FMU-139C/B Electronic Bomb Fuze Design Update

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David Liberatore
ATK Tactical Systems
(304)726-7587

50th Annual
NDIA Fuze Conference
Norfolk, VA

Agenda

An advanced weapon and space systems company

FMU-139 Description

FMU-139 Background

ATK FMU-139B/B History

FMU-139C/B Design

- Requirements
- Design Approach
- Results
- Status

Questions?

FMU-139 Description

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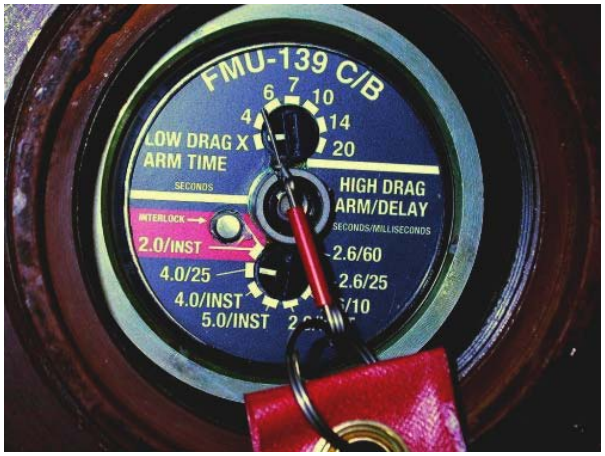
General-Purpose, Electro-Mechanical Bomb Fuze

- Joint-service fuze (NAVAIR PMA-201 is lead service)
- Used with M117 and MK80 GP warheads, incl. JDAM and Paveway
- Out-of-line, rotor-based safing and arming



Versatile, Multi-Mode Performance

- Selectable arm times: 2 to 20 seconds
- Impact, proximity, or delay detonation settings
- Powered by FZU-48 Initiator (USAF) or FFCS energy burst (USN)
- Offers limited cockpit programmability in FFCS mode
- Capable of high or low drag delivery; auto-detects drag conditions

FMU-139 Description (cont'd)

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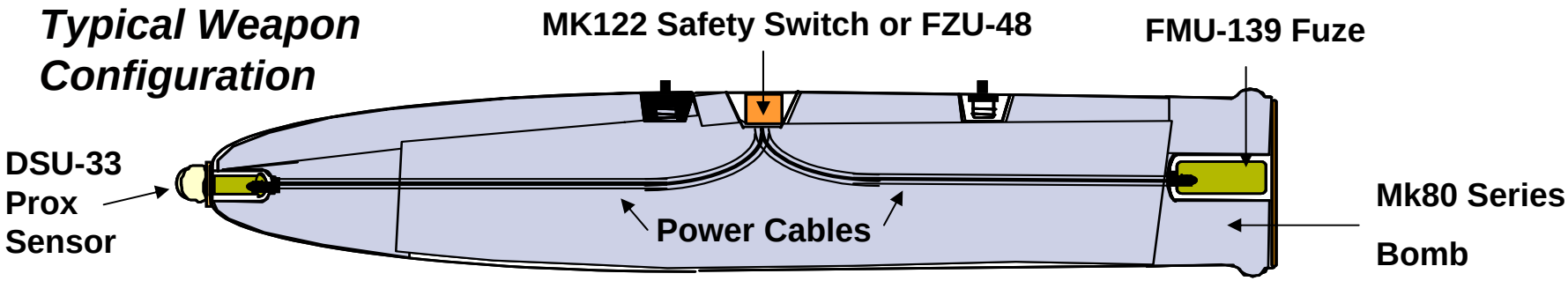
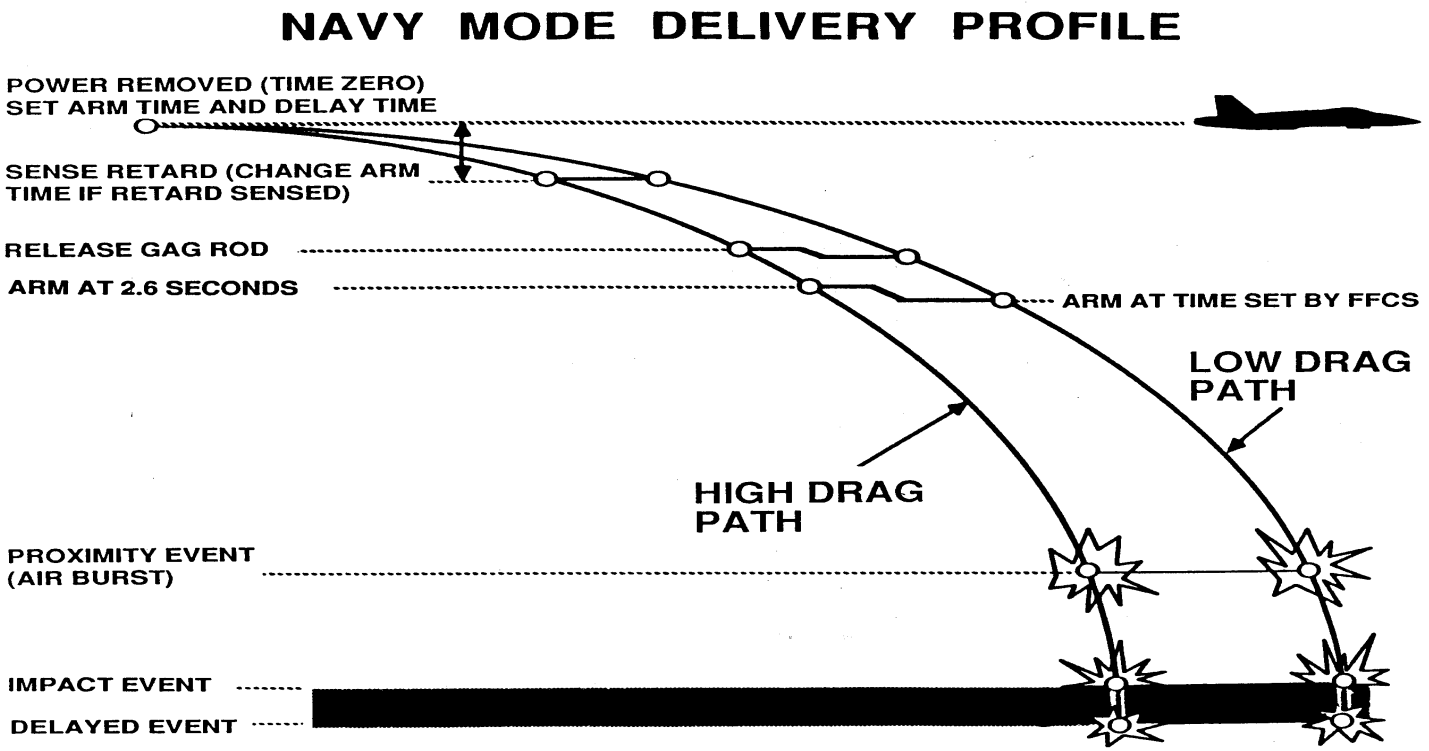
Typical Weapon Configuration





