THALES NDIA-09 Briefing

AURORA – Next Generation Fuzing System

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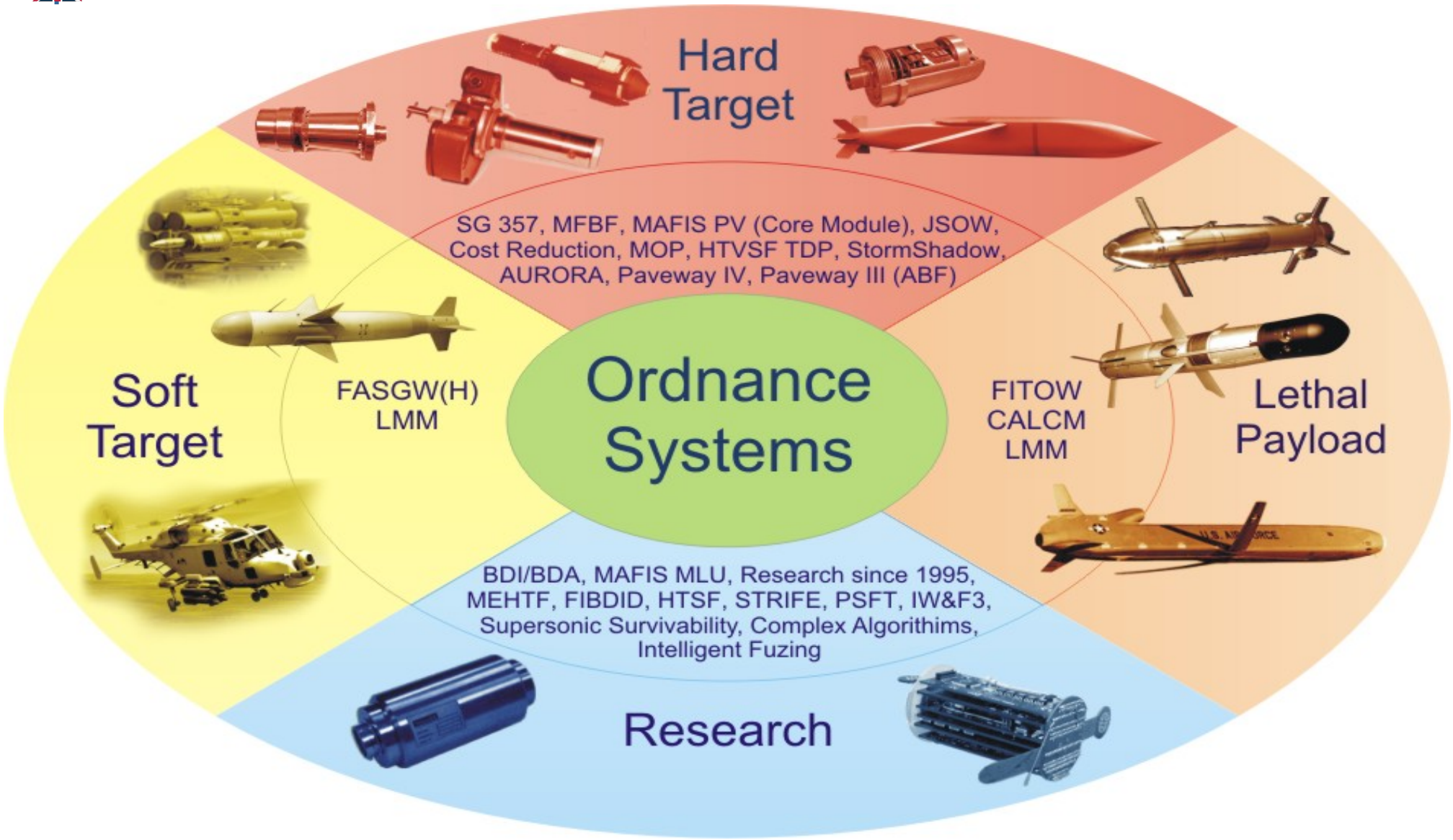
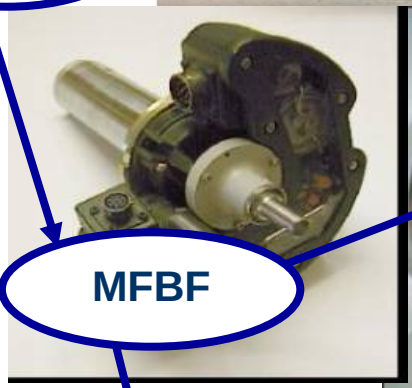
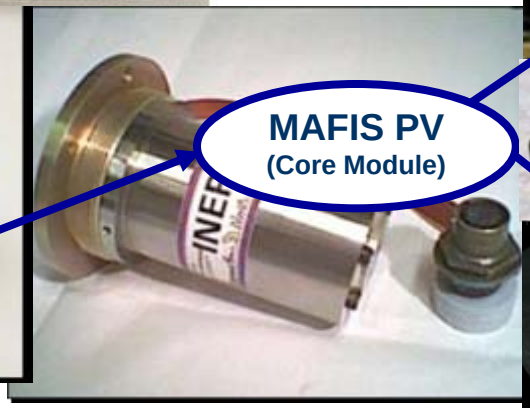


