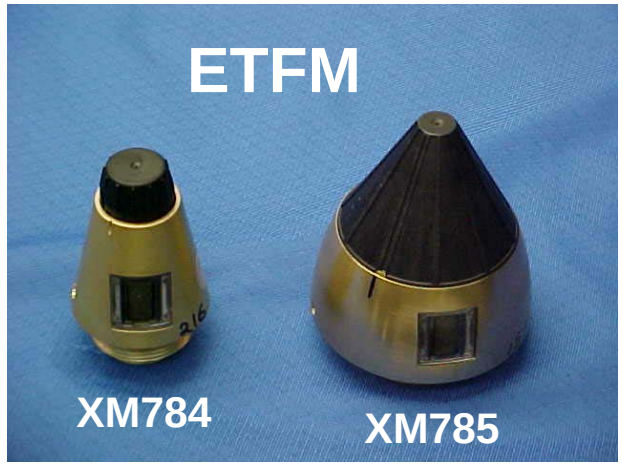
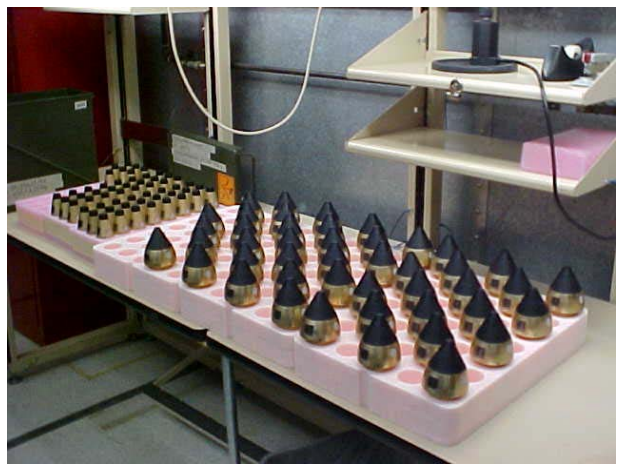
XM784 and XM785
Electronic Time Fuze for Mortars (ETFM)

XM784/XM785 ETFM
Development Program
28 April 2004





OPM-CAS Project Officer: Kwok Cheung (PM-CAS)

Fuze IPT Leader: Anthony Pergolizzi (ARDEC)

Fuze Technical Lead: Dennis Ward (ARDEC)

Contractor Project Manager: Marty Davis (ATK)

Alliant Techsystems has patents related to munitions hardware including patent number 5,693,906 which applies to the safe and arm mechanism and patent number 5,914,469 which applies to the snap dome switch in fuze applications.

ETFM Program Evolution

- **No US Fielded ET Fuze for Mortars Exists**
  - US Requirements Filled By Foreign Source:

    M776 / M772 Diehl/Junghans (Germany)

    Under Waiver From US Safety Standards

- **User Persistently Indicated Need For a US ET Fuze (Since Mid ’80’s)**

- **No NDI Design Solution Exists**
  - Foreign Comparative Studies
  - Engineering Studies
  - Contractor Studies

ETFM Program Objective

The next generation Mortar Time Fuze

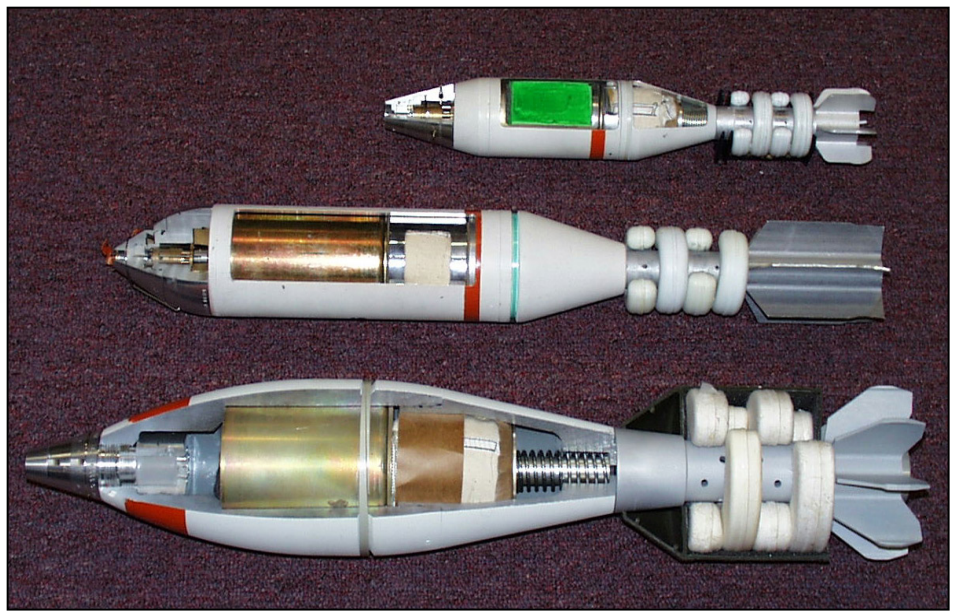
Develop mortar electronic time fuzes to replace the mechanical time fuzes (M776 & M772) currently employed by the US Army on the 60 mm, 81mm and 120 mm white light & IR illumination rounds, and the 81 mm smoke round.

M776
(60mm & 120mm)

XM784

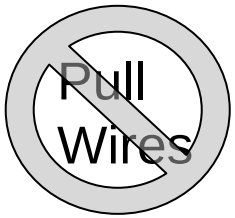
M772 (81mm)

XM785



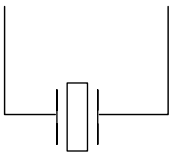
Why ETFM?