FMU-139 Background

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FMU-139/B development completed in 1980's by USN/Motorola

- **One of the first fuzes to utilize a microprocessor**

Over 800,000 FMU-139A/B fuzes produced through 1995 by Motorola

USN developed FMU-139B/B in 2000 and upgraded its inventory:

- **Improved IM: Replaced CH-6 Booster with PBXN-7**
- **Improved ESD Protection: Added Transient Voltage Suppression**

ATK acquired Motorola fuzing design and production assets in 1998

FMU-139: Supporting Freedom for More Than 20 Years!

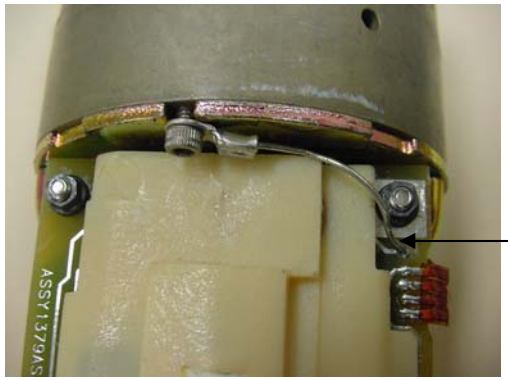
ATK FMU-139B/B History

An international market for FMU-139 existed but:

- **FMU-139A/B no longer producible - component obsolescence**
- **USN issued an FMU-139B/B performance specification**

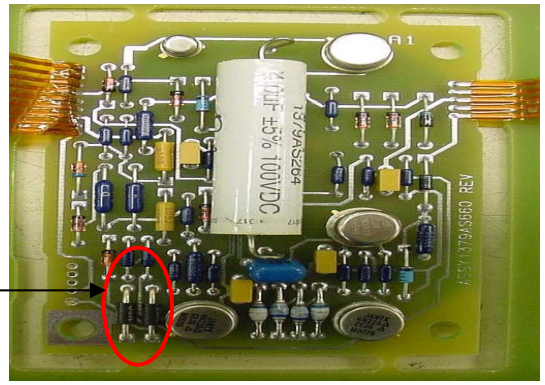
ATK Approach - retain proven design but address obsolescence:

- **Replaced COP4 microprocessor with COP8; rewrote software**
- **Replaced timing crystal, firing circuit thyristors, encapsulant**
- **Also incorporated USN FMU-139B/B IM and ESD improvements**



USN FMU-139B/B

ATK B/B incorporated Transient Voltage Suppression (TVS) components into main circuit board



ATK FMU-139B/B

ATK FMU-139B/B History (cont'd)