TME Ordnance Hard Target Fuzing Pedigree

SG 357



MFBF



MAFIS PV
(Core Module)

JSOW

Cost Reduction

MOP

HTVSF
JCTD

Storm
Shadow

MAFIS MLU

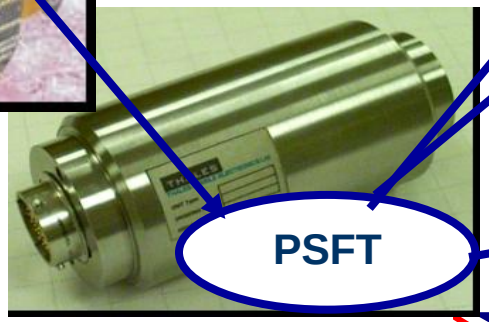
Intelligent Fuzing
Research since 1995

MEHTF

FIBDID

STRIFE

HTSF



PSFT

AURORA
Paveway IV

Paveway III
(ABF)

Background To Aurora Fuze

MFBF

MAFIS

JSOW

Storm Shadow

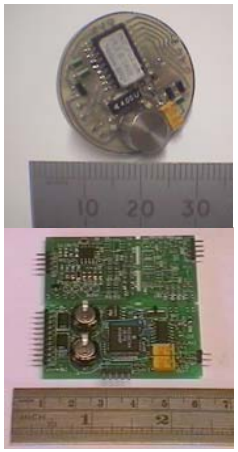
IF research since 1995

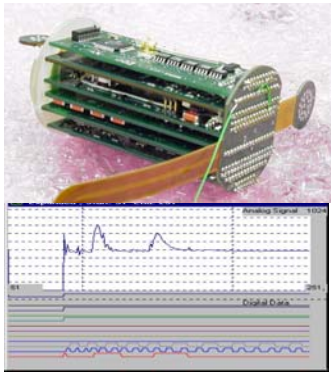
MEHTF

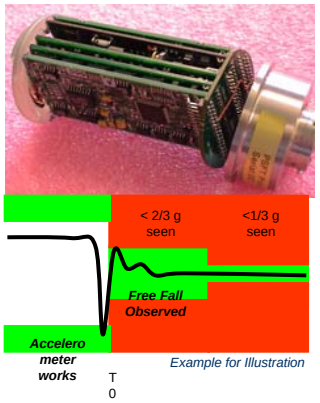
PSFT

AURORA

Paveway IV (PGB)







