52nd Annual Fuze Conference
13-15 May 2008, Sparks, NV

SBF – Smart Barometric Fuze

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Scope

• Introducing RAFAEL Advanced Defense Systems LTD
• Introducing RAFAEL’s Expendable Decoy Systems
• Motivation for the SBF development
• Challenges
• Classical problematic aspects
• SBF Logic and Block diagram
• Critical components
• Conclusions and Future
Rafael’s Mission

• RAFAEL as a system house aspires to provide a quality defense products to the international defense market, while maintaining its special contact with the IDF.

• RAFAEL predicts the needs of current and future combat forces worldwide and provides the technologies and systems required by those forces.
On Land

- **Trophy**
  - Active Protection System

- **SkyLite B**
  - Mini-UAV System

- **Terra Sonic**
  - Pipeline Protection

- **Terra Sonic**
  - Urban Star

- **Stalker**
  - Mobile Reconnaissance & Surveillance

- **Add-on Armor**
  - Passive and Reactive Protection

- **Tycoon**
  - Tactical C4I System

- **Spyder**
  - Air Defense Systems

- **Carpet**
  - Minefield breaching and counter-IED solution

- **Hotspur**
  - Counter-IED Solution

- **Spyder**
  - Tactical Precision Weapon System

- **Spike Family**
  - E/O Small Arms Detection System

- **ORCHID**
  - Biometric Face Recognition

- **SpotLite-Mk2**
  - E/O Small Arms Detection System

- **ORCHID**
  - Training and Simulation
    - For Land Applications

- **Simon**
  - Door Breaching Rifle Grenade

- **SADS**
  - Small Arms Detection System

- **Samson RCWS**
  - Remote Controlled Weapon Systems

- **Thor**
  - Mobile Counter-IED Solution

- **Thor**
  - Urban Star

- **Matador AS**
  - Anti-Structure Munition

- **Matador WB**
  - Wall Breaching Munition

- **Matador MP**
  - Multi-Purpose Breaching Munition

- **Matador AS**
  - Add-on Armor

- **Matador WB**
  - Passively Reactive Protection

- **Spyder**
  - Air Defense Systems

- **Spyder**
  - Mobile Reconnaissance & Surveillance

- **Spyder**
  - Active Protection System
EW Expendable Decoy Systems

Decoys And Launcher Controller

Rotatable Launcher

Rotatable Launcher With SRBOC Tubes
EW Expendable Decoys Clips

- LRCR
- MRCR
- WIZARD
- BT-4
EW Expendable Decoy Systems
Integrated Ship-Defense

- Rotatable launchers
- Three lines of defense
- Precise decoy location
- Computerized operation

Launcher & Decoys Controller
WI ZARD
MRCR
LRCR
BT-4
EW Expendable Decoy Systems

Generic Fuze

- C-Gem
- BT-4
- HEATRAP
- LESCUT
- LRCR
- WI ZARD
- MRCR
### LRCR

#### Performance
- **RCS**
- **Frequency**
- **Range**
- **Altitude**
- **Rise Time**
- **Persistence**

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<th>Performance</th>
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<tr>
<td>RCS</td>
<td>X,C,S</td>
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<tr>
<td>Frequency</td>
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<tr>
<td>Range</td>
<td>12-14km.</td>
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<tr>
<td>Altitude</td>
<td>900m.</td>
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<tr>
<td>Rise Time</td>
<td>less than 10 sec.</td>
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<tr>
<td>Persistence</td>
<td>up to 10 min.</td>
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#### Dimensions
- **Rocket Diameter**
- **Rocket Length**
- **Fins Span**
- **Rocket Weight**
- **Chaff Weight**

<table>
<thead>
<tr>
<th>Dimensions</th>
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<tr>
<td>Rocket Diameter</td>
<td>90mm.</td>
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<tr>
<td>Rocket Length</td>
<td>922mm.</td>
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<tr>
<td>Fins Span</td>
<td>179mm.</td>
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<tr>
<td>Rocket Weight</td>
<td>9.4kg.</td>
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<tr>
<td>Chaff Weight</td>
<td>1.3kg.</td>
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Motivation for the SBF Development

- Answer the Fuze’s classical problems
- Better safety
- Better reliability
- One fuze for all decoys and launchers
- Programmable electronics
- Miniaturization
Challenges

• Flexibility
• Compatibility with launchers
• Adaptation to Rocket’s Type
• Mode of Operation Selection
Classical Problematic Aspects

• Low Power / Energy Consumption
• Safety
• Environmental Conditions
• Reliability
• Low cost
Energy Consumption

• The current fuze approach
  – Energized by a limited pulse width
  – Input capacitance check before launch
  – Electro-Mechanical pressure switch
  – Analog electronics design

• SBF approach
  – Energized by the same pulse
  – Same Input capacitance
  – Low power electronic pressure sensor
  – Low power CPU – TI’s MSP430
Safety

- 2 CPUs in series arming
- BIT before launching
- Capacitors discharge
- S&A Device
- Safety delay
- Time out – fail safe
Logic’s Capacitors Bank
Logic’s Capacitors Bank
Before switching – Serial charge
Logic’s Capacitors Bank
After switching – Parallel Discharge
**SBF Logic**

- **Start**
  - Capacitors Charge
  - SBF BiT
  - BIT OK?
    - no: Capacitors Discharge
    - yes: Safety Delay

- **ARM**
  - Rocket Ignition

- **Pressure sensing**
  - Activation Decision Rule
    - no: Time out
    - yes: Payload Activation

- **Time out**
  - no: Payload Activation
    - yes: SBF Logic

- **Payload Activation**
  - no: SAFE
  - yes: END

- **SAFE**

- **END**
The Pressure Sensor

**BAROMETER MODULE**

- Integrated pressure sensor
- Pressure range 300-1100 mbar
- 15 Bit ADC
- 6 coefficients for a software compensation stored on-chip
- 3-wire serial interface
- 1 system clock line (32.768 kHz)
- Low voltage / low power
Pressure Sensor Block Diagram
CPU

• Main Performances
  – Low power microcontrollers – TI’s MSP430
  – 2 serial CPUs for arming
  – Idle state while not in use – energy conservation
  – Flexibility in design
  – Activation algorithm, performance and accuracy are mainly software dependent
  – Variable sampling rate along mission
  – Low cost
CPU

• Electrical Characteristics
  – Low Supply-Voltage Range, 1.8 V . . . 3.6 V
  – Ultralow-Power Consumption:
    • Active Mode: 280 μA at 1 MHz, 2.2V
    • Standby Mode: 1.6 μA
  – Wake-Up From Standby Mode in less than 6 μs
  – Two 16-Bit Timers
  – On-Chip Comparator
  – Serial Onboard Programming
CPU

Functional block diagram

MSP430x13x
Conclusions and Future

• The SBF new design fits all its specification and requirements
• Prototypes has been assembled and successfully tested
• We believe that the SBF is the next generation fuze for EW Expendable Decoys
Thank you

Questions?