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

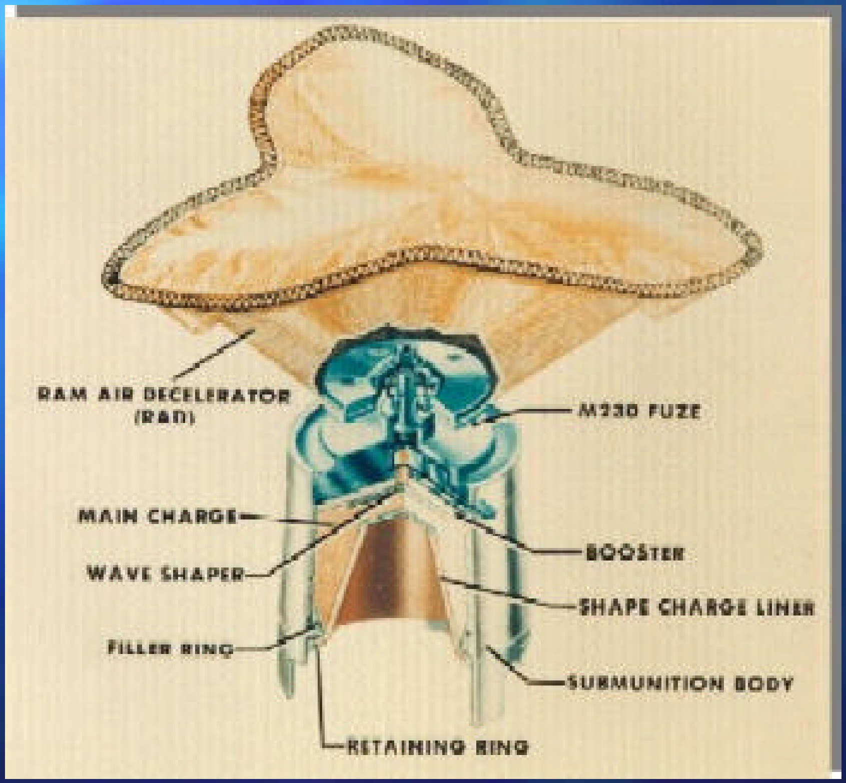
- As part of the D862 Fuze Technology Integration program to upgrade existing fuze designs, the Fuze Division initiated an in-house design effort to incorporate an electronic self-destruct mode into the M230 rocket submunition fuze.
- Program Goals
  - Improved reliability of training ammo - Reduced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

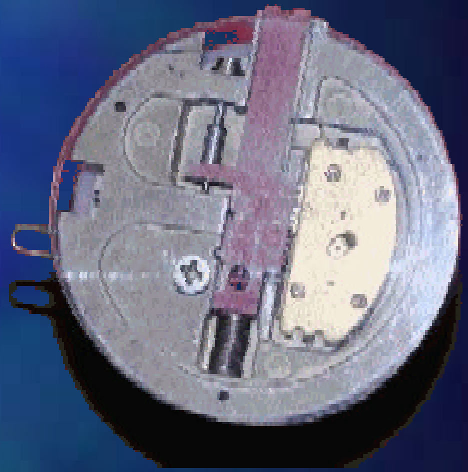
Basic M230 Fuze Operation

- 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

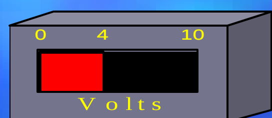
Rocket Expulsion

SD Mode

Initiate Battery

↓

Battery comes up to voltage



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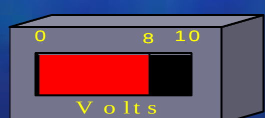
PIC-micro begins charging sequence