Aurora

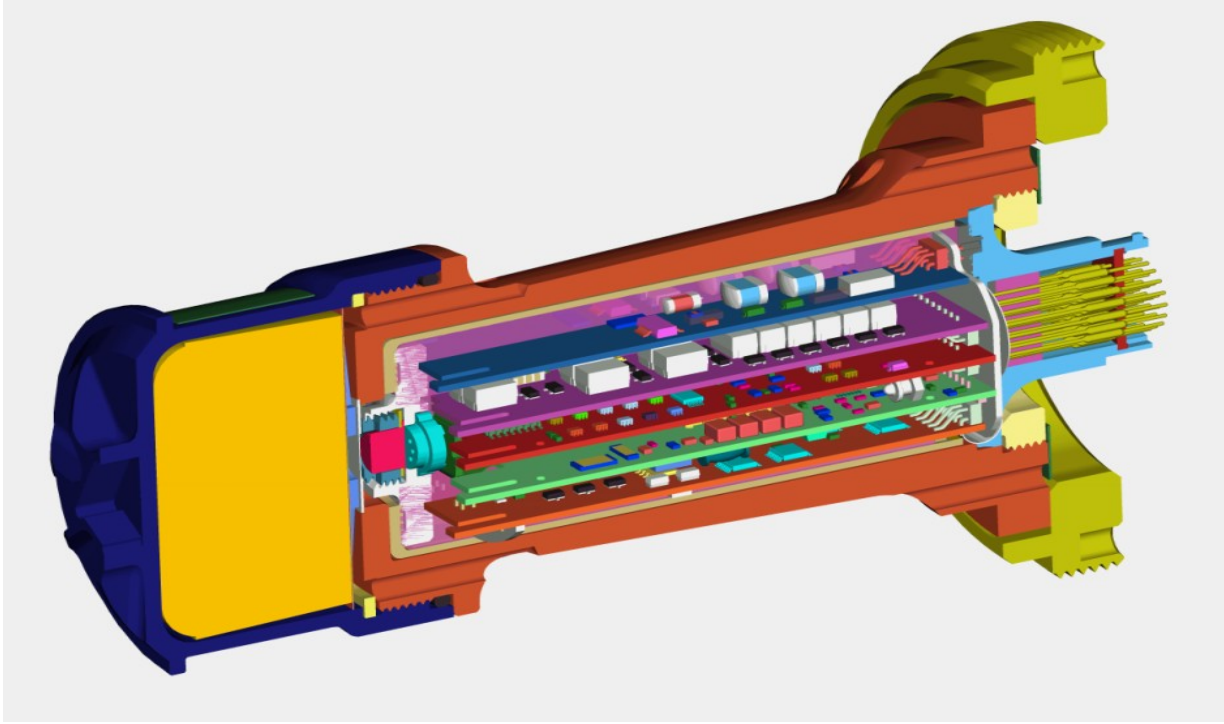
Design, Develop and Qualify fuze for Paveway IV Weapon

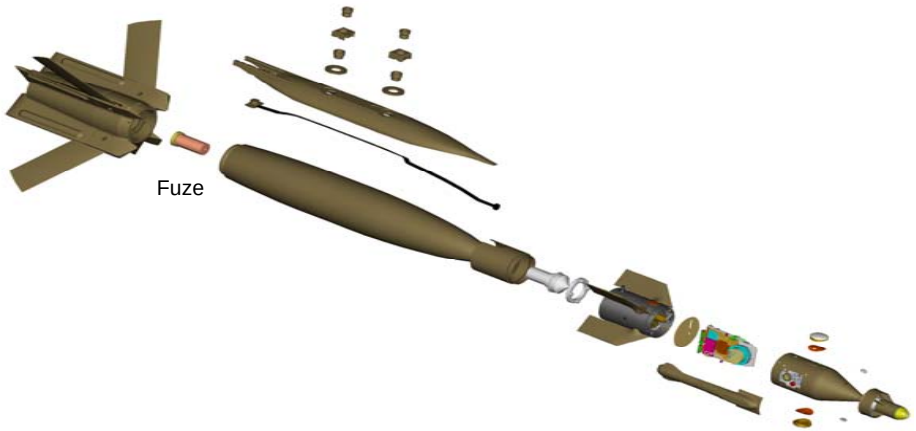
Development contract for Fuzing System in Jan 2004

Contract covers development & production

Successful qualification in early 08

In Full Rate Production





High Reliability Programmable Guided Weapon Fuze

In-Line Safety and Arming System based on MEHTF/PSFT.