ETFM Provides:



- Elimination of pull wires w/new dual safe S&A device

- Hand Settable w/o Tools – day & night settable w/back lit LCD



163.84KHz

- Enhanced time function accuracy w/Crystal time base

- Auto set (inductive) adaptability

- Development of Growth Technologies:
  - ⇨Smooth bore 2nd enviro sensor
  - ⇨Dual micro safety architecture
  - ⇨Command-to-arm S&A

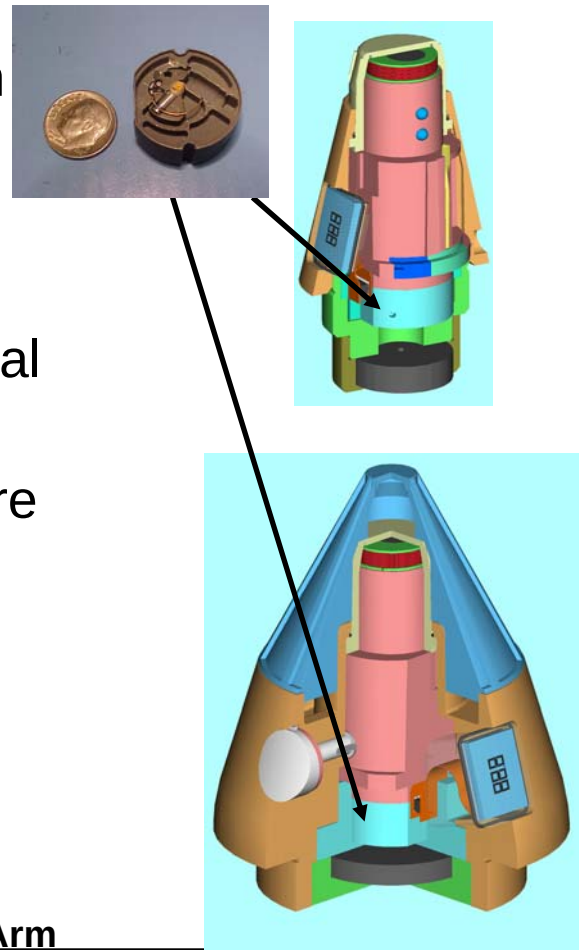
Program Approach

- **Joint Government/Contractor program IPT**
  - US Army Infantry Center (USAIC), Fort Benning
  - PEO Ammo
  - PM CAS
  - Army Fuze Management Office
  - ARDEC Fuze Division
    - -Picatinny
    - -Adelphi
  - Alliant Techsystems

- **Government Technology Studies**
- **ATK Engineering & Manufacturing Development**
  - Designed for Production
  - Production processes developed with design
  - Process control developed with process

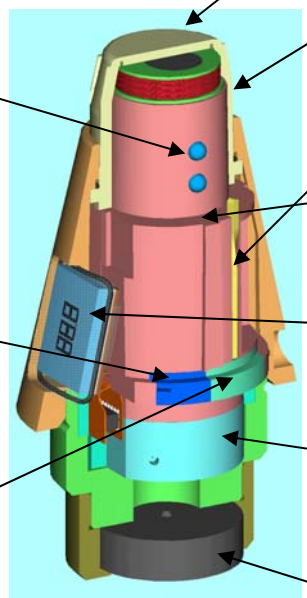
Fuze modernization with state-of-the-art technologies

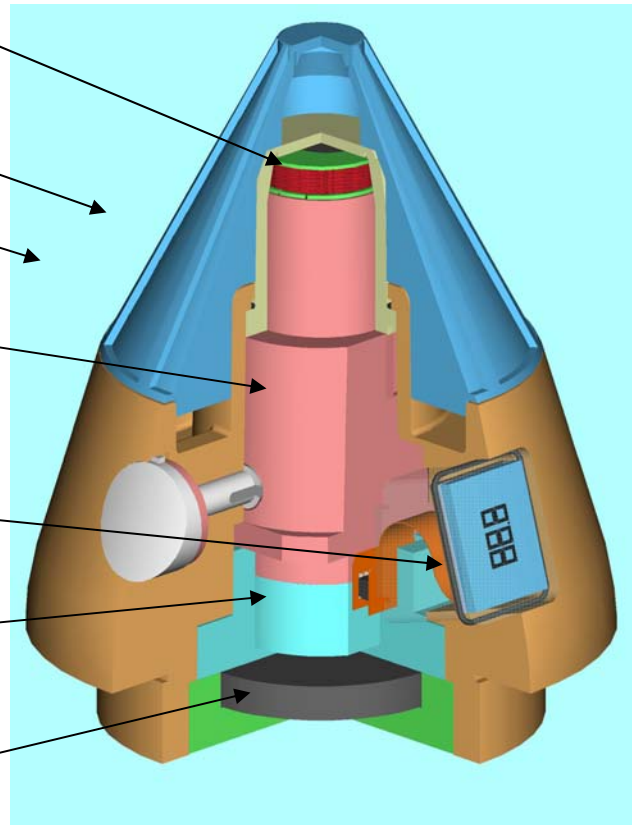
- Modular design approach - one fuze design fits both housings
- Miniaturized electromechanical command-to-arm S&A
- Magnetic 2nd environment safety (Non-spin, non-air breathing application)
- Magnetic Sensor coil provides adaptability for dual usage for inductive auto-setting
- Dual micro-controller electronic safety architecture
- Commercial off the shelf (COTS) surface mount electronics
- Lithium Thionyl Chloride reserve battery
- Hand Settable / LCD Display
- NVM Self-Diagnostics Tool



