



XM1156 Precision Guidance Kit (PGK) Overview

for

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PGK Overview

- **XM1156 Precision Guidance Kit (PGK) Is A GPS Guidance Kit with Fuzing Functions to Reduce Ballistic Dispersion of Artillery Projectiles**
 - Increment 1: $\leq 50\text{m}$ CEP for 155mm High Explosive (HE) projectiles
 - Future Increments will develop compatibility for 105mm projectiles, cargo projectiles, and future artillery platforms
- **Alliant Techsystems (ATK, Plymouth, Minnesota) was awarded the Increment 1 System Development and Demonstration (SDD) option based on competitive shoot-off**
- **PGK program has completed its Hardware Critical Design Review and is beginning government qualification testing this summer**
- **PGK is scheduled to begin production in 4Q US Fiscal Year 2010, and be fielded in US Fiscal Year 2011**

PGK Requirements

	Increment 1 IOC FY11	Increment 2 IOC FY15	Increment 3 IOC FY18
Key Performance Parameters			
1. Net Ready			
2. Reliability	92% (T); 97% (O)		
3. Accuracy	≤ 50m CEP (T); ≤ 30m CEP (O)	≤ 30m CEP (T=O)	≤ 30m CEP (T); ≤ 20m CEP (O)
Attributes			
Munition Type	155mm HE (M107, M795, M549A1)	Adds 105mm HE (T); 105/155mm HE & Cargo (O)	155mm HE (T); 105/155mm HE & Cargo (O)
Platform Types	M777A2, Paladin	Adds M119A3 (105mm) (T)	Adds Future Cannon (T); Paladin, M777A2, M119A3 (T)
Fuzing Function	PD, Proximity	Adds Delay & Time (O)	

T: Threshold Requirement
O: Objective Requirement



Current Focus is Increment 1

Comparative 155mm Projectile Accuracies

The Most Cost-Effective Munition Will Be Chosen Based on Mission Need:

- Target Defeat Capability
- Collateral Damage Risk

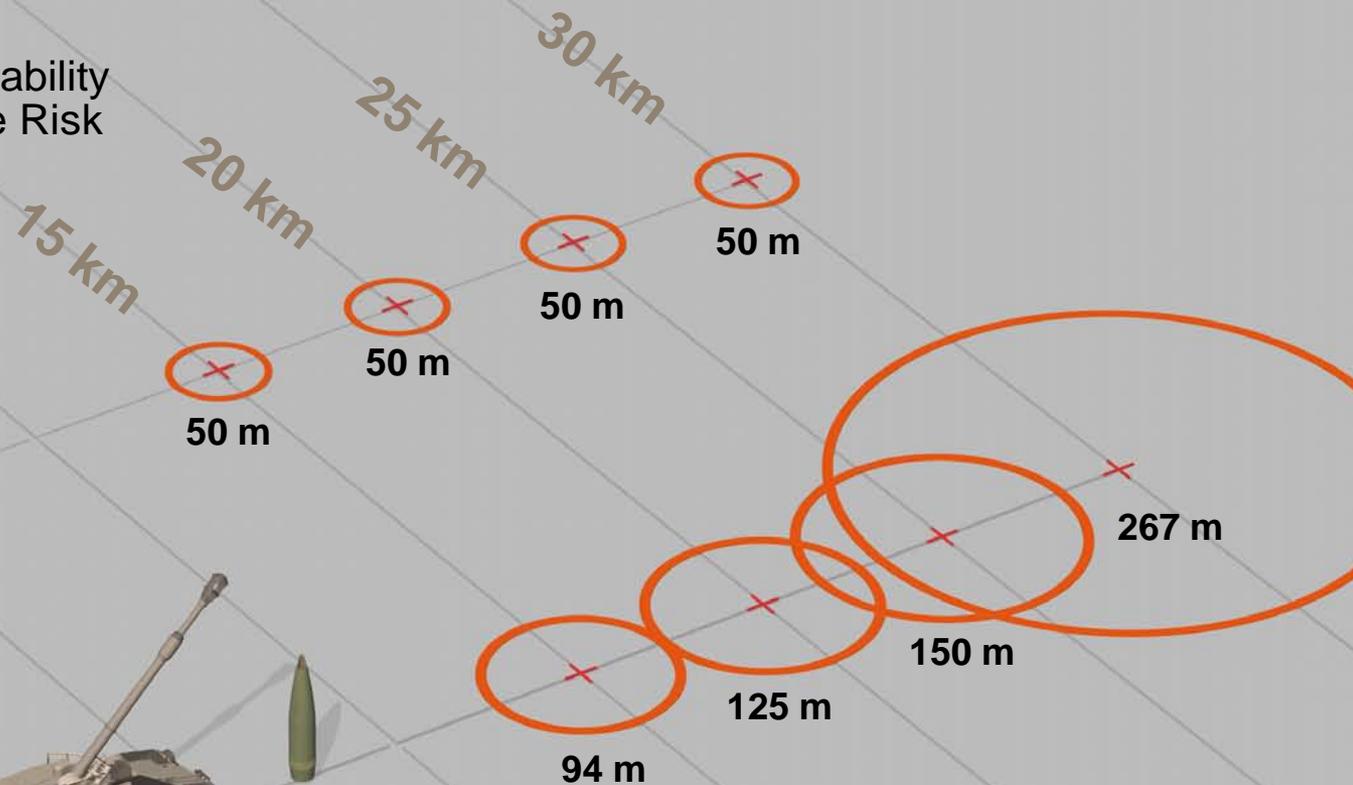


M549A1 with PGK



M549A1

All using
1/2 hour old
Meteorological data



Circles represent accuracy in terms of CEP (Circular Error Probable) at different operational ranges from the firing platform

PGK Projectiles & Platforms

PGK Projectiles with M109A6 (Paladin)