Hardened, 3” Fuzing System using 2” electronics

Employs Novel Post Release Safety Environment Sensing

THALES MISSILE ELECTRONICS LIMITED

Summary of Requirements for Safety Sensors:

1st Sense the Intentional Release from the launch platform

2nd Confirm Weapon has been released into the expected environment

(Operation of at least one of the independent safety features shall depend on sensing an environment after first motion in the launch cycle or on sensing a post launch environment.) STANAG 4187 & Mil-Std-1316

Safety (Probability of False ARM)

- The Post Launch Environment Signature Shall be Unique
- Cannot be generated by credible accident, in normal handling, use, deployment or be subject to a single point failure

Reliability (Probability of Detection)

- Throughout the operational flight envelope
- In line with the system requirement

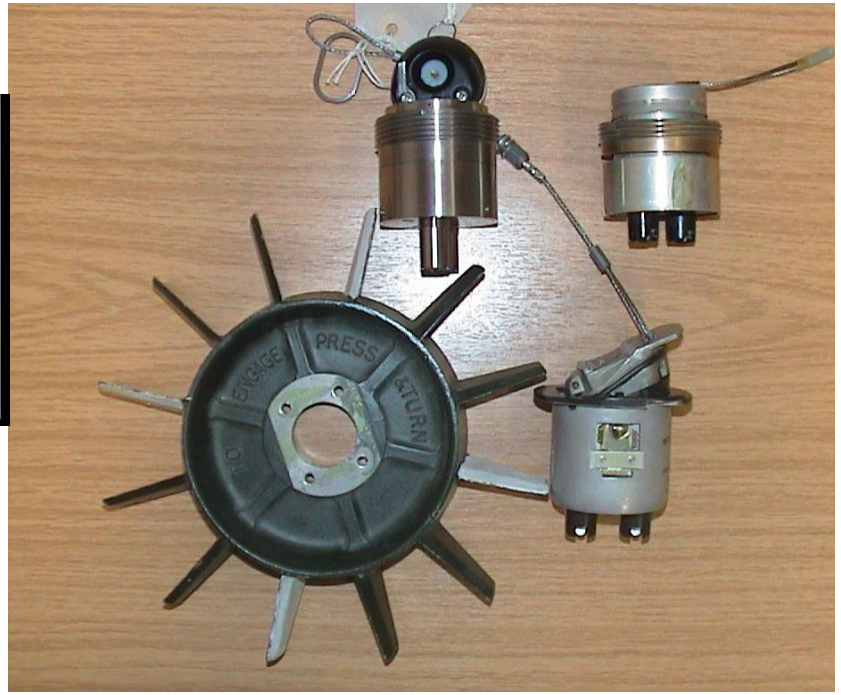
Typical Sensors

Air Flow:

Can provide a power source

But: senses an environment that is not totally unique to either “First Motion” or “Post Launch” (mainly “lanyard pulled”)

Also issues with high altitude, thin air, damage, drag etc.