Safe & Arm

Modular Design
One Set of Modules Fits Both Housings





2nd Environment Sensor Coil

Setting ring

Increment / Decrement Switches

Battery Stab Rod

Potted Electronics Assembly

Battery Primer Assembly

Back-lit LCD

S&A

Battery Stab Assembly

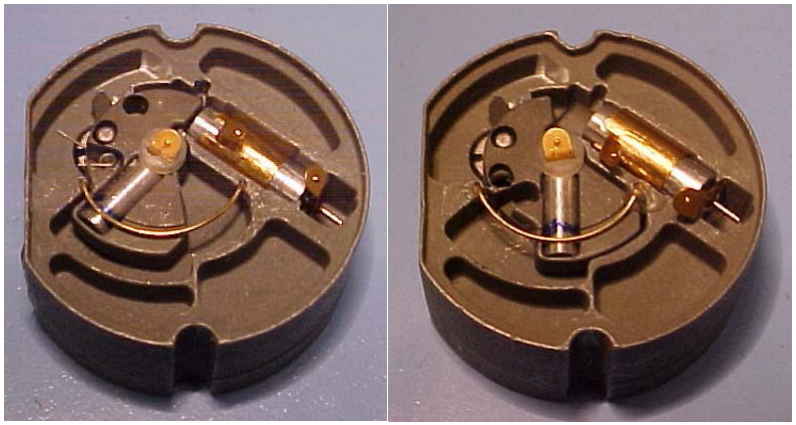
*Expulsion Charge

XM784

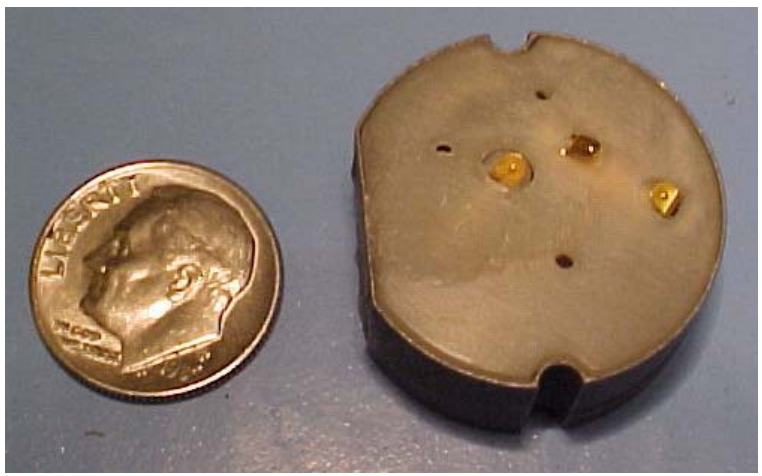
XM785

*not common

Miniature command-to-arm S&A provides application flexibility



SAFE ARMED

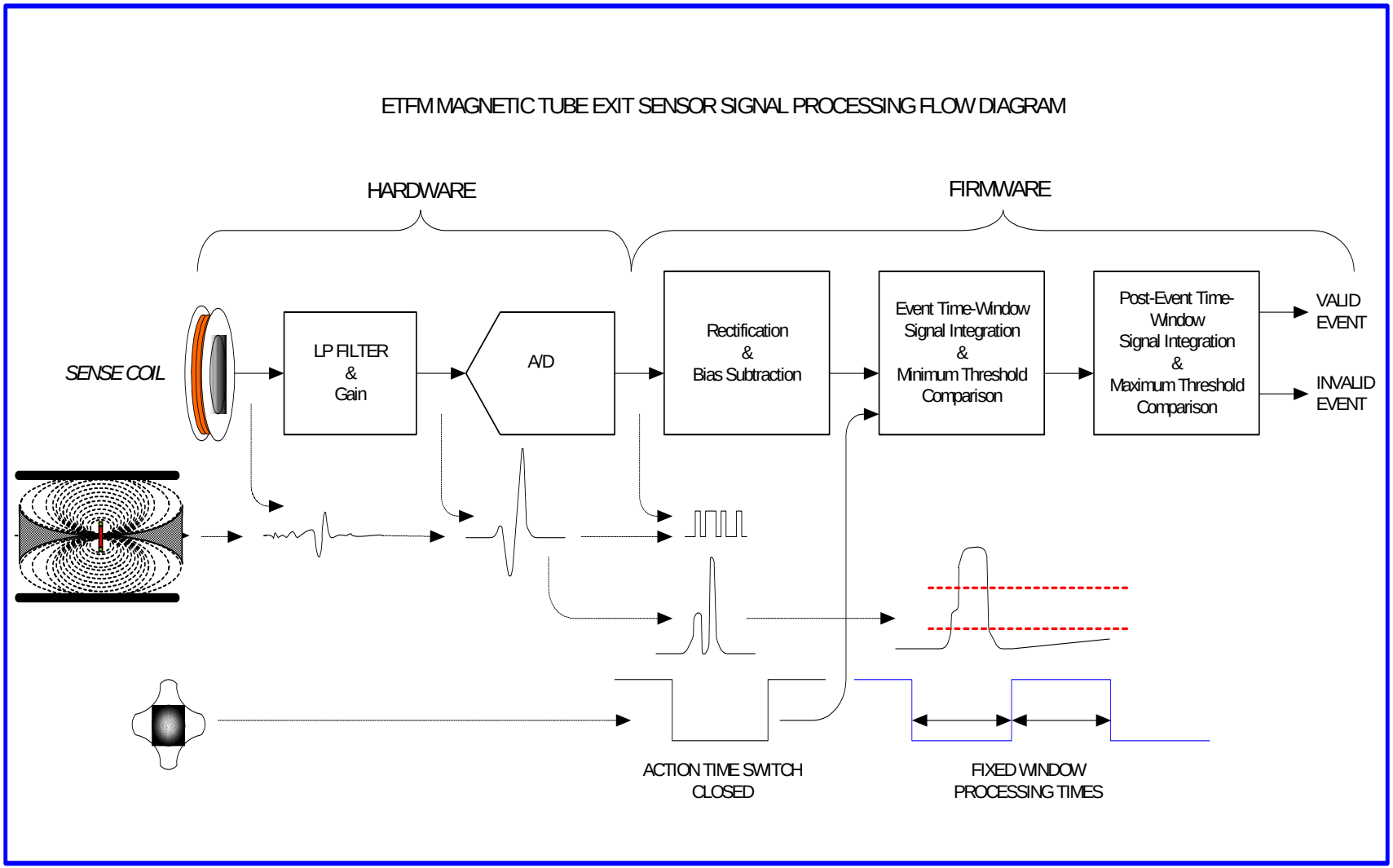


Command-to-arm S&A applications:

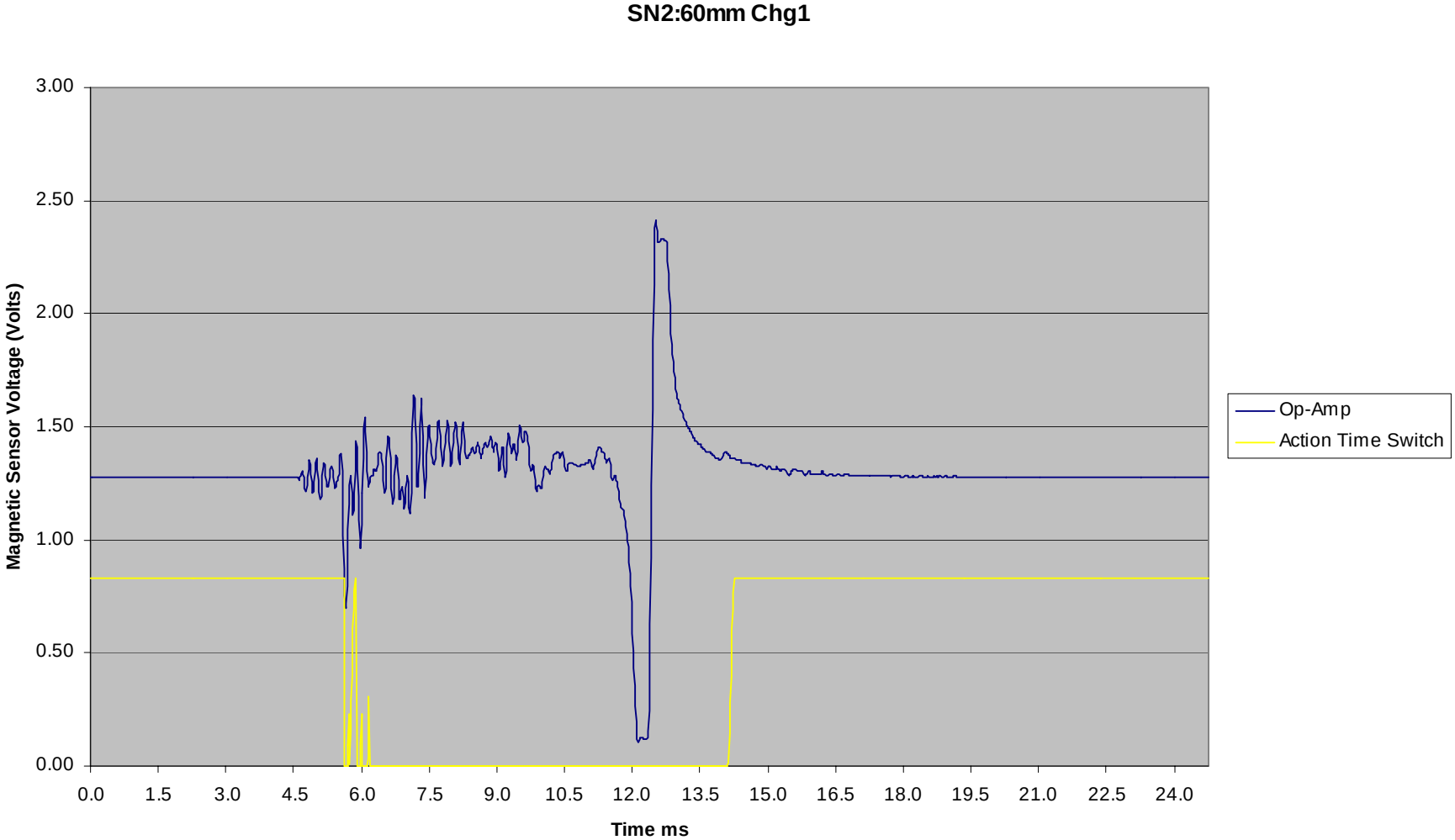
- ETFM fixed arm time (electronic delay)
- ETFM Expulsion charge
- Arm Time flexibility (overhead safety or short range engagement)
- HE initiation
- Rocket motor initiation