Navy design oversight and approval was required to assure safety, reliability, and interoperability:

- **Utilized a Commercial Services Agreement (CSA) with USN**
- **Design certification and safety approvals granted 2001 & 2002**

Passed software FQT and First Article Testing in 2001

Over 9,000 fuzes were delivered to several allied nations 2002 – 2004

USN oversight continued during international production via CSA

HP3070
CCA Tester

Performance assured by electronic testing at both board level and fuze level

EDT 4
Fuze Tester

FMU-139C/B Requirements

New mission scenarios required longer time of operation in pulsed power (Navy FFCS) mode:

- **Increased mission life from 1 to 4 minutes**
- **Increased inrush current from 80 to 135 mA**

Improved safety required resolution of two legacy concerns:

- **Ensure microprocessor reset at power-up to preclude early enable (firing of piston actuator)**
- **Prevent out-of-sequence firing of Bellows Motor (at or before PA fire)**

FMU-139C/B Design Approach

Continued spiral improvement to the proven FMU-139 family

Hardware Highlights:

- **Increase energy storage capacitance by 125%**
- **Use precision reference diodes (stabistors) for superior control**
- **Re-layout Printed Wiring Board**
- **Revise Gag Flex to short Bellows until cut by Gag Rod at enable**
- **Minimize changes – 7 new parts, 6 deletes, 16 value changes = 29 total**

Software Highlights:

- **Improve energy management**
- **Split initial firing capacitor charge into 2 phases**
- **Reduce firing capacitor refresh rate**

Risk Mitigation Highlights:

- **Perform Design Verification Testing (DVT) early**
- **Perform 20-unit Confidence Build after CDR**

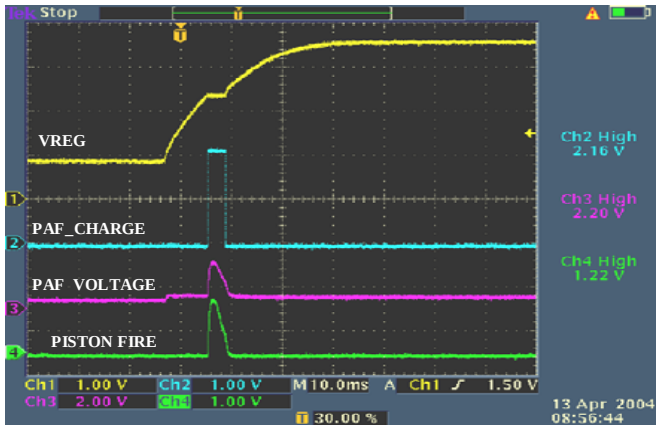
FMU-139C/B Results

Lifetime Requirement Met with Robust Margin!

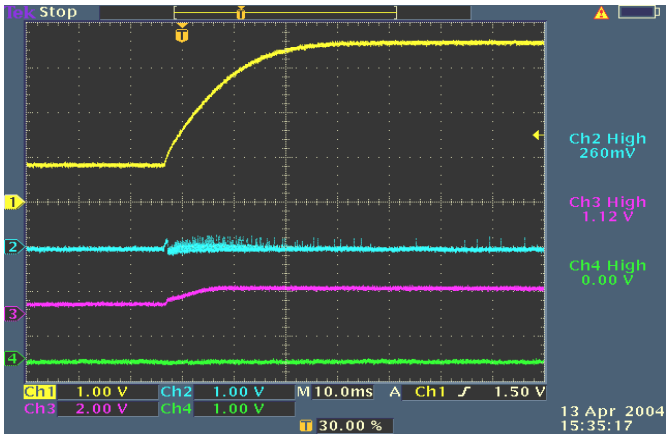
- Requirement = 240 sec, minimum
- Demonstrated = 330 sec (ambient), 300 sec (cold), 290 sec (hot)
- Max current draw of 135 mA met = 128 mA max observed

Safety Improved!

- Revised Gag Flex shorts Bellows until enable completed
- Reset Circuit improved to prevent early PA fire at power-up



Before – Note Enable at Power Up



After Reset Circuit Improvements

FMU-139C/B Status

Build of First Article fuzes has been completed

First Article Testing currently in progress and will complete in June

- **FAT must demonstrate 95% reliability at 90% confidence**

Required safety presentations have been made to the Navy Technical Review Panels – Fuze Initiation (FISTRP) and System Software (SSSTRP)

Initial Production delivery planned for September

FMU-139C/B Wrapup

- ✓ **Proven, legacy design fully understood**
- ✓ **New customer requirements fully understood**
- ✓ **Changes kept to a minimum**
- ✓ **Extensive testing performed**

RESULT: FMU-139C/B is on track!

The FMU-139 Fuze will continue to support freedom for years to come.....

ANY QUESTIONS??

Contact Information:

Dave Liberatore

ATK Tactical Systems

(304)726-7587

dave.liberatore@atk.com

THANK YOU!