Retardation sensing:

Parachute operation detection

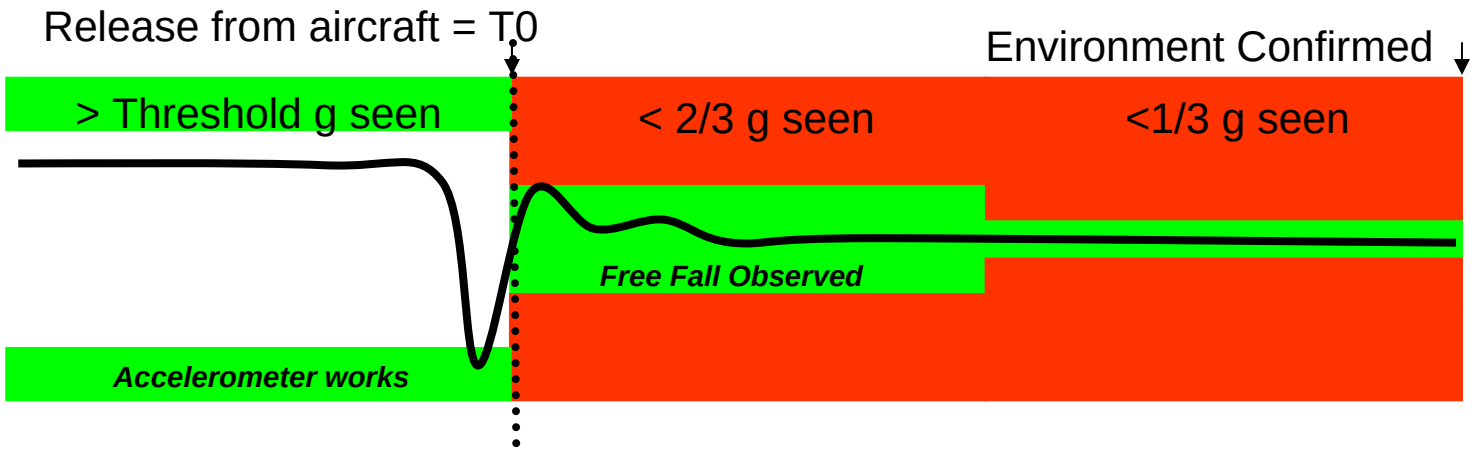
Air pressure:

Pitot (air speed)

Motor operating

Weapon Arming Manoeuvre (WAM)

➔PSFT introduced crossed axis MEMS Accelerometers and Processor to sense Post Release Environment



EXAMPLE : Internal Fuze Accelerometers monitor unique launch “g” followed by post launch zero “g” to confirm post launch environment

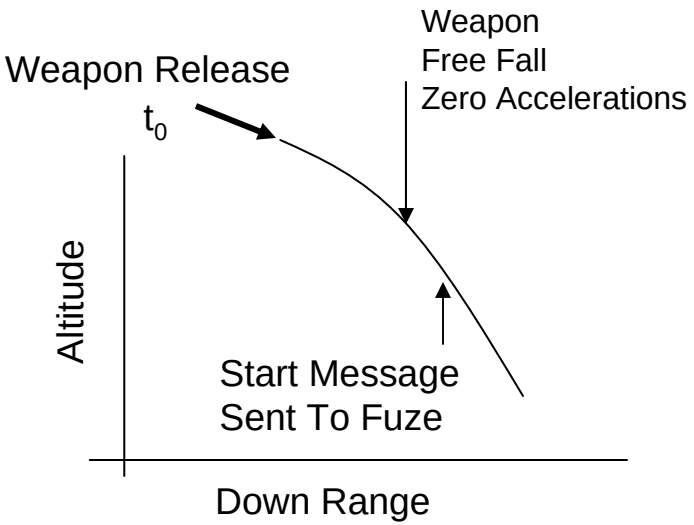
Implementation

- ➔Allow weapon to determine start point
- ➔Two stage manoeuvre
  - Enable Arming
- ➔Late Arm signal
  - Weapon Armed