M777A2



M107

- 95 lbs
- Max Range* 17.5Km
- Warhead 15 lbs

M795

- 103 lbs
- Max Range* 22.5Km
- Warhead 23.8 lbs

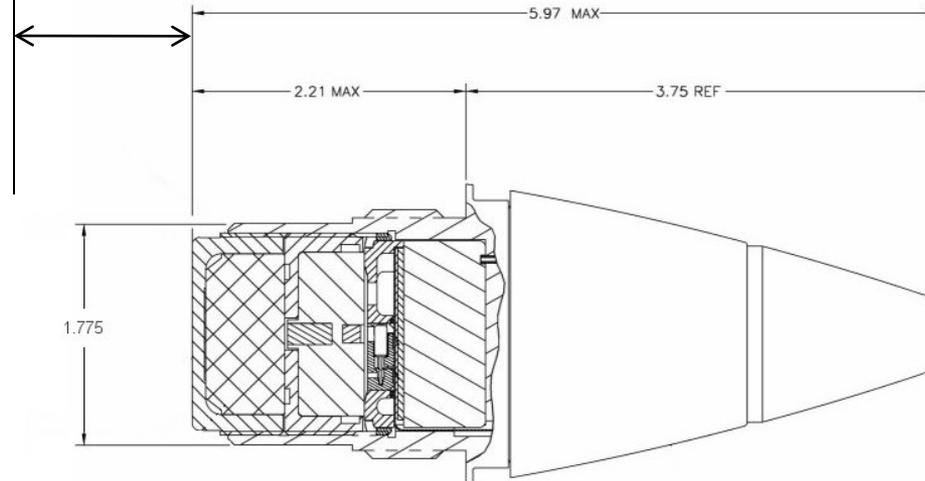
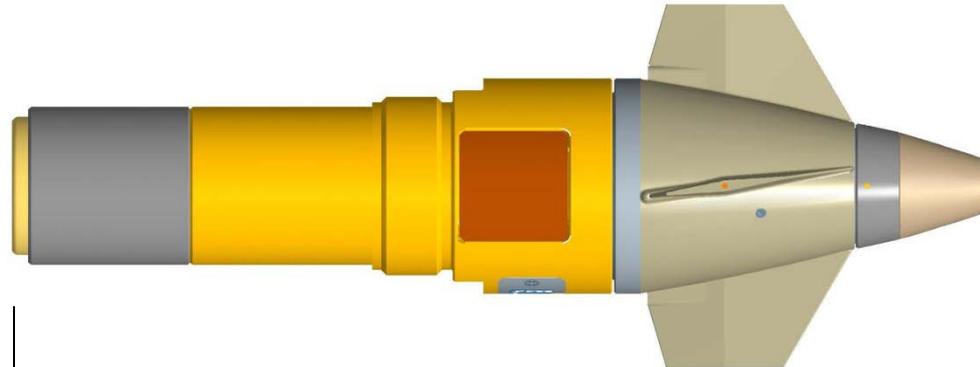
M549/A1

- 96 lbs
- Max Range* 30Km
- Rocket Assisted
- Warhead 15 lbs

* Maximum Range without PGK shown. Max Range will be reduced by no more than 10% with PGK

PGK External View (dimensioned)

2.70 inch (68.6 mm)
longer than US Multi-
Option Fuze, Artillery
(MOFA)