↓

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

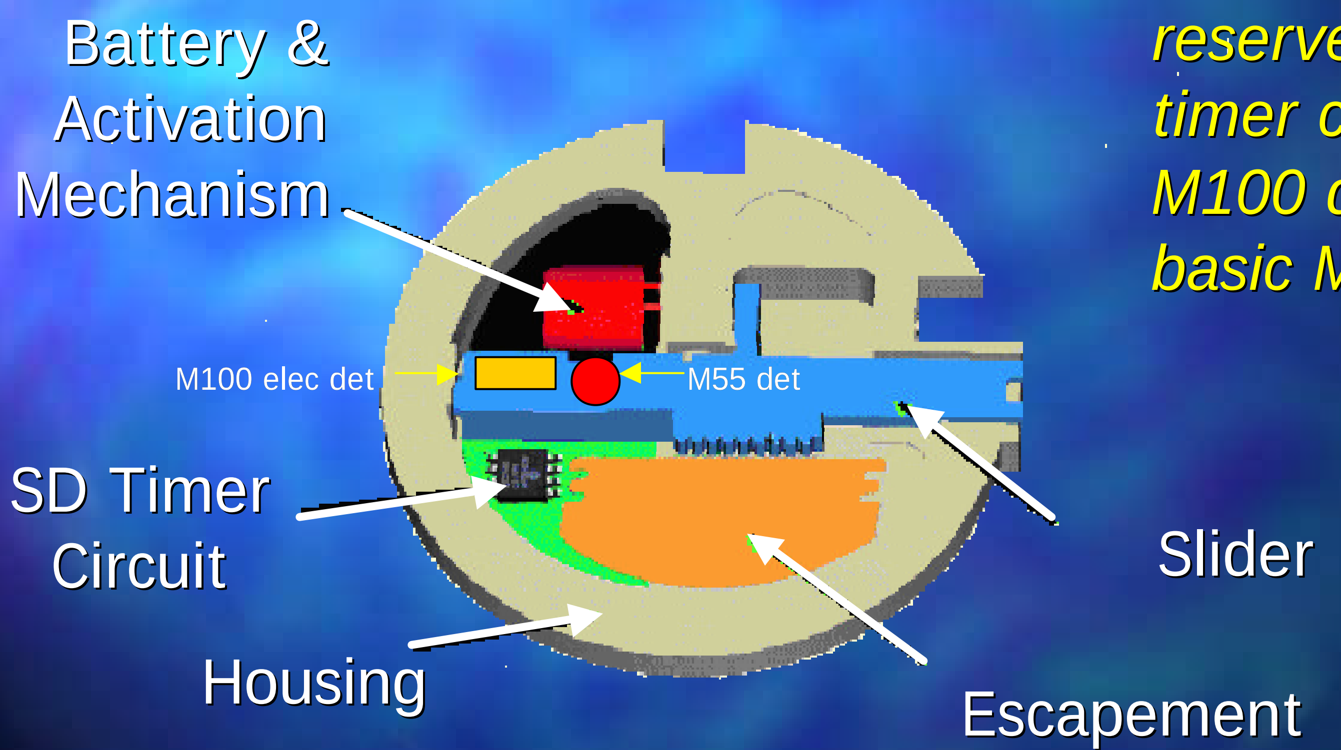
↓

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



Incorporates a reserve battery, timer circuit, and M100 detonator into basic M230 fuze

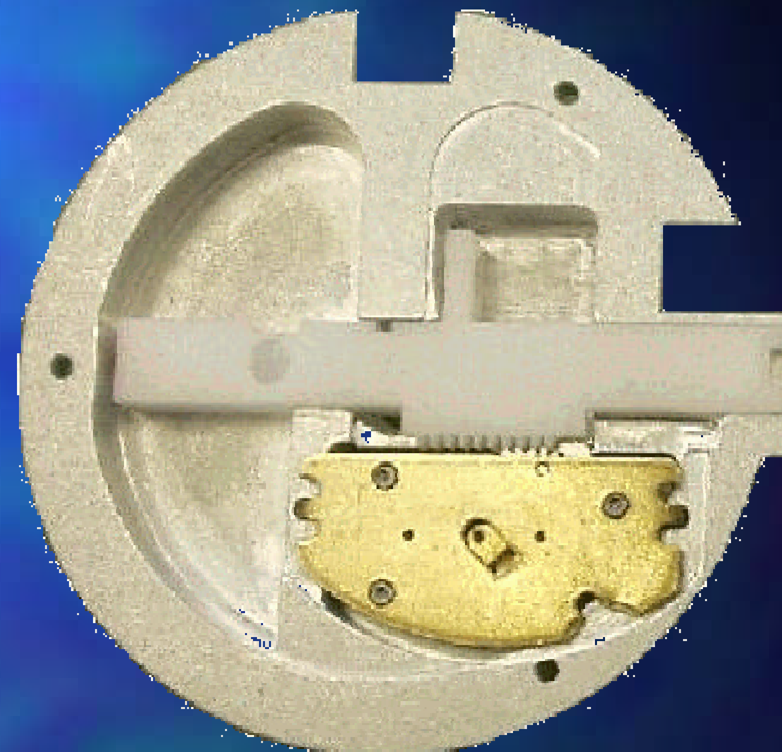
Adds a totally independent self destruct mode