ATK S&A Patent Pending

Innovative magnetic sensor for non-spin second environment safety



Typical Tube Exit Signature



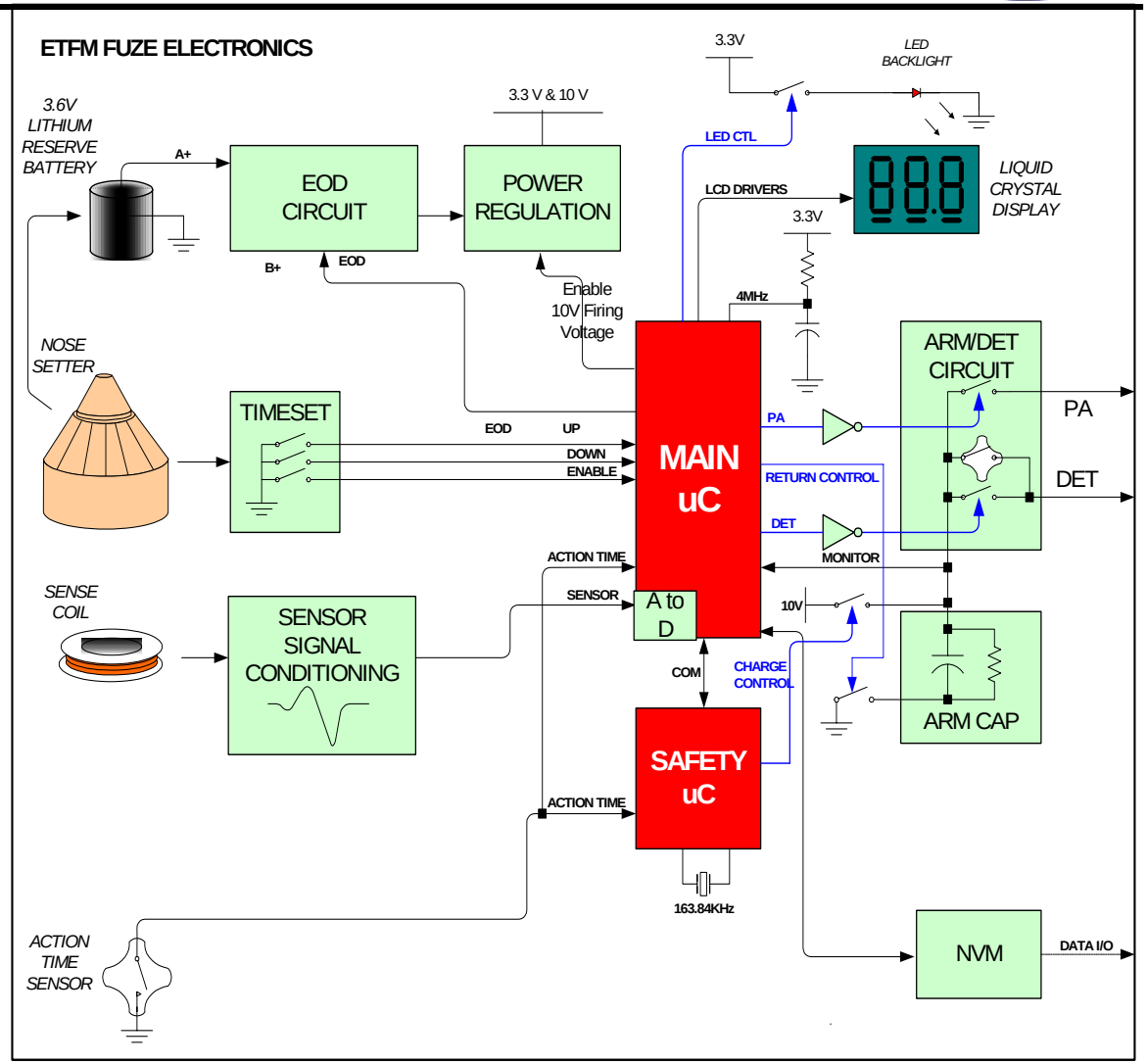
Dual Micro-Controllers Ensure Safety

Main Micro

1. Action Time Sense input
2. 2nd Enviro Sig Process
3. Bi-directional Comm Link
4. A/D inputs
5. Time Set I/O
6. LCD Backlight Control
7. ARM & FIRE control
8. EOD control

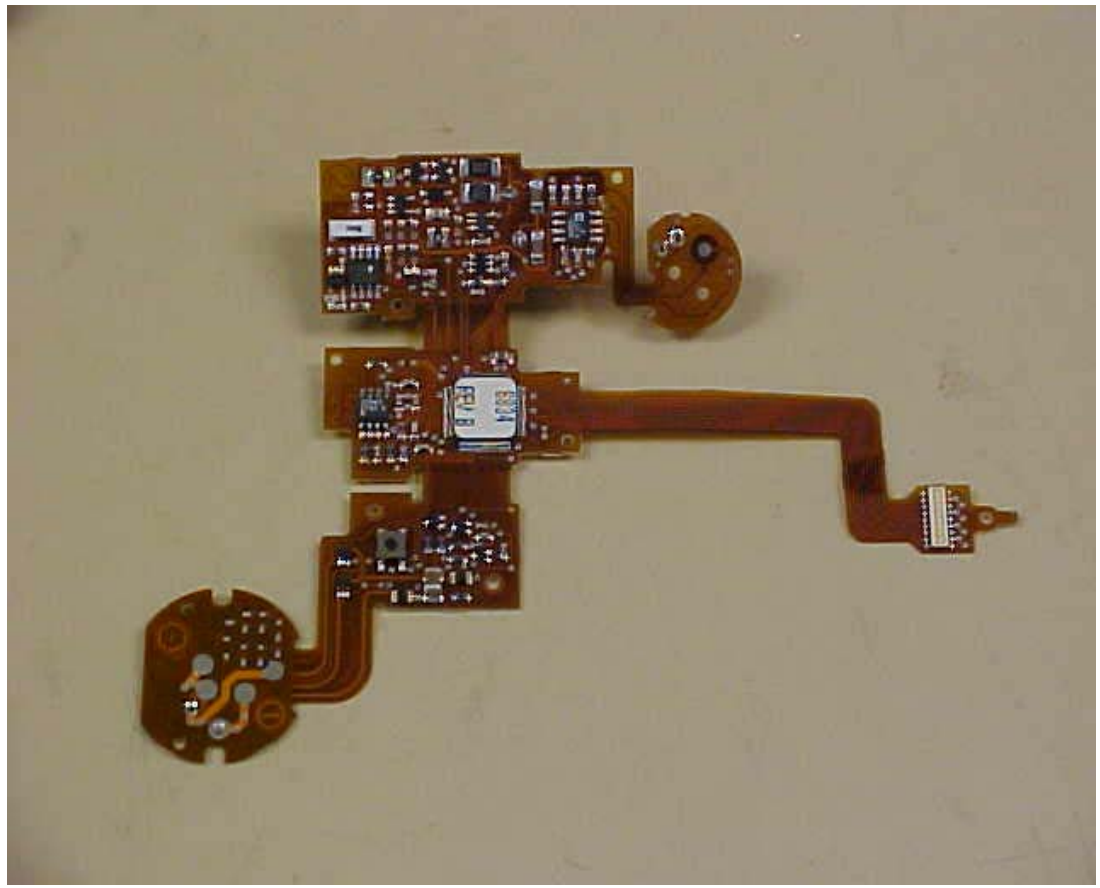
Safety Micro

1. Action Time Sense input
2. 2nd Enviro validation
3. Bi-directional Comm Link
4. Fire Capacitor charging



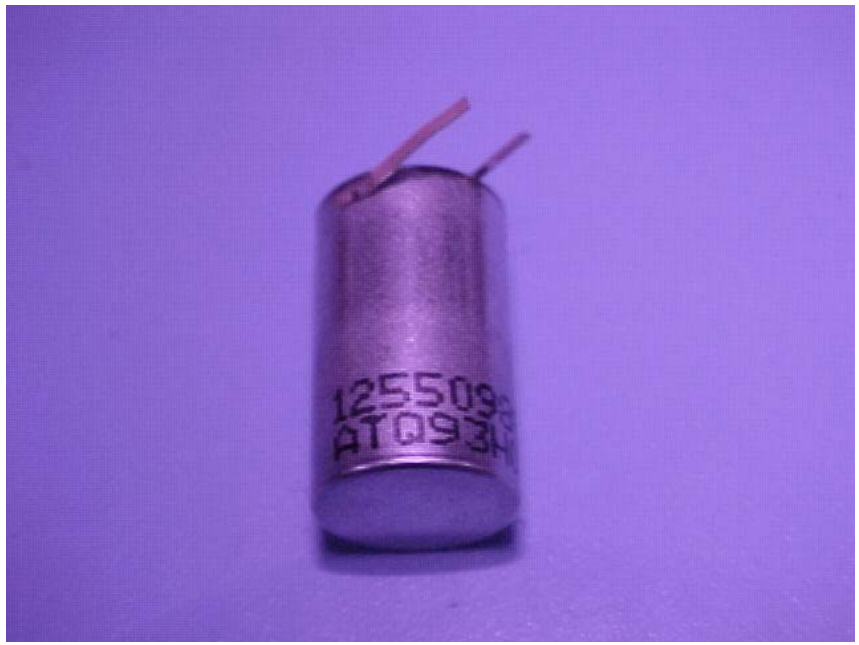
Cost effective COTS technology

- 2-Layered Stiffened Flex PWB
  - -Top-side components
  - -Back side stiffener
  - -Minimize interconnects
  - -Easy to package
- Standard surface mount components
  - -Standard pick-and-place/re-flow solder
  - -No ASIC's
  - -SMT connectors