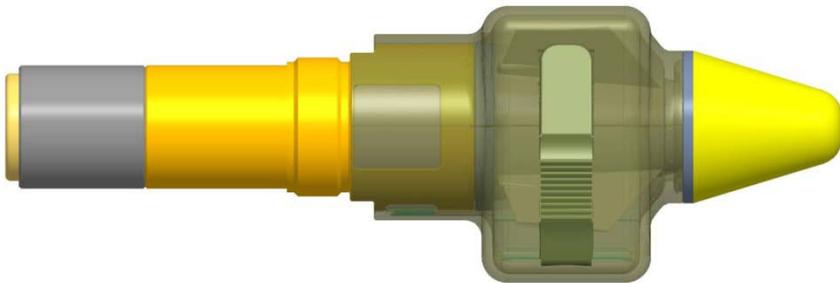
Dimensions in inches

PGK is only Compatible with Deep Intrusion Projectiles

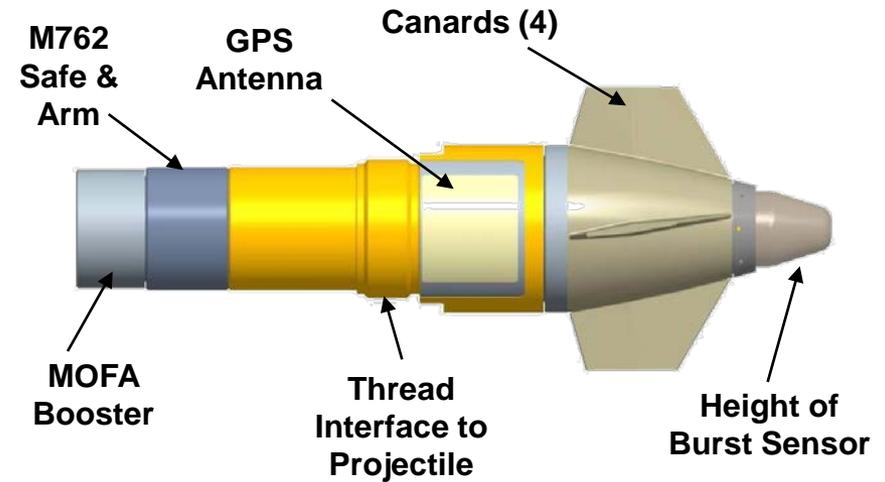
PGK Design Description

PGK With Cover

Cover Provides Environmental Protection & Interface to Fuze Setter



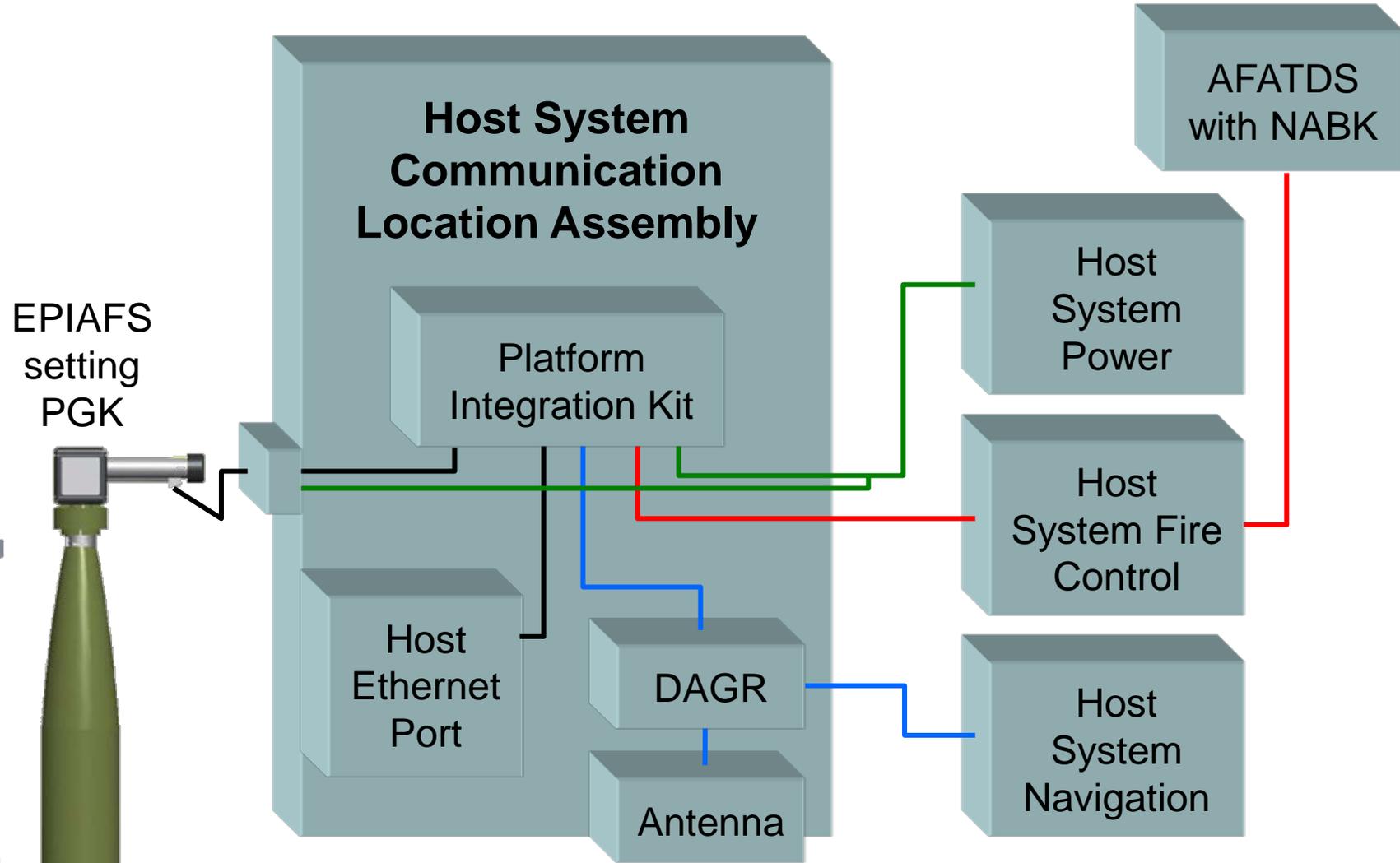
PGK with Cover Removed



- Fits In Std 155mm HE Artillery Projectile Fuze Wells (Deep Intrusion)
- GPS Guidance (With SAASM)
- 20 Year Storage Life (No Battery)
- Proximity & Point Detonating Fuzing

EPIAFS Interface & Host System Support

Enhanced Portable Inductive Artillery Fuze Setter



Compatible with Excalibur & PGK

Excalibur

Enhanced Portable Inductive Artillery Fuze Setter (EPIAFS) and Platform Integration Kit (PIK)



DAGR



← EPIAFS

PIK

- EPIAFS:
 - Conventional Fuze & Excalibur/PGK Setter
 - Programs Excalibur & PGK with mission information
- Platform Integration Kit
 - Interface circuit from platform fire control systems, DAGR (GPS receiver) to EPIAFS



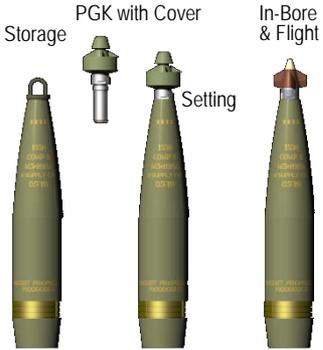
PIK in M109A6 (Paladin)



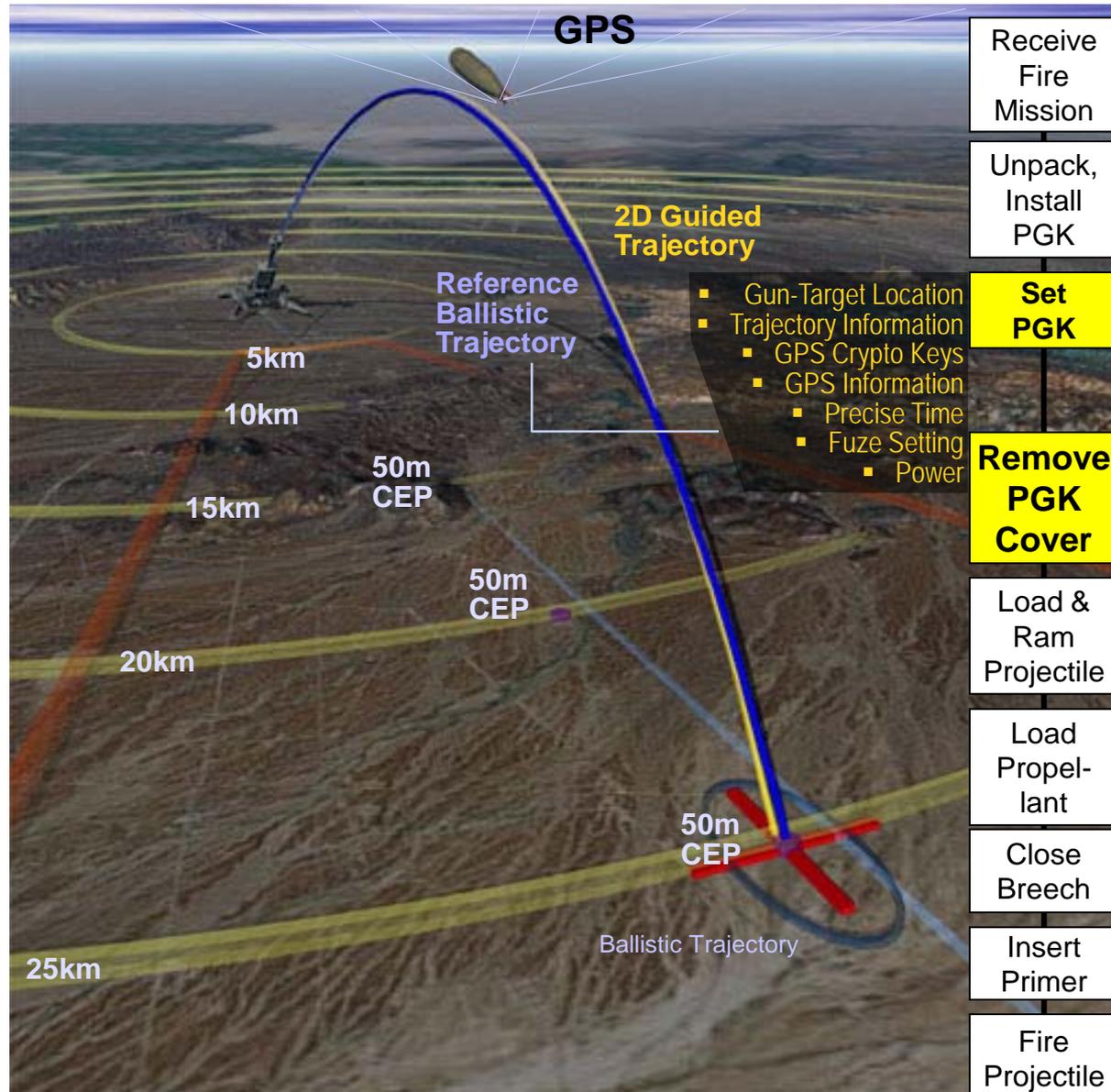
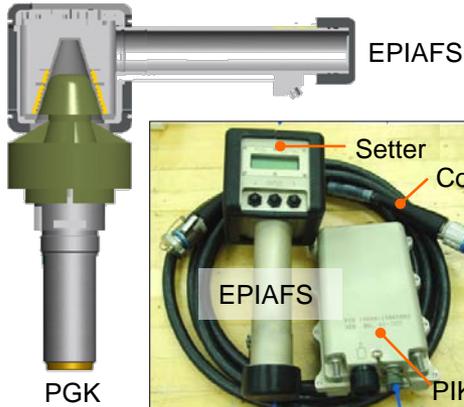
PIK on M777A2