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

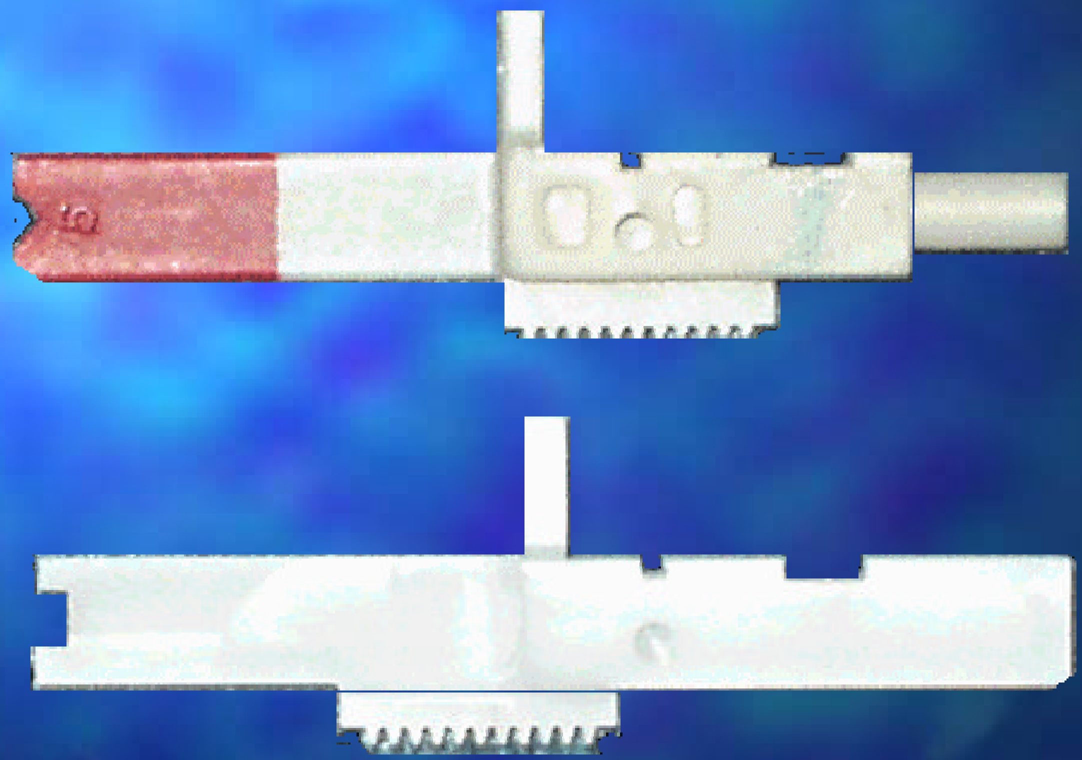
M230 Fuze



M230 Fuze w/ SD

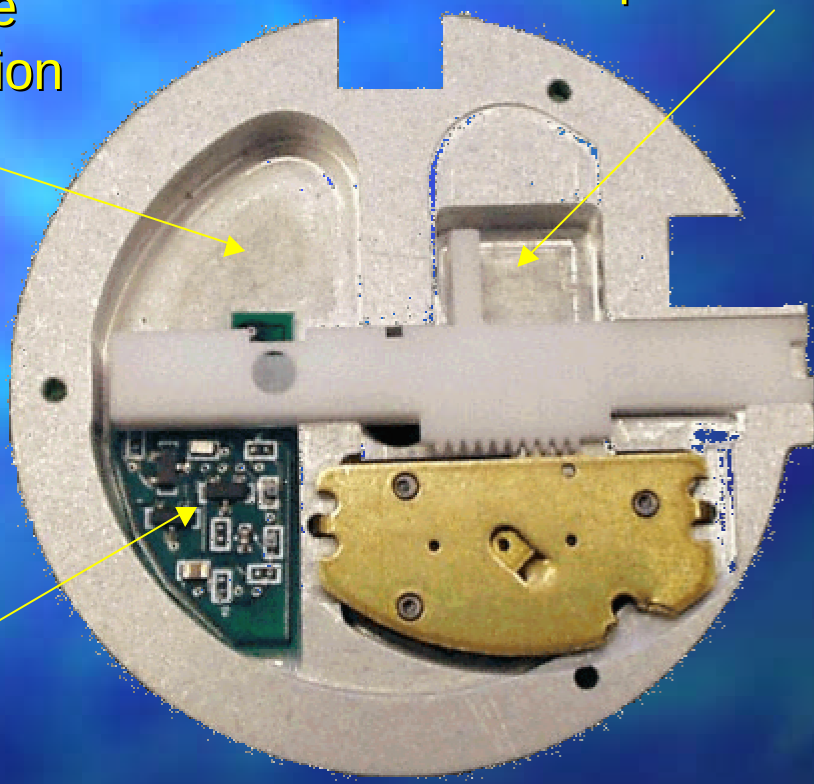
Relocation of Gear Teeth

M230 fuze



M230 SD fuze

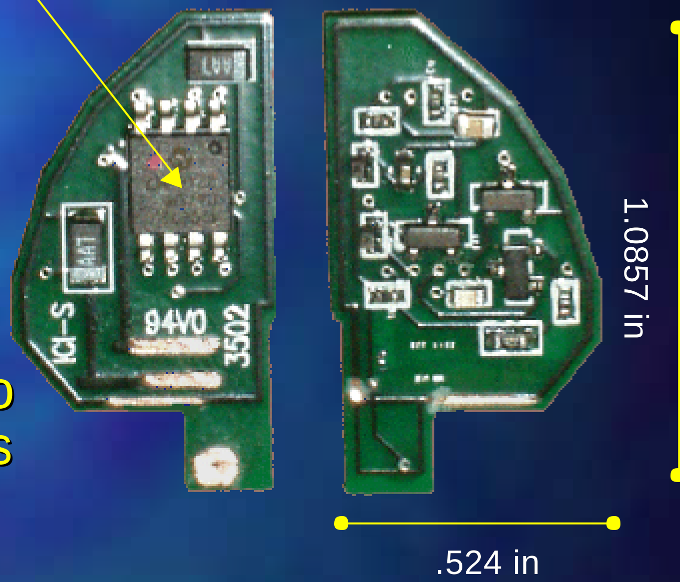
