FMU-139C/B Electronic Bomb Fuze Design Update

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Agenda

FMU-139 Description

FMU-139 Background

ATK FMU-139B/B History

FMU-139C/B Design

- Requirements
- Design Approach
- Results
- Status

Questions?

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FMU-139 Description

An advanced weapon and space systems company

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)

Typical Weapon Configuration

- MK122 Safety Switch or FZU-48
- FMU-139 Fuze
- DSU-33 Prox Sensor
- Power Cables
- Mk80 Series Bomb

NAVY MODE DELIVERY PROFILE

- POWER REMOVED (TIME ZERO)
- SET ARM TIME AND DELAY TIME
- SENSE RETARD (CHANGE ARM TIME IF RETARD SENSED)
- RELEASE GAG ROD
- ARM AT 2.6 SECONDS
- ARM AT TIME SET BY FFCS
- LOW DRAG PATH
- PROXIMITY EVENT (AIR BURST)
- HIGH DRAG PATH
- IMPACT EVENT
- DELAYED EVENT

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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
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
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
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)
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??

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THANK YOU!

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