Adding an Electronic Self Destruct Mode to the M230 Fuze

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Briefing Outline

- Program Objective
- Background on existing M230 Ground Impact Fuze and M261 Hydra Rocket
- Design of M230 Fuze with electronic self-destruct
- Future plans
Project Objective

- As part of the D862 Fuze Technology Integration program to upgrade existing fuze designs, the Fuze Division initiated an in-house design effort to incorporate an electronic self-destruct mode into the M230 rocket submunition fuze.

- Program Goals
  - Improved reliability of training ammo - Reduced Duds
  - Existing fuze reliability 95% (5% dud rate)
  - Goal of SD fuze - meet OSD policy of <1% unexploded ordinance on the battlefield
M261 HE MPSM Warhead

- Part of the Hydra 2.75 rocket system
  - Fired by Apache and Cobra Helicopters
- Effective against Light Armor, Materiel, and Personnel.
- Main Fuze - M439 Remote Set Time Fuze
- Contains 9 M73 submunitions
- Each submunition fuzed by a M230 fuze
The M230 fuze combines a Ram Air Decelerator (RAD) and a bore rider/slider combination.
Basic M230 fuze
Sequence of Operation

- Upon expulsion from the warhead the bore rider safety is removed.
- The air stream forces deployment of the RAD, breaking the shear wire and retracting the arming pin. Retraction of the arming pin unlocks the slider.
- The arming spring pushes the slider to the armed position with the escapement providing safe separation.
- When the slider is in the fully armed position the trigger is unlocked.
- Upon impact the trigger releases the detent ball. The firing pin is now free to move.
- The spring force of the firing pin causes the firing pin to impinge upon the M55 detonator initiating the explosive train.
M230 fuze with self-destruct

- Two independent functioning modes
  - **Primary mode** – Operates in the same manner as the existing M230 fuze - same safe and arm mechanism and impact mode switch. The fuze arms after expulsion and the M55 detonator initiates the explosive train & grenade at impact.

  *If the primary mode fails, then*

  - **Secondary SD mode** - Operates independent from arming. The electronic circuit & power source fire an electric detonator at a fixed time after expulsion. The electric detonator output initiates the primary mode’s M55 detonator. If the fuze is armed the warhead functions (*self destruct*) – if the fuze is not armed the sensitive detonators are eliminated (*self neutralization*).
M230 SD Sequence of Operation

**SD Mode**
- Initiate Battery
- Battery comes up to voltage
- PIC-micro begins charging sequence
- Charge firing capacitor

**Primary Mode**
- RAD deploys breaking shear wire and unlocking slider
- Spring pushes slider to armed position
- M55 detonator aligns with lead explosive
- **Ground impact – primary M230 impact fuze functions or**
  - SD Circuit sets off M100 detonator

IF SD and primary modes fail, timer turns off and bleed down circuit discharges electrical power
Concept for M230 Fuze with Electronic Self-Destruct Feature

- Battery & Activation Mechanism
- SD Timer Circuit
- Slider
- Housing
- Escapement
- Incorporates a reserve battery, timer circuit, and M100 detonator into basic M230 fuze

Adds a totally independent self destruct mode
Modifications to the M230 Fuze to Incorporate the Self-Destruct Mode

- Modified the housing to move the gear train and make volume for electronics
- Modified the slider to add an M100 detonator for SD functioning and relocated the gear teeth
- No changes to the impact switch, RAD, firing pin, or the fuze booster plate
- Minor modifications to the bottom plate of the gear train assembly
Housing with slider and gear train

M230 Fuze

M230 Fuze w/ SD
Relocation of Gear Teeth

M230 fuze

M230 SD fuze
Location of SD electronics

Cavity for reserve battery and activation mechanism

Self-destruct circuitry

Impact switch parts not shown

M230 Fuze w/ SD Circuitry
Electronic Design

- Utilizes PIC micro-controller to perform timing functions, and operate 2x charge pump
  - Low power consumption
  - On board nonvolatile memory
  - Small size - 8 pin SOIC package
  - On board flash memory can be used to “tag” ckt & prevent multiple power ups from operating the circuit in dud fuzes

- Battery bleed circuit in case M100 detonator fails to function
Electronic Circuit Schematic

- PIC-micro
- Bleed down
- RC Oscillator
  Frequency = 30KHz
- Firing Circuit

Components:
- R1: 1M
- C1: 0.001uF
- R2: 15k
- R3: 1k
- C2: 0.002uF
- PIC: 12087
- C3: 0.001uF
- R4: 22M
- M100
- HEXFET
- R5: 1k
- C4: 6.8uF
- C5: 6.8uF
- R6: 1k
- Vss

Power Supply: 3.47V
Software Flowchart

1. Power Apply
2. Set flag in EEPROM
3. Call 4 Sec. Delay
4. Turn On Voltage Doublers
5. Call EEPROM
6. YES to Exit
7. Assembly Language Code Generated and Debugged
8. NO to Call 1 Min Delay
9. Call 1 Min Delay
10. Fire DET
11. Turn On Bleed Circuit
Power Source Options

- Reserve battery to activate on expulsion
- Key Requirements:
  - Electrical: 3-5 volts @ 150 μA Typical
  - Active life: Less than 2 minutes required
  - Storage life: 10 years min
- Candidates examined
  - Reserve battery in M234 fuze
    - Miniature size, performed well in lab tests with the circuit production line being setup
  - Prototype OICW battery supplied by ATK
    - Larger size may enhance producibility
    - Can fit into M230 design but smaller size desirable
  - Lab Tests planned
**Lab Tests – Circuit Output**

*Vmax = 7.469 V*

**Typical Charging Chart of Circuit Output**

- Produces 3700 Ergs
- Draws less than 100μA
- Time to detonation

![Graph](image-url)
M100 Firing Voltage Test

Used the Langlie Method to test 35 M100 detonators to determine “All-fire” and “No-fire” Voltages.


det

“All-Fire” = 4.5V

“No-Fire” = 1.8V

SD Circuit produces > 6 volts and exceeds detonator all-fire voltage by a large margin!
Lab Tests with M234 Battery

Charging Curve of SD circuit with M234 reserve battery

- Firing Cap begins to charge
- Firing Cap reaches max voltage
- Detonation

Note: Test performed at ~45F
Future Plans

- Complete design
- Fabricate prototypes
- Perform rocket tests with prototypes