BWAD Requirements

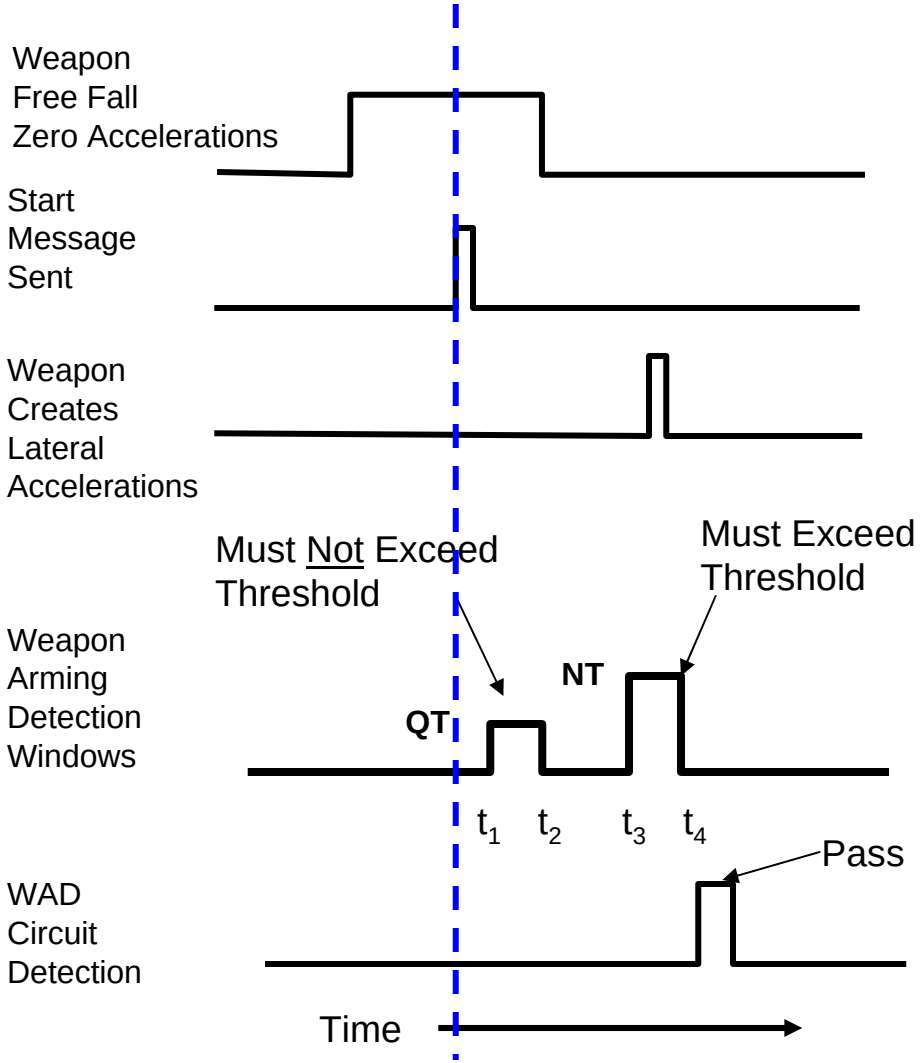
- The Ballistic Weapon Arming Detector (BWAD) will detect two events:
  - ➔ The presence of ballistic flight called the “quiet zone”.
  - ➔ A manoeuvre at a precise time following the “quiet zone”.
- Ballistic WAD Threshold and Timing:
  - ➔ Upon receipt of the start command from the weapon, the Fuze will enable the circuitry to validate the weapon motion during quiet zone and manoeuvre.
  - ➔ Two different acceleration thresholds (g levels) are defined; one for each event.
  - ➔ During the quiet zone the g levels must remain below the acceleration threshold.
  - ➔ Following the quiet zone, the g level must cross the acceleration threshold during the manoeuvre
- A Dual Axis Accelerometer is used to measure the “g” levels as the manoeuvre is performed
- Accelerations due to Vibration on the Wing Encountered During Training and Tactical Missions and due to vibration encountered during transport or assembly not be mistaken for the WAM