Location of SD electronics



M230 Fuze w/ SD Circuitry

Electronic Design

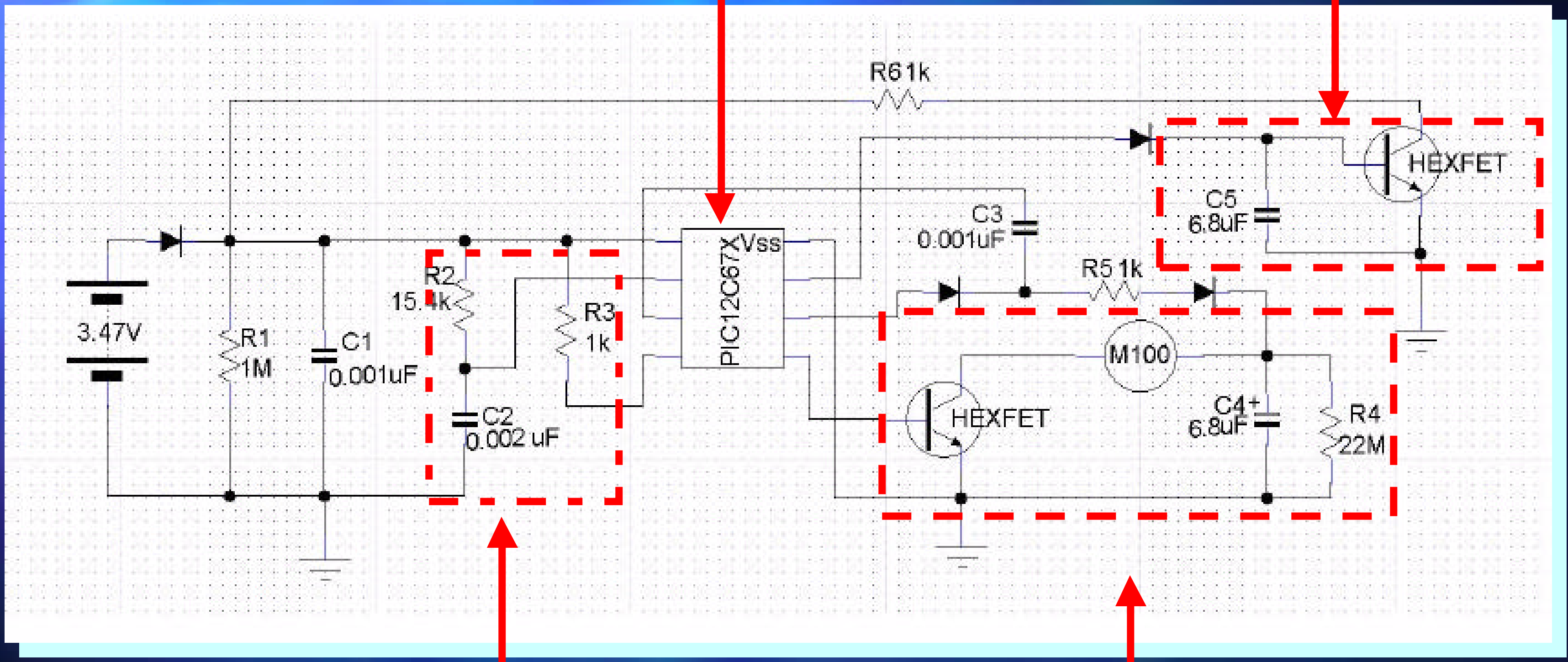
- Utilizes PIC micro-controller to perform timing functions, and operate 2x charge pump
  - Low power consumption
  - On board nonvolatile memory
  - Small size - 8 pin SOIC package
  - On board flash memory can be used to "tag" ckt & prevent multiple power ups from operating the circuit in dud fuzes
- Battery bleed circuit in case M100 detonator fails to function