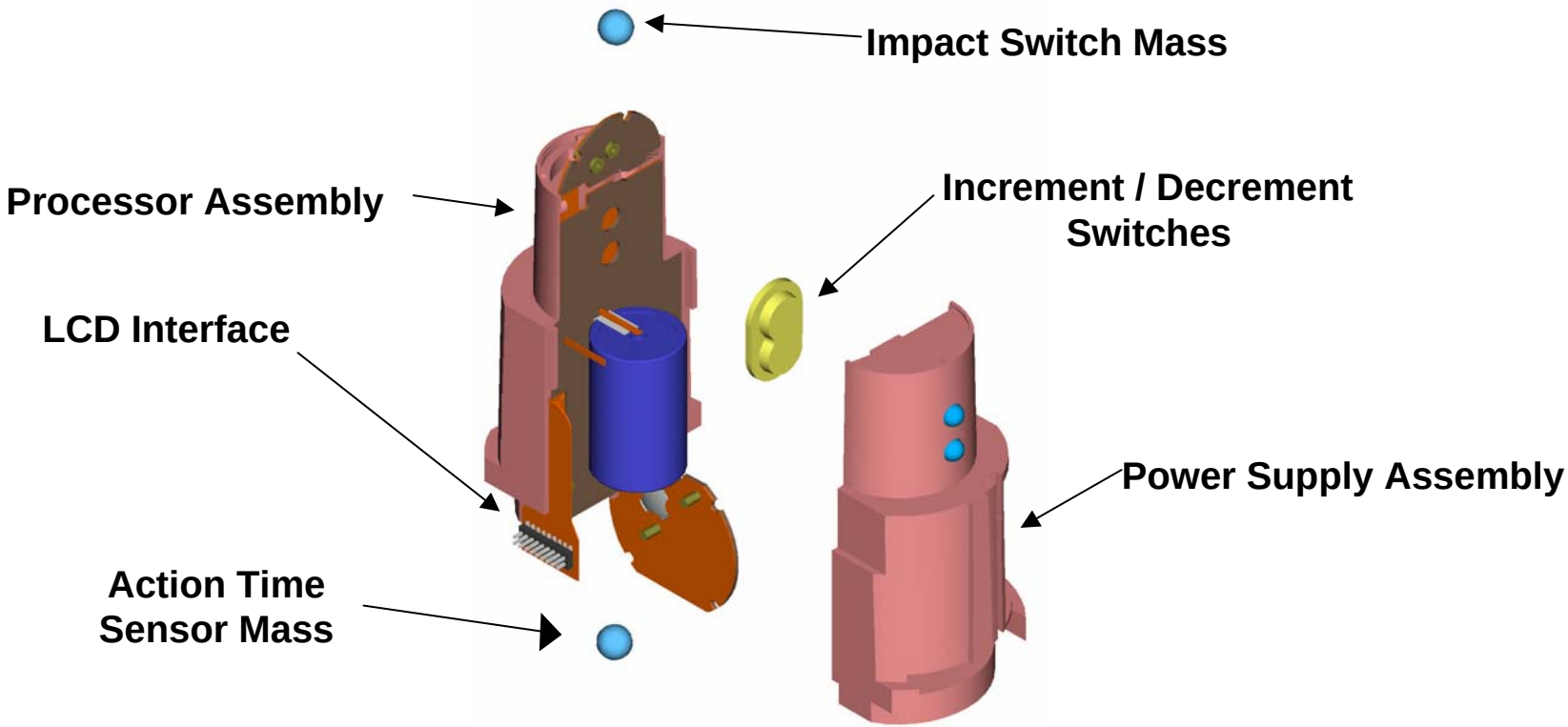
Low risk power source

- Production Proven M762/M767 Lithium Thionyl Chloride Reserve Battery
- M762/M767 Battery Primer Assembly
- XM773 Battery Stab Assembly



