Inductive Settable Electronic Time Fuze for Mortars

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Disadvantages of Conventional Mortar Time Fuzes

- Second environment sensor – Pull wire
- Not compatible with autoloader systems
- Timing inaccuracy – especially at temperature extremes
- External lighting source required at night
- Ballistic range changes due to profile
- Excessive time required for setting
- Special tools required for setting
Design Objectives for a new Mortar Time Fuze

- Compatible with all 60mm to 120mm mortar systems
- Inductive time setting within 1.5 seconds
- Settable from 5.0 to 199.9 sec in 0.1 sec steps
- Time read-back facility
- Time accuracy better than 100mS
- External profile compatible with DM93 fuze
- Impact Backup Mode
- Use of two independent timers
- Overall Reliability >99%
- STANAG 4157 / 4187 Compliant
Inductive Set Mortar Time Fuze – MTF01

• Characteristics
  • Based on well proven proximity fuze M9327
  • Turbine Generator Powered
    • No Stored Electrical Energy
  • Inductively Set
    • STANAG 4369 Based protocol
    • Supports inductive “readback”
    • Settable 5.0 to 199.9 sec in 0.1 s steps
  • Microprocessor based electronics
    • ‘Flash’ Microprocessor Technology
    • Indefinite memory retention
    • Dual Independent Timers
  • Timing accuracy better than 100ms
  • Electronic Safety time 4.0 sec
• MTF01 Characteristics – Continued

• Electronic Superquick Impact Backup
• Safe and Arm Device:
  • 180° Out of line when safe
  • Turbine Driven Reduction Gearbox
• Dual Environments:
  • Setback
  • Airspeed
• Turbine protected against overspeed
• Black Powder Pyrotechnic Charge
• Waterproof nose cover for storage
• Fuze Mass (Nominal) 375gr
Inductive Set Mortar Time Fuze – MTF01

- Programming Coil
- Turbine Generator
- Timer Electronics
- Electric Detonator
- Impact Switch
- Safety and Arming Device
- Expulsion Charge
Design Challenges

- Fitting of turbine generator and SAD into the available space.
- Design of electronics to operate near apex on low charges.
- Inductive coil dimensions and position
- Timebase Circuitry:
  - Accuracy
  - G-Hardeneing
  - Independent Timer
- Calibration of the electronics via inductive interface
MTF01 - Functional Block Diagram

- Inductive Coil
- Coil Interface
- Low Power CMOS Timer
- Impact Switch
- Microprocessor
- Fire Circuit Arming Timer
- Turbine Generator
- FIRing Circuit
- Detonator

**Key:**
- = Used in all modes
- = Used before firing only
- = Used in flight only
## Operational Limits

<table>
<thead>
<tr>
<th></th>
<th>Minimum</th>
<th>Maximum</th>
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</thead>
<tbody>
<tr>
<td><strong>Temperature</strong></td>
<td>-46ºC</td>
<td>+63ºC</td>
</tr>
<tr>
<td><strong>Acceleration</strong></td>
<td>600g's</td>
<td>18 000g's</td>
</tr>
<tr>
<td><strong>Muzzle Velocity</strong></td>
<td>65m/s</td>
<td>480m/s</td>
</tr>
<tr>
<td><strong>Terminal Velocity</strong></td>
<td>60m/s</td>
<td>480m/s</td>
</tr>
<tr>
<td><strong>Mechanical Safe Distance</strong></td>
<td>60m</td>
<td></td>
</tr>
<tr>
<td><strong>Electronic Safe Time</strong></td>
<td>4 sec</td>
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**Time Function**

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<table>
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<tr>
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<tbody>
<tr>
<td><strong>Time Setting</strong></td>
<td>5.0 sec</td>
<td>99.9 sec</td>
</tr>
<tr>
<td><strong>Accuracy</strong></td>
<td>Better than 100 ms</td>
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**Point Detonating Backup Function**

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<tr>
<td><strong>Impact Angle</strong></td>
<td>20º</td>
<td>90º</td>
</tr>
<tr>
<td><strong>Deceleration</strong></td>
<td>100g’s (3ms)</td>
<td></td>
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Status

- Successful dynamic firings on various charges and mortar weapon systems in South Africa.

- Successful firings on an autoloading 120mm dual barrel “mortar under armour” system.

- Design is ready for production
Hand set Mortar Time Fuze - M9813

- Hand settable electronic time fuze
  - Settable 4.0 to 99.9 sec.
- Usable on 60mm, 81mm, 120mm Mortar
- Similar “building blocks” to MTF01
  - Turbine generator/SAD
  - Electronic timer
- Electronic super quick impact mode backup
- Mass 350g nominal
M9813 - Physical Characteristics

- Setting Rings
- Locking Buttons
- Switch PC Boards
- Turbine Impeller
- Turbine Generator
- Timer Electronics
- Safety and Arming Device
- Expulsion Charge
M9813 – Hand Settable Fuze

Functional Block Diagram

TIME SELECTOR RINGS

MICROPROCESSOR

FIRE CIRCUIT ARMING TIMER

LOW POWER CMOS TIMER

IMPACT SWITCH

TURBINE GENERATOR

FIRING CIRCUIT

DETONATOR

KEY:

:white_square: = USED IN ALL MODES

:green_square: = USED IN FLIGHT ONLY
Inductive Setters for Mortar Time Fuzes

Option 1 - M22 Handheld Setter
- STANAG 4369 setter modified for mortar fuzes
- Battery operated
- Handheld
- Supports Read Back
Inductive Setters for Mortar Time Fuzes

- Option 2 – FS 2000
  - Designed for M109 Howitzer
  - Can be customised for Mortar under Armour
  - Serial interface to Fire Control Computer
  - LED Alphanumeric Display
  - Two Colour LED Indicator of Setting status
  - Keypad for Manual data entry
FS 2000 - Integrated Fuze Setter
Inductive Setters for Mortar Time Fuzes

- Option 3 - (Future) Flashlight Setter
  - Pocket Size
  - Battery operated
  - Handheld

- Option 4 - Fully Automatic Custom setter design
Conclusion

- The MTF01 Completes Fuchs Electronics’ lineup of Electronic Time fuzes for Mortar and Artillery applications