XM784 and XM785
Electronic Time Fuze
For Mortars (ETFM)

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XM784 / XM785 ETFM
Background

- 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
XM784 / XM785 ETFM

Need

• Army Safety Standards MIL-STD-1316 (Dual Environ Safety)
  • No Current Mortar Time Fuze Meets Standards

• Need For Increased Timing Accuracy
  • Effects Cartridge Performance

• Three Fuze Types
  • PROX: (M734A1 Multi-Option Fuze)
  • PD / Delay: (XM783)
  • Time: (XM784 (60 / 120 mm) & XM785 (81 mm))

• Legacy Fuzes Require a Wrench To Set
  • Difficult to Read
  • Require External Lighting

• Mortar Time Fuze Modernization
XM784 / XM785 ETFM
Requirements

• Cartridge Compatibility:
  • 60 mm (M721 Illum & M767 IR Illum)
  • 81 mm (M853A1 Illum, XM816 IR Illum & M819 RP Smoke)
  • 120 mm (XM930 Illum, XM983 IR Illum)

• Hand Settable Required (Inductive Set Desired)
  • Self Illuminating

• Accuracy 98%
• Set Time 5 – 99.9 Seconds (0.1 Sec Increments)
• Cannot Significantly Degrade Cartridge Range
• 20 Year Shelf Life (Controlled Environment)
XM784 / XM785 ETFM
Ammunition Application

M776 (60mm & 120mm)
XM784

M772 (81mm)
XM785
XM784 / XM785 ETFM
Conventional Mortar Fuze Overview

User Payoff
- Go to War Fuze
- Increased Performance & Safety

Proximity
- M734
- M734A1

Point Detonating & Delay
- M745
- M783
- M935

Time
- M772
- M776/DM93

Mortar ET
- XM784
- XM785

• Training Fuze
• Over 90% Commonality with M734A1
• 1/2 the cost of M734A1

• Replaces mechanical with electronic timing
• Increased performance and safety
• CONUS production
XM784 / XM785 ETFM
Overall Program Plan

• Systems Engineering / IPT Approach
• Contract Awarded To ATK
  • Phase 1: Develop & Demo Design Solutions
  • Phase 2: Production Qualification / TC
    • Conduct Government Ballistic Tests (PQT)
    • TC Standard
  • Phase 3: Low Rate Initial Production
  • LRIP Effort (22k – 60k fuzes)
    • FAAT
    • Three Production Lots to MR
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ETFM Technologies

- Modular design approach - one fuze design fits both housings
- Commercial off the shelf (COTS) surface mount electronics
- Dual micro-controller electronic safety architecture
- Magnetic 2nd environment safety (Non-spin, non-air breathing application)
- Lithium Thionyl Chloride reserve battery
- Miniaturized electromechanical (command-to-arm S&A)
- Hand Settable / LCD Display
- NVM Self-Diagnostics Tool
XM784 / XM785 ETFM
Modular Design

- Increment / Decrement Switches
- Battery Primer Assembly
- Battery Stab Assembly
- 2nd Environment Sensor Coil
- Setting ring
- Battery Stab Rod
- Potted Electronics Assembly
- Back-lit LCD
- S&A
- *Expulsion Charge
  *not common

XM784

XM785
Easy to Assemble

Platform for Growth
Adaptable to cargo projectile (Overhead Safety)
Command-to-arm S&A applications
  - Expulsion charge
  - HE initiation
  - Rocket motor initiation
Magnetic 2\textsuperscript{nd} environment sensor applications
  - Non-spin
  - Non air breathing

Facilitates Change
Adaptable to embedded fuze applications
Add performance enhancements
  - Velocity measurement
  - Turns counting
2-Layered Stiffened Flex PWB
- Top-side components only
- Back side stiffener
- Minimize interconnects
- Easy to package

Standard surface mount components
- No ASIC’s
- SMT connectors

XM784 / XM785 ETFM
Highly Cost Effective Use of COTS

- LCD I/F
- Sensor I/F
- Sensor Circuit
- Regulation
- Battery (Backside)
- Main uC
- PA/DET Circuit
- NVM
- Safety uC
- S&A Interface

Highly Cost Effective Use of COTS
XM784 / XM785 ETFM Sensor Processing Flow Diagram

ETFM MAGNETIC TUBE EXIT SENSOR SIGNAL PROCESSING FLOW DIAGRAM

HARDWARE

SENSE COIL

1KHz LP FILTER & 100dB Gain

8-Bit A/D 10 KHz Sample Rate

FIRMWARE

Absolute Value (Full Wave Rectification) & Bias Subtraction

Event Time-Window Signal Summation & Minimum Threshold Comparison

Post-Event Time-Window Signal Summation & Maximum Threshold Comparison

VALID EVENT

INVALID EVENT

ACTION TIME SWITCH CLOSED

FIXED WINDOW PROCESSING TIMES
XM784 / XM785 ETFM
Typical Magnetic Sensor Profile

SN2:60mm Chg1

Graph showing Magnetic Sensor Voltage (Volts) vs. Time (ms) for Op-Amp, Sensor-Amp, and Action Time Switch.
XM784 / XM785 ETFM
Low Risk Power Source

Production Proven
M762/M767 Lithium Thionyl Chloride Reserve Battery

XM773 Battery Stab Assembly

M762/M767 Battery Primer Assembly
• Fixed Arm time (determined by electronics)
• Explosive train flexibility
  - Expulsion charge
  - High Explosives
  - Rocket motor
• Over head safety achievable

XM784 / XM785 ETFM
Miniature Command-To-Arm S&A

ATK S&A Patent Pending
The Processor and Power Supply assemblies are ultrasonically welded together and then potted with polystyrene.
The Coil Assembly & Battery Primer Assembly contacts interface with sockets in the CCA.
XM784 / XM785 ETFM
Designed For Production – Con’t

Level 1 Assembly, XM784

- Magnet retained in coil assembly
- 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
The S&A, S&A Retainer, LCD Connector Support, and Expulsion Charge Assembly are supported within the Level 1 Assembly by the Expulsion Charge Cup.
XM784 / XM785 ETFM
Summary

❖ **Operational Flexibility**
Manually settable day or night without tools
Future Growth – Inductive Setting

❖ **Improved Performance**
Meets all MIL-STD-1316E safety requirements
Supports future mortar fire control systems
Achieves Increased time function accuracy

❖ **Value For The Dollar**
Platform for growth (Adaptability)
Designed for producibility
Up-to-date technologies