigation

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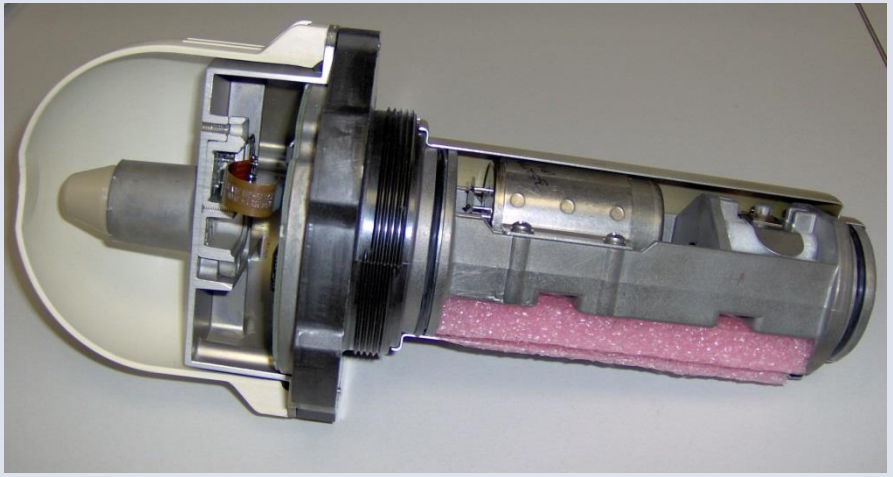
- Even the most robust product development efforts will be unable to prevent or detect all failure mechanisms
- Long production runs, involving tens or hundreds of thousands of units, inevitably introduce the “Cumulative Effect of Variation Over Time”
- Impact: End-item performance problems will arise during production. Situations Northrop Grumman has successfully managed include:
  - Fire pulse variability
  - Battery Initiation difficulties
- Mitigation strategies include:
  - Revising and clarifying requirements
  - Qualifying an improved Battery and Battery Igniter
  - Screening & binning key components to improve production test yields



Keys to Success

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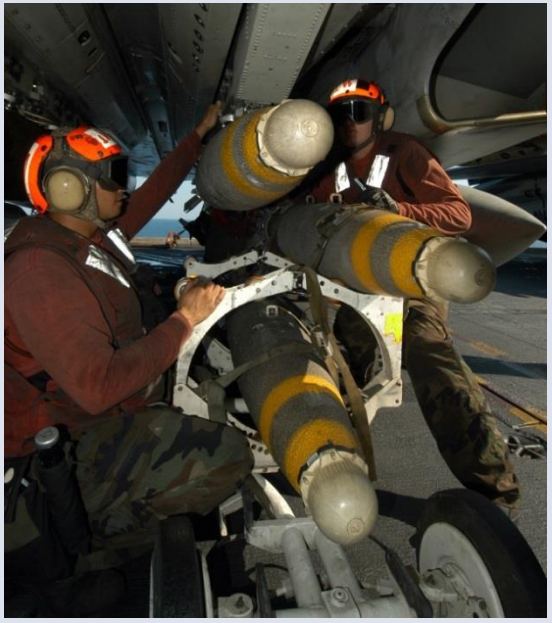
- **Product Knowledge:** As the Government's industry partner during development and high-rate production of the last 3 DSU models, we understand the Sensor
  - Northrop Grumman has the full-service capability to resolve any issue
- **Program Continuity:**
  - DSU-33 production has been essentially continuous for almost 19 years
  - DSU-33 Support Team staffing has been managed carefully to ensure success
- **Customer Support:**
  - DSU-33 has always had a strong Government/Contractor IPT
  - Ongoing cooperation from the USAF (EAFB and HAFB), Army, and Navy has enabled success
  - Frank and open communication has fostered partnership and trust



The Future for DSU-33D/B

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- The program is in the final year of the current U.S. Government FRP4 contract:
  - Deliveries to the USG will conclude in 2020
- International interest remains high, resulting in high likelihood of ongoing commercial sales
- A contingency requiring a future U.S. procurement is possible
- For these reasons, Northrop Grumman is working closely with the Government to ensure that the DSU-33D/B Technical Data Package (TDP) remains up-to-date and viable to support ongoing production
- The DSU-33 production line, Support Team, and experienced supplier base will remain in place for the foreseeable future

Summary

- DSU-33 has been one of the most successful air weapon fuzing/sensor programs in the last 40 years
- The program has been successful because of its maturity, supported by ongoing engineering and TDP updates
- Northrop Grumman remains committed to maintaining the capability of the DSU-33D/B to support ongoing customer requirements
- DSU-33 will remain a viable proximity sensor solution for many years
- Thank you!

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