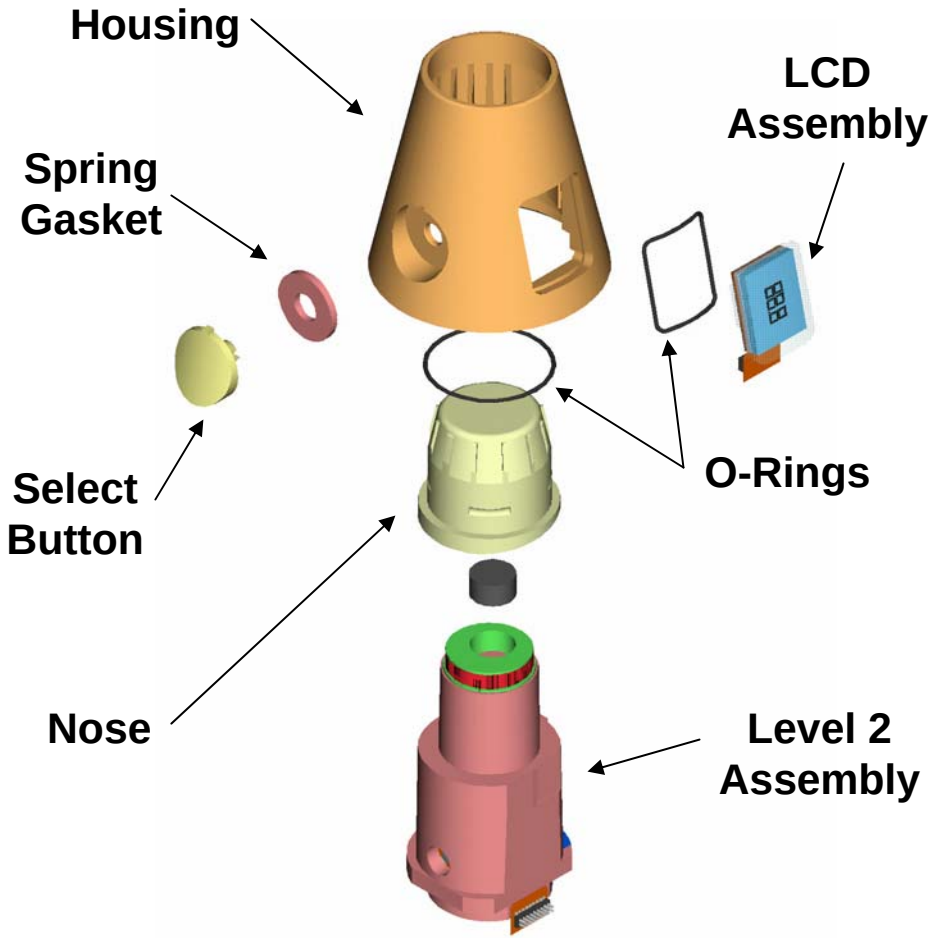
Designed for Production

Electronics Assembly



Designed for Production

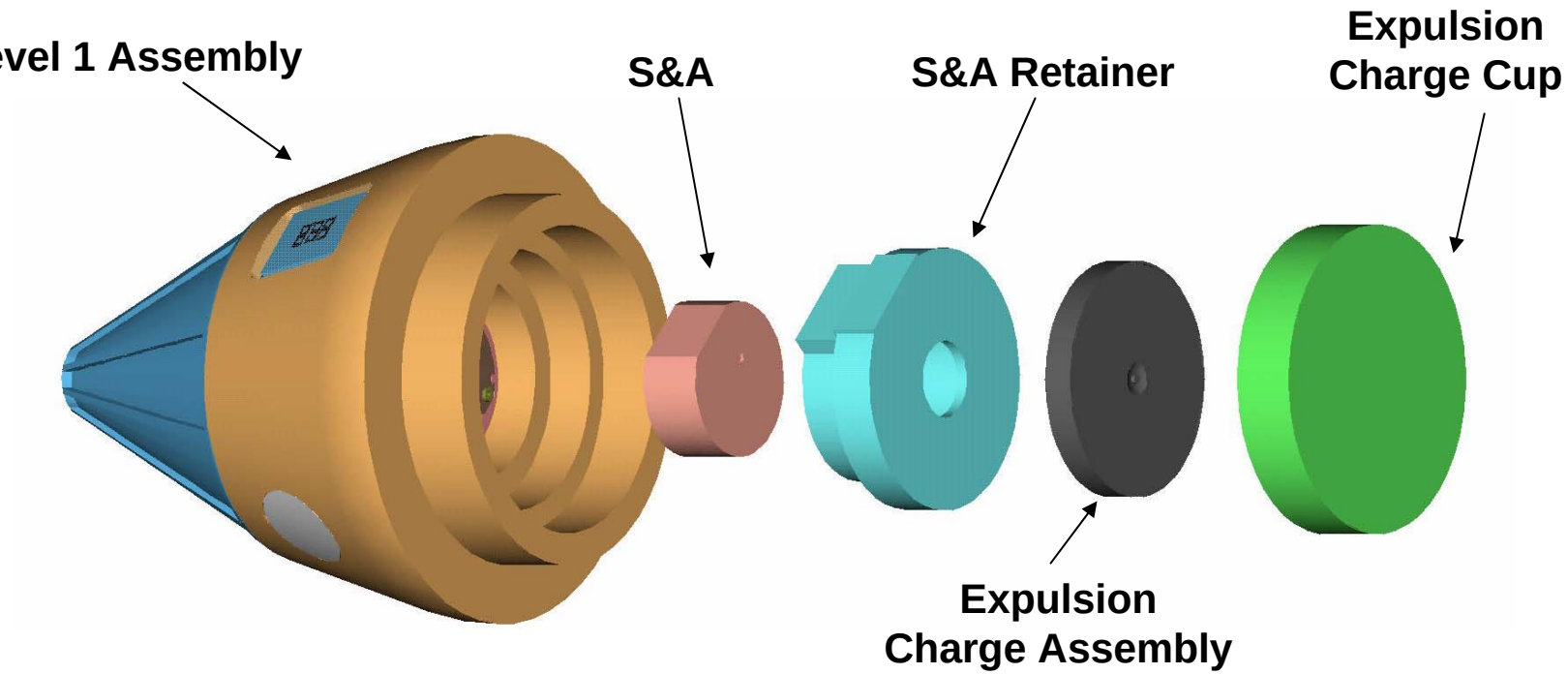
Level 1 Assembly, XM784



- LCD Assembly snaps into Housing.
- Nose & O-Ring slide over Level 2 Assembly and this assembly inserts into the Housing.
- The Spring Gasket is placed on the Select Button. Then Select Button snaps into Housing