Electronic Circuit Schematic

PIC-micro

Bleed down

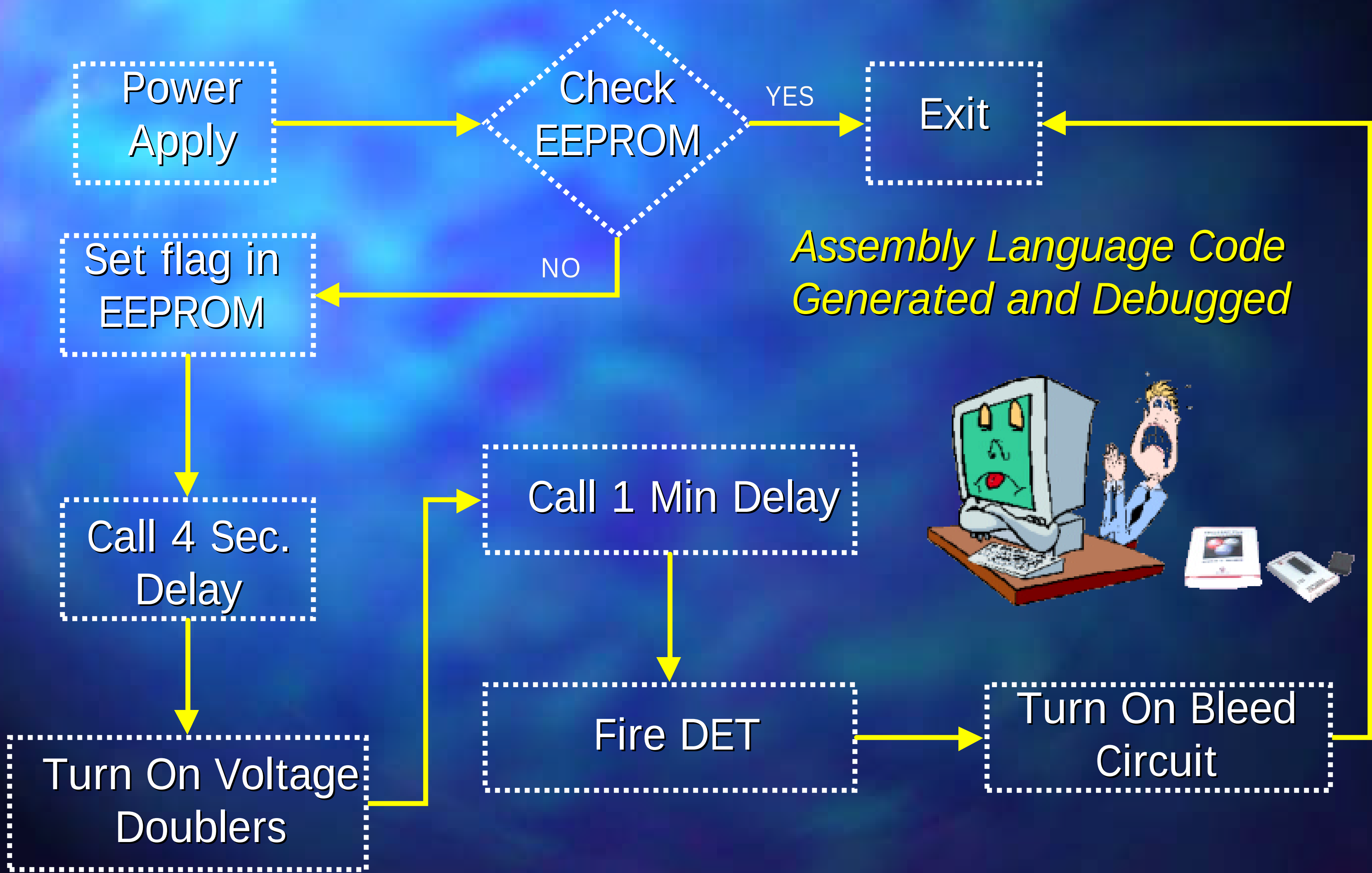


RC Oscillator

Frequency = 30KHz

Firing Circuit

Software Flowchart



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

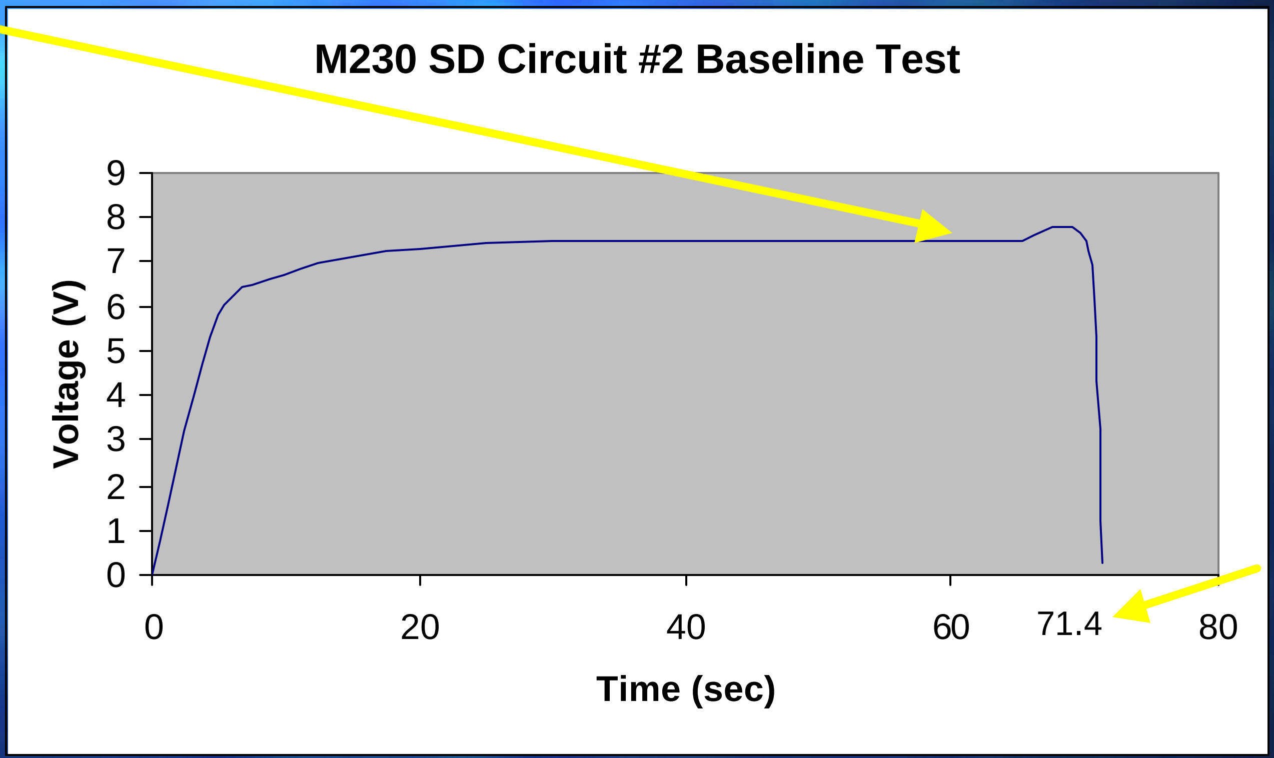