Ballistic Weapon Arming Detection (BWAD) Description



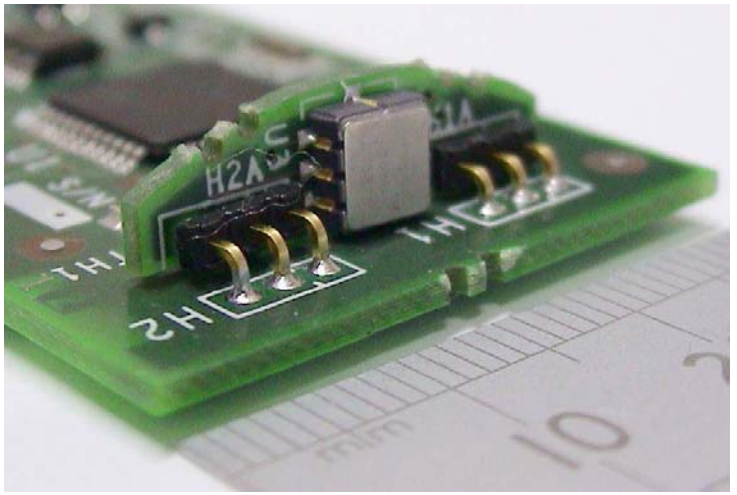
BWAD Variables

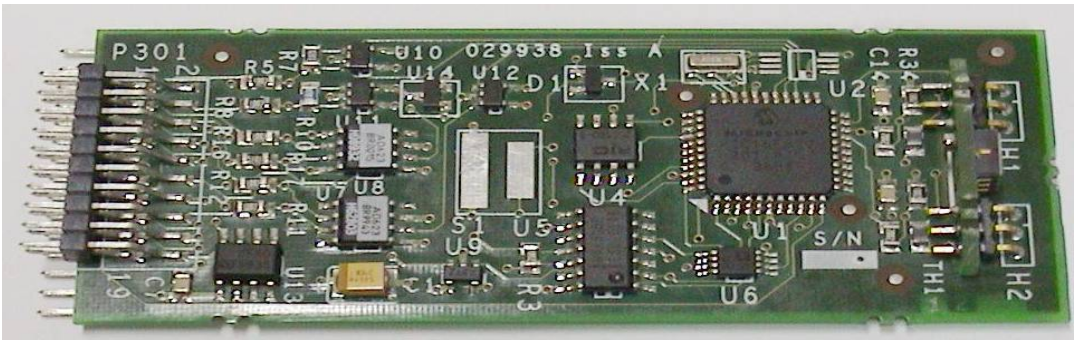
Quiet Zone Threshold	QT
Noise Zone Threshold	NT
Quiet Zone Witness Window Open Time	t_1
Quiet Zone Witness Window Close Time	t_2
Noise Zone Witness Window Open Time	t_3
Noise Zone Witness Window Close Time	t_4



Advantages:

- Unique second environment
- Manoeuvre is at commanded time:
  - ➔When convenient to weapon
  - ➔Can be set to specific flight parameters
  - ➔Expands release envelope
- Simple in operation
  - ➔All "Hardware" checking logic
  - ➔No (Safety Critical) Software





Analyse and Prove Safety & Reliability performance

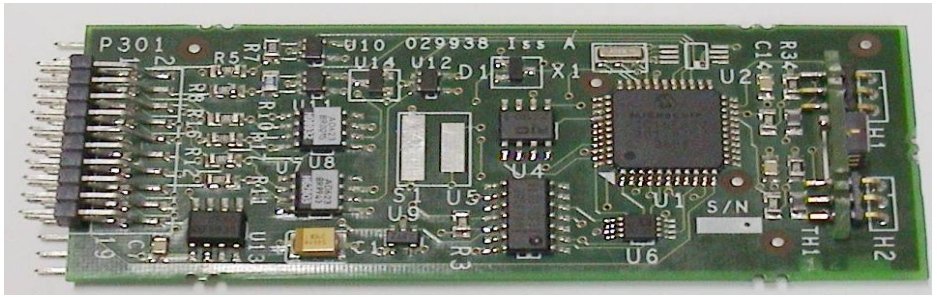
- Develop a model of the sensor and circuit