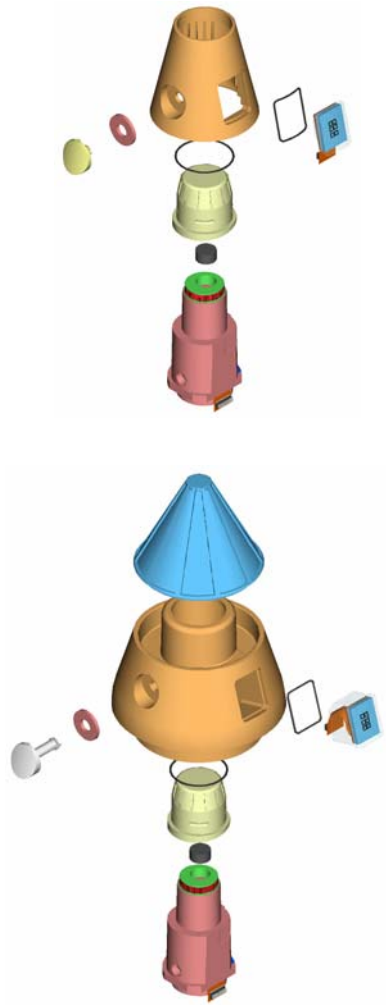
Designed for Production

Final Fuze Assembly, XM785

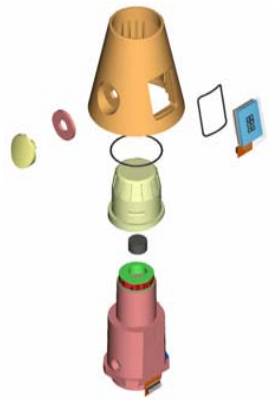


ETFM's Modular Design Provides Flexibility

- **Easy to Assemble**
- **Platform for Growth**
  - Command-to-arm S&A applications:
    - -Expulsion charge
    - -HE initiation
    - -Rocket motor initiation
    - -Arm time flexibility (overhead safety or short range engagements)
  - Magnetic 2nd environment sensor applications
    - -Tube launched, Non-spin, Non air breathing
  - Dual micro safety architecture
    - -Adaptability for other missions (PD, Prox, Delay)
    - -Adaptability for other electronic environmental sensors
  - Easy to incorporate in embedded fuze applications

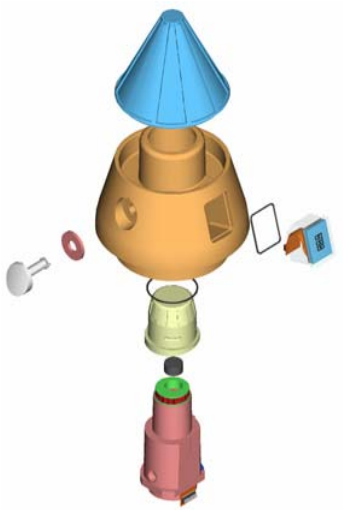


Recent Test Results



Design verification tests – March 2004

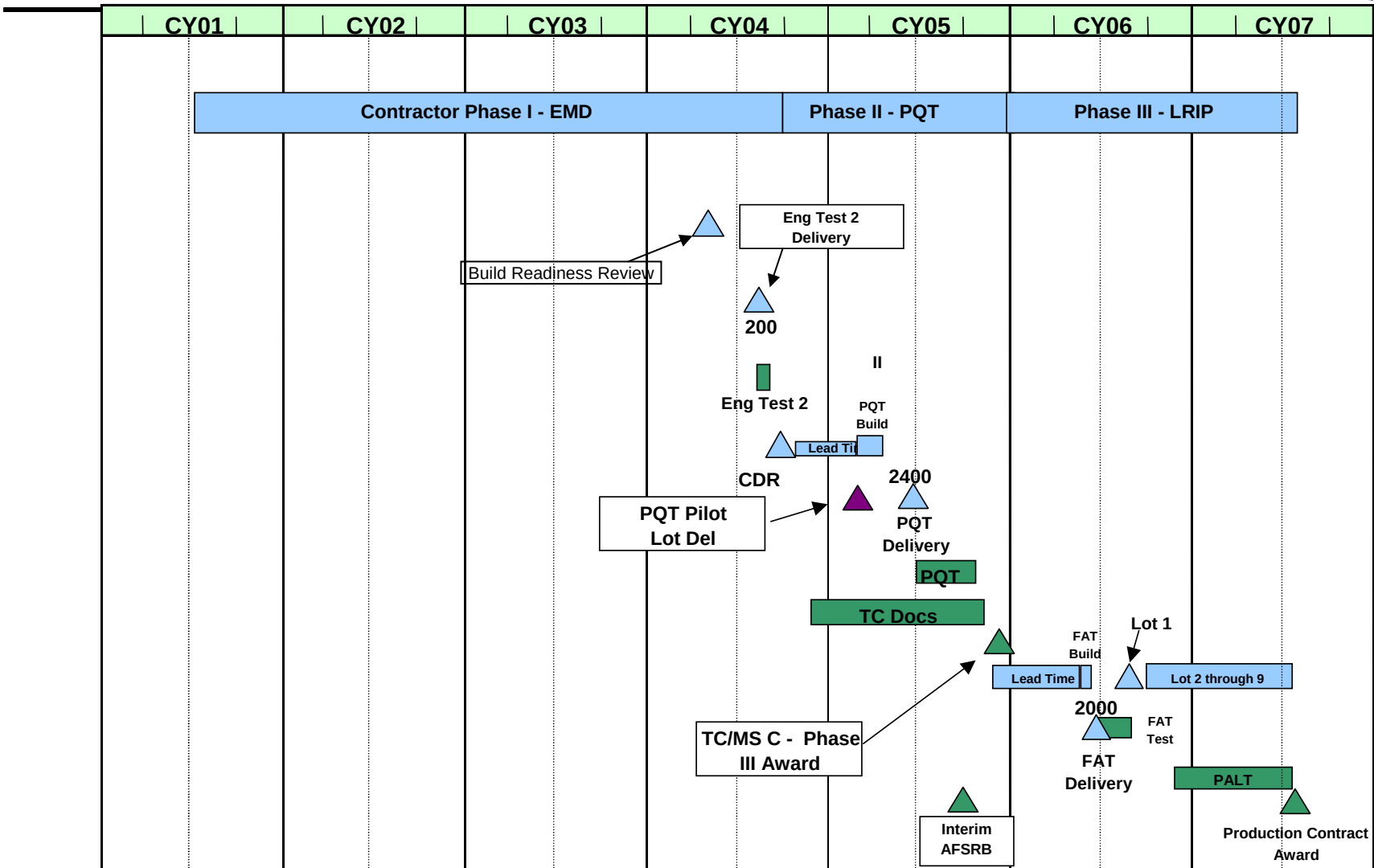
- 40 fuzes for design verification test
- Min & Max charge weights
- Operational temperature extremes
- 94% proper fuze function rate



Next test planned – July 2004

- 200 fuzes for design validation ballistic test
- Full range of environmental and ballistic test conditions

XM784/ XM785 ET Fuze for Mortars Schedule



Summary & Conclusion

- **Operational Flexibility**
  - Manually settable day or night without tools
  - Adaptable for inductive auto set
- **Improved Performance**
  - Meets all MIL-STD-1316E safety requirements
  - Supports future mortar fire control systems
  - Achieves Increased time function accuracy
- **Value For The Dollar**
  - Designed for producibility
  - Platform for growth (Adaptability)
- **Demonstrated by Successful Ballistic Test**