Lab Tests – Circuit Output

Vmax = 7.469 V

Produces

3700

Ergs



Draws

less than

100µA

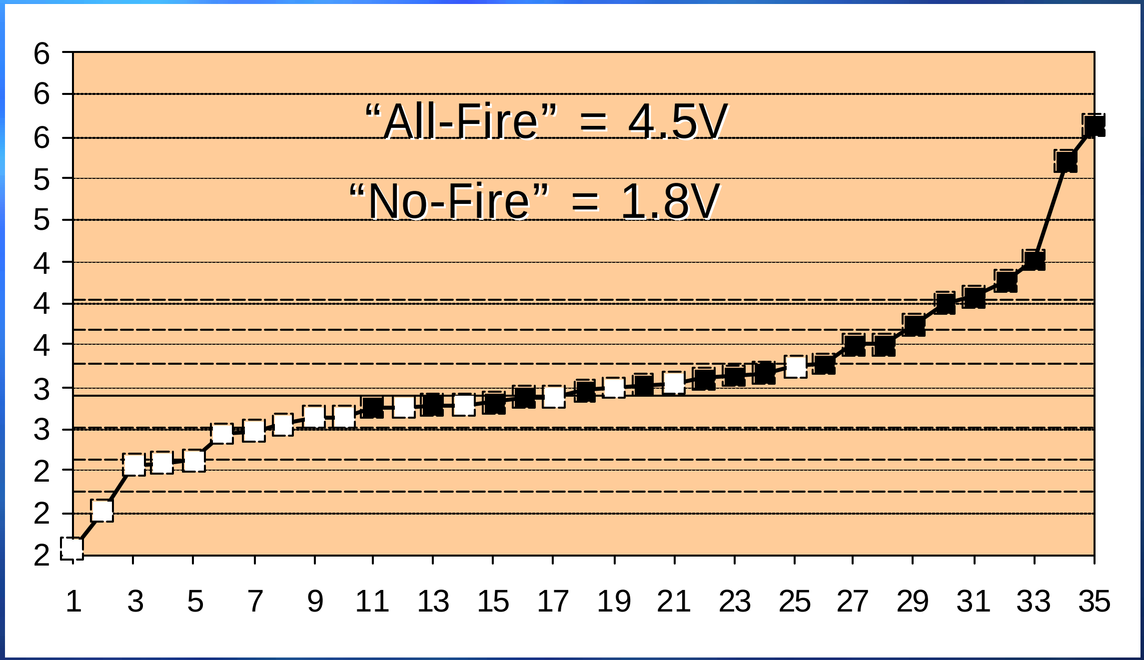
Time to
detonation

Typical Charging Chart of
Circuit Output

M100 Firing Voltage Test