Precision PGK Mission



Planning the PGK Mission



Contractor Fuze Qualification Test Results

- Test Standard: MIL-STD-331C
- Conditions:
 - Transportation/Vibration (Hot & Cold)
 - Temperature/Humidity
 - Storage at Extreme Hot & Cold
 - Thermal Shock
 - Loose Cargo & Tactical Vibration (Hot & Cold)
 - 2.1 meter drop (Hot & Cold)
- All PGKs then fired on M549A1 and M795 projectiles at Hot & Cold
- Results:
 - Safety = 100% (15 of 15)
 - Reliability Objectives = 100% (14 of 14; 1 no-test (M549A1 rocket motor did not ignite))
 - Performance Objectives = met < 50m CEP requirement

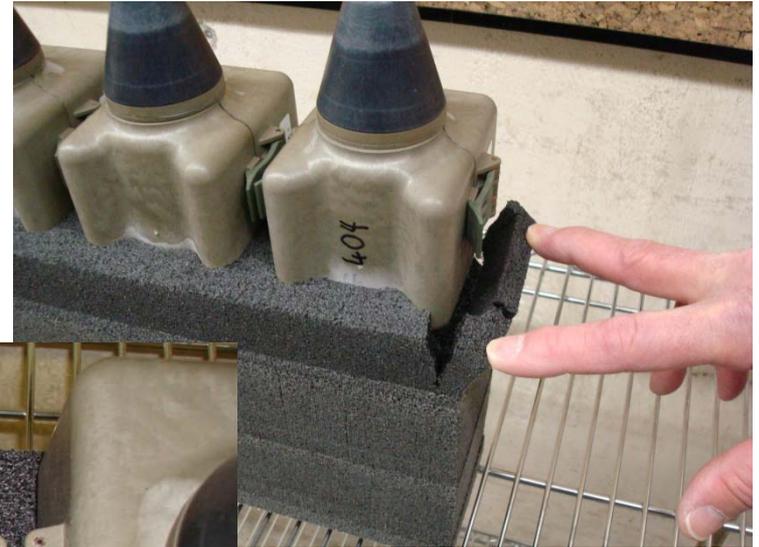
PGK Test Results

Precision Guidance Kit (PGK)
Increment 1 Live Firings
4 September 2009
(Yuma Proving Ground)

155mm M549A1 in Point Detonating
and Proximity Modes

247:16:42:35.34

Dunnage from 2.1m Cold Drop Test



All units passed
EPIAFS setting tests
after drops tests

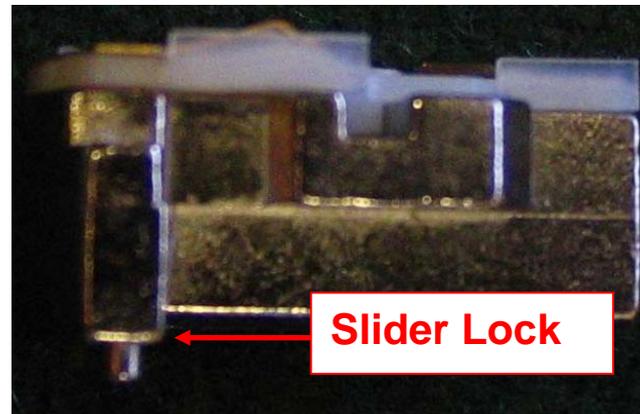
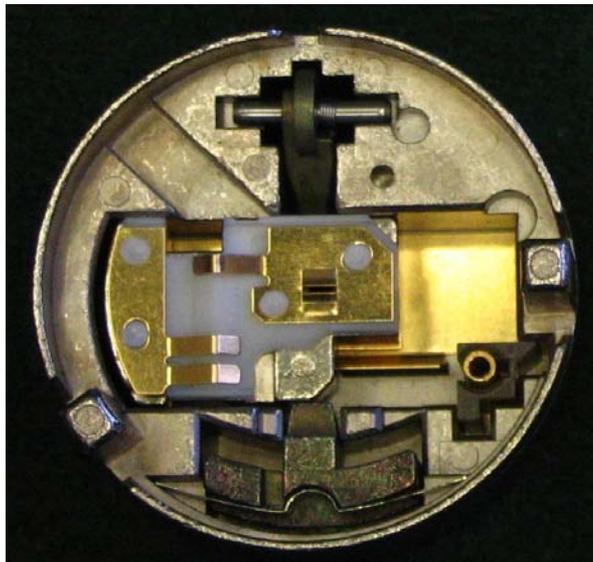
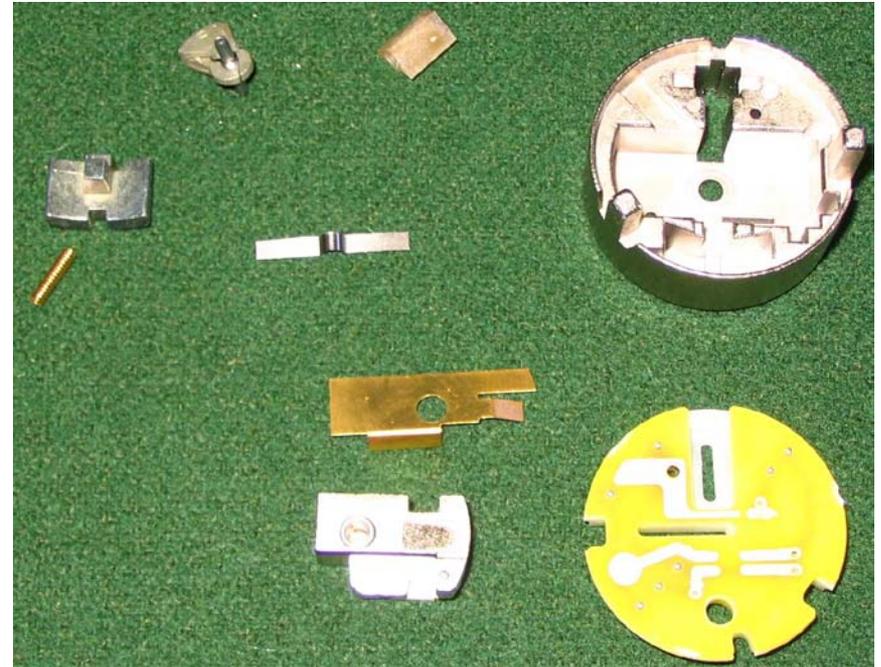
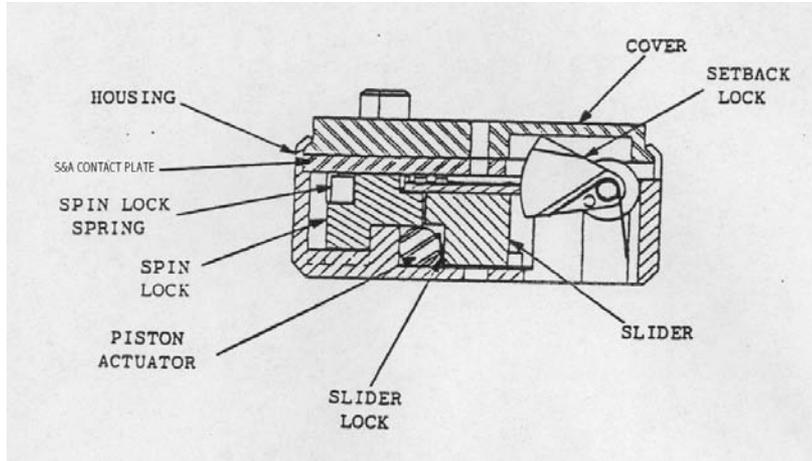
Minor damage to
Cover Anti-Rotation
Layer

PGK Accomplishments & Up-Coming Events



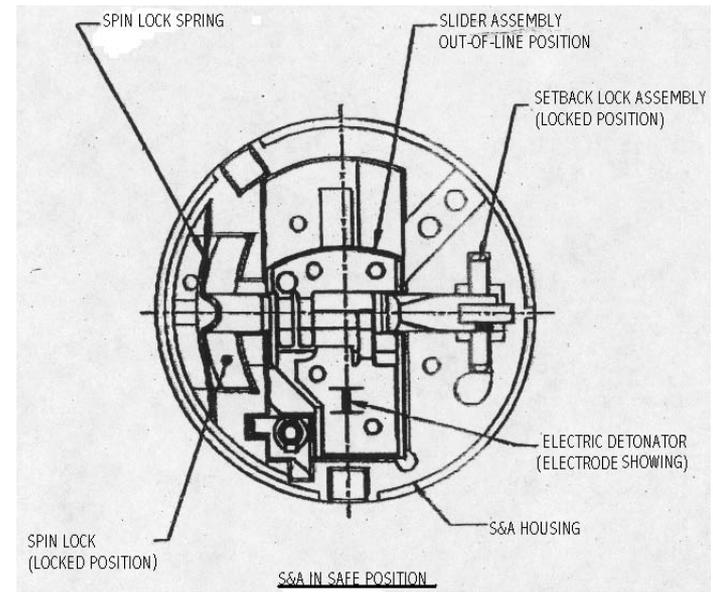
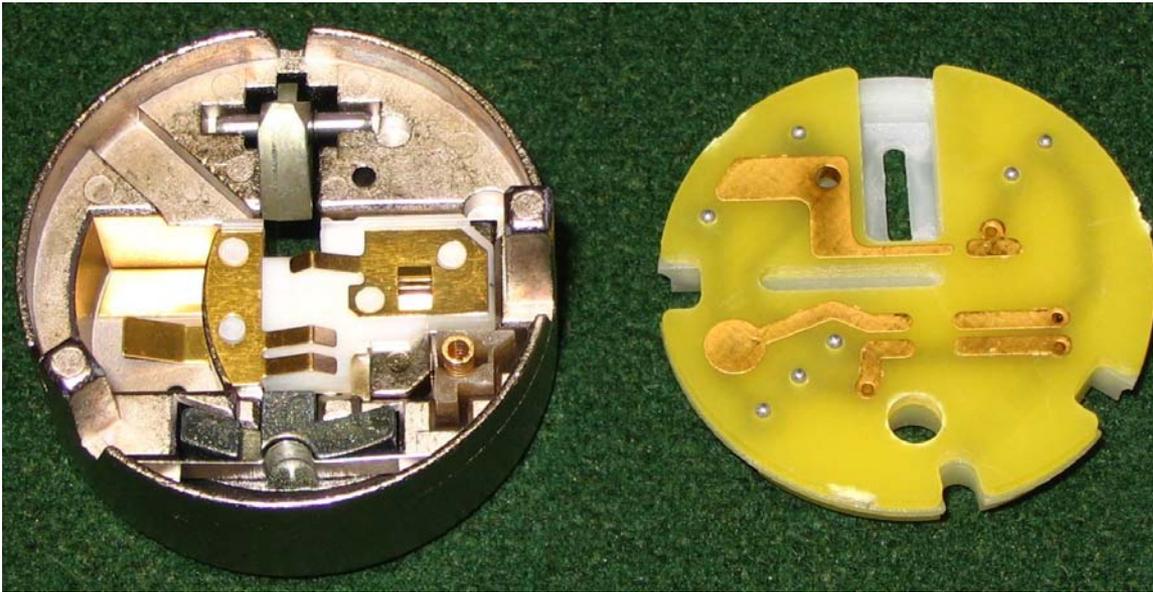
- Hardware Critical Design Review (CDR): Jan 09
 - Design Meets All Requirements Via Analysis or Testing
- AFSRB Initial Certification: Feb 09
- Guided Flight Tests: Apr 09
- Successful User Evaluation: Ft Sill, Apr 09
- Successful Vertical Gun Tests: May 09
- Algorithm CDR: July 09
- Successful Military Standard 331 Testing: Jun 09 through Mar 10
- Successful Electromagnetic Environmental Effects (E3) Testing: Nov 09 through Feb 10
- Sequential Environmental Safety - Safety: Jun 10
 - 64 PGKs fired after environmental conditioning (Hot & Cold)
- Sequential Environmental Tests - Performance: Jun 10
 - 20 PGKs fired after environmental conditioning (Hot); additional 20 planned for Cold portion of test in 1QUSFY11
- Milestone C (Production Decision): 4QUSFY10
- Initial Operational Capability (IOC): 4QUSFY11

M767A1 Safe & Arm (S&A) Mechanism



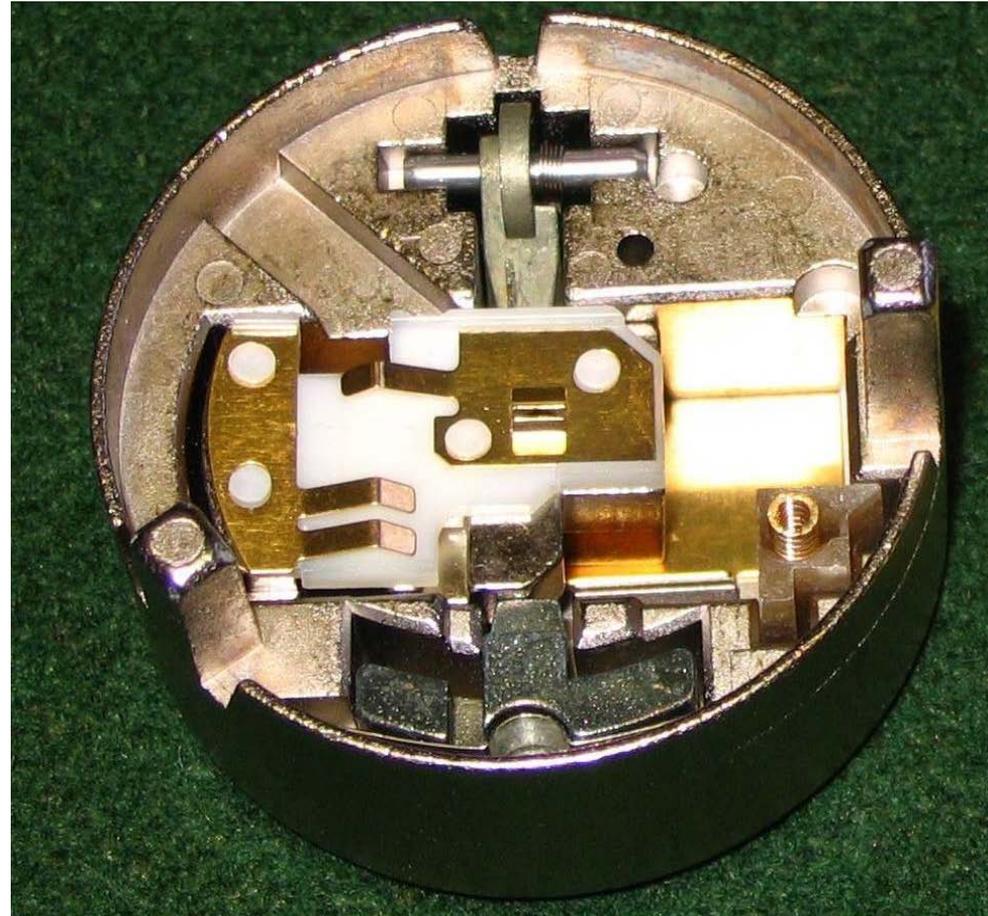
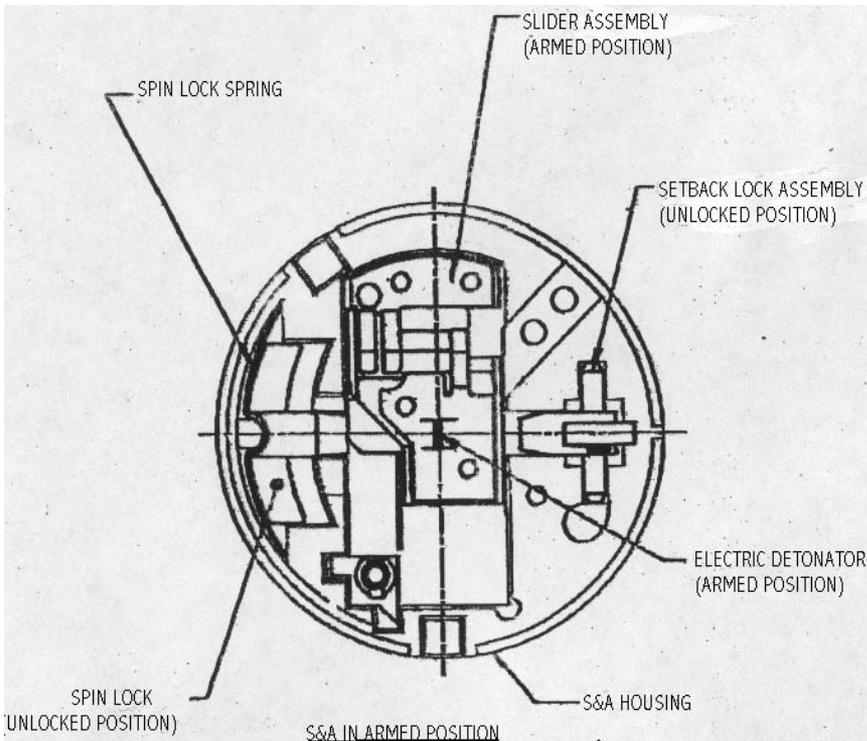
Safe Position

- Setback weight up
- Spin lock pushed in

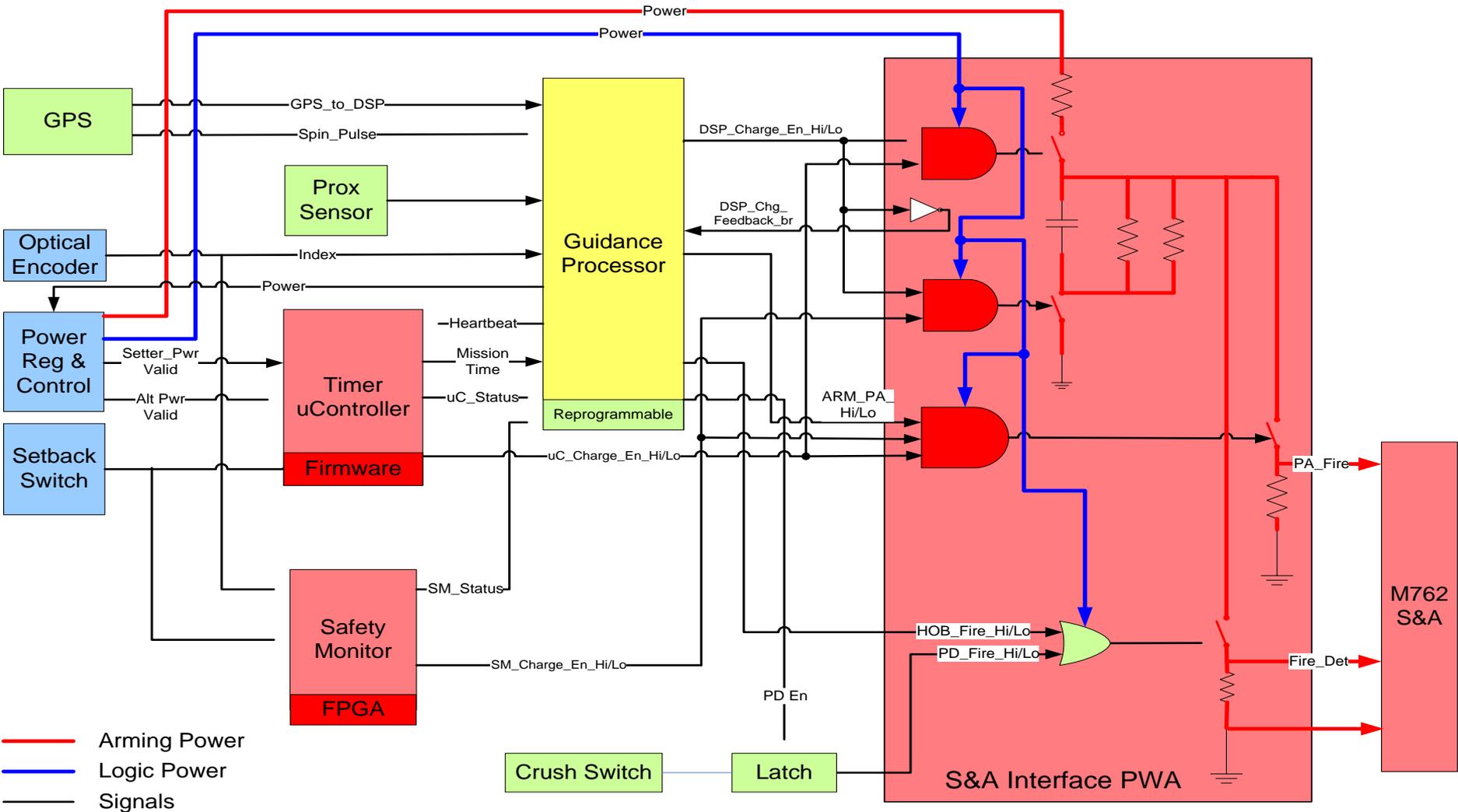


Armed Position

- Setback weight down
- Spin lock pushed out



PGK Fuzing Architecture



PGK Growth Potential

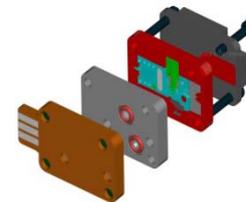
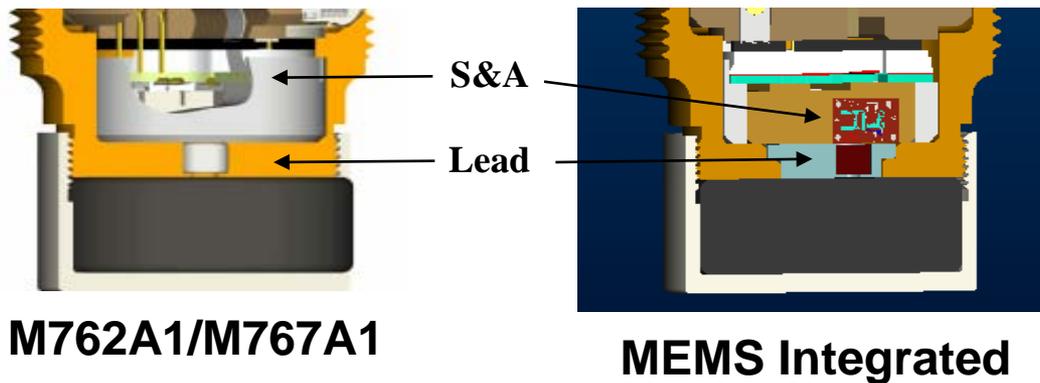
Potential Technology Insertions:

- MEMS S&A
 - Smaller / More Cost Effective
- Booster Modification
 - Initiates IM Energetics
 - Optimized Size
- Next Generation Proximity Technology
 - Small & Cost Effective

Micro-Electro Mechanical Systems (MEMS) S&A Development

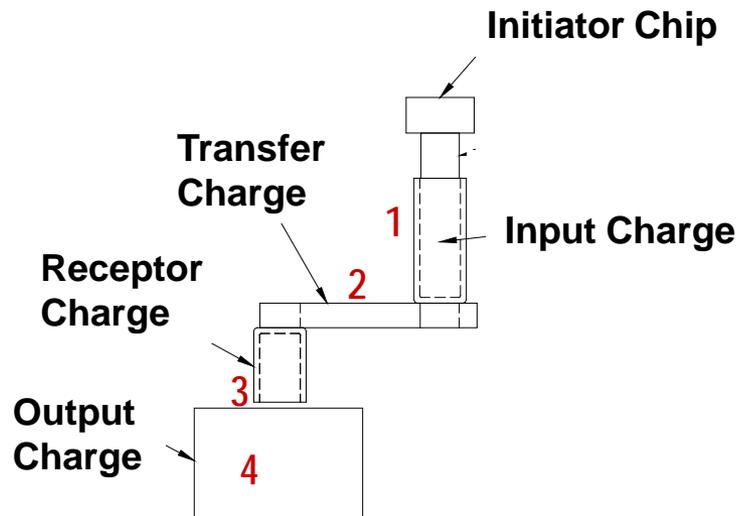
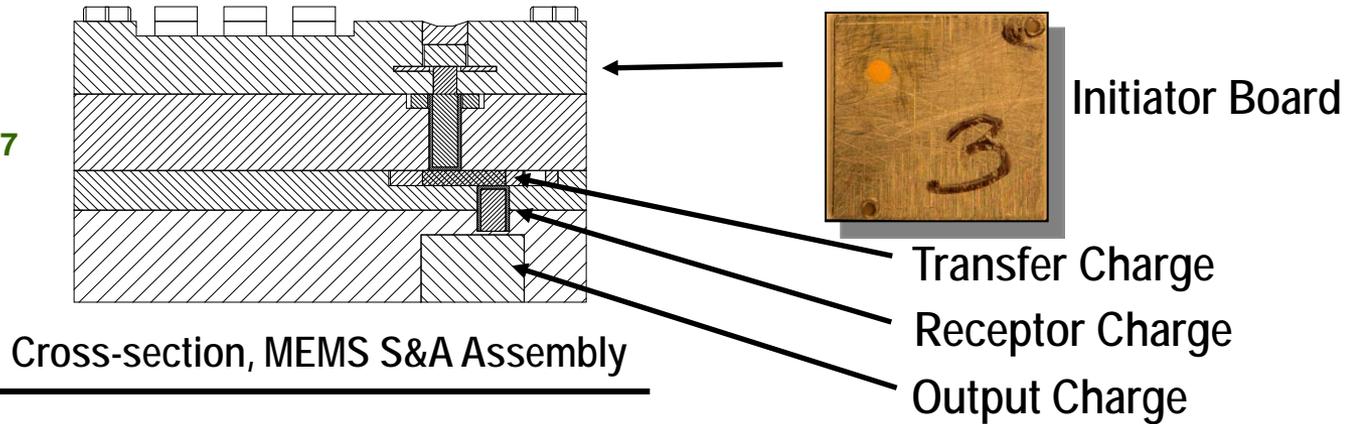
M762A1 Fuze Used To Evaluate MEMS S&A Performance For Artillery

- Improved MEMS Design
- Suitable For High and Low Propellant Charges
- Command-To-Arm Feature
- ***S&A Volumetric Savings = 95%***

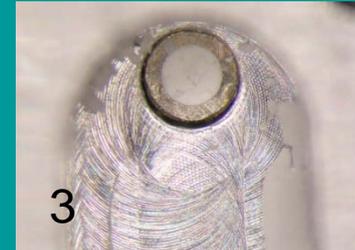
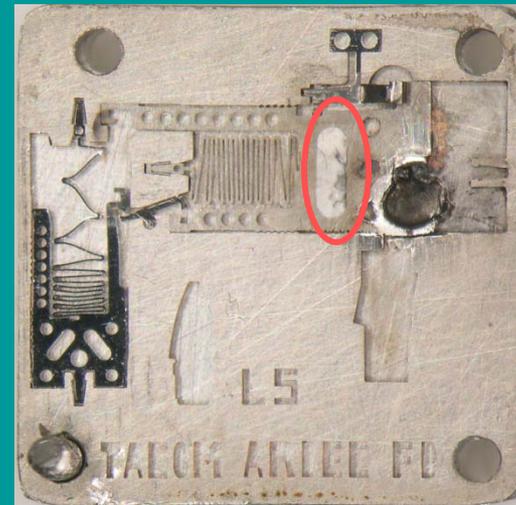


Micro-Scale Firetrain (MSF)

U.S. Patents 7055437
and 7069861



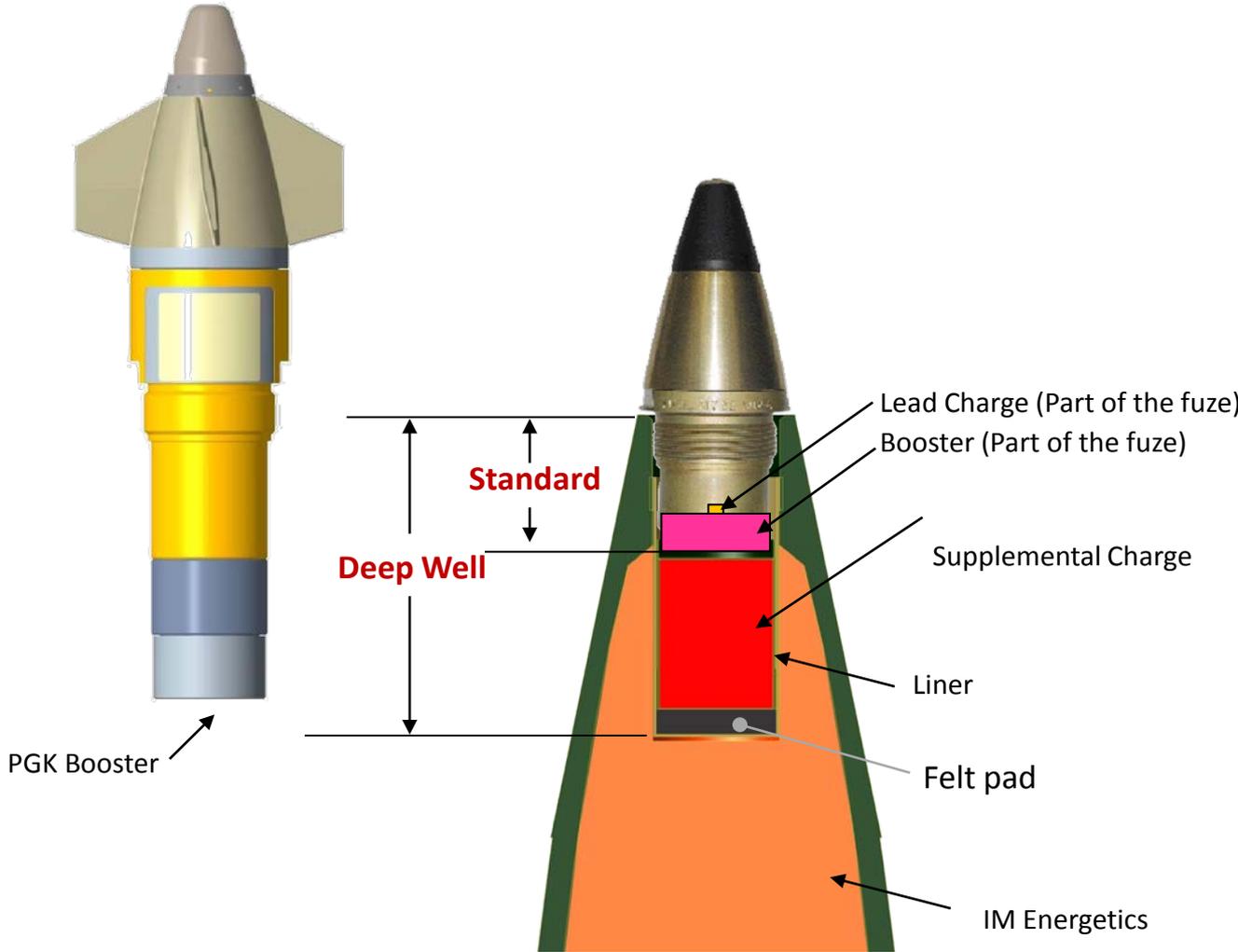
Barrier Safety



Charge 1 Function
Charge 2 (Transfer) Safe

Charge 3 (Receptor) Safe
Charge 4 (Output) Safe

Potential PGK Booster Re-Design



Develop Optimized Booster for use in Projectiles with Insensitive Munition Fill

Summary

- PGK (Increment 1) Provides Warfighter $\leq 50\text{m}$ (CEP)
 - 155mm High Explosive Projectiles
 - Future Increments Increase Capabilities For 105mm & 155mm Projectiles
- PGK Design Leverages Existing Technology (High Maturity)
- PGK Safety Design
 - Uses Proven M762 S&A Design
 - Redundant Electronic Architecture
- Warfighter Benefits Include:
 - Improves Munition Accuracy
 - Improves Munition Efficiency
 - Increased Number of Stowed Kills (Reduces Logistics Burden)
 - Greatly Reduces Possibility of Collateral Damage
- PGK Increment 1 Fielding Planned in US Fiscal Year 2011