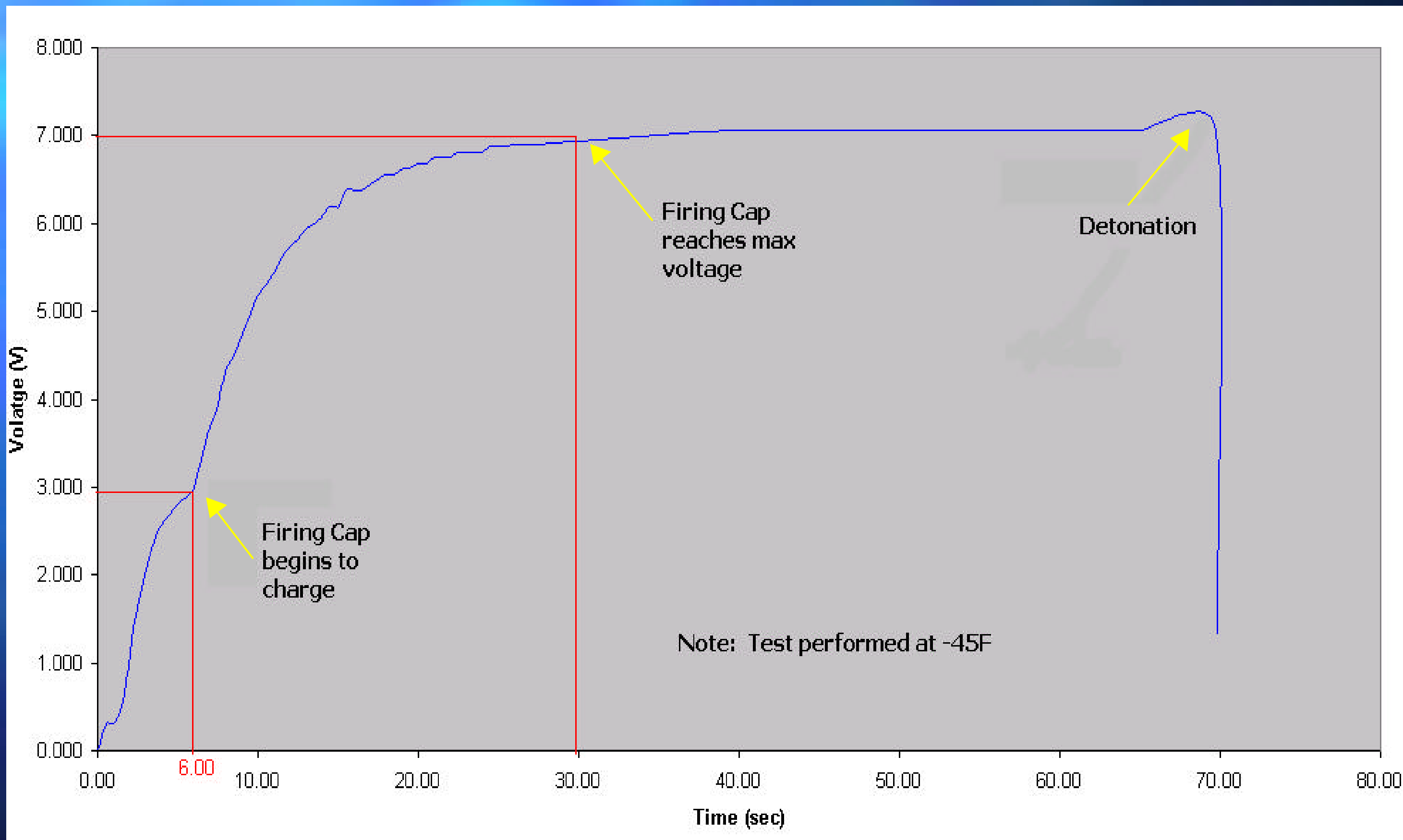
Used the Langlie Method to test 35 M100

detonators to determine "All-fire" and "No-fire" Voltages



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

Future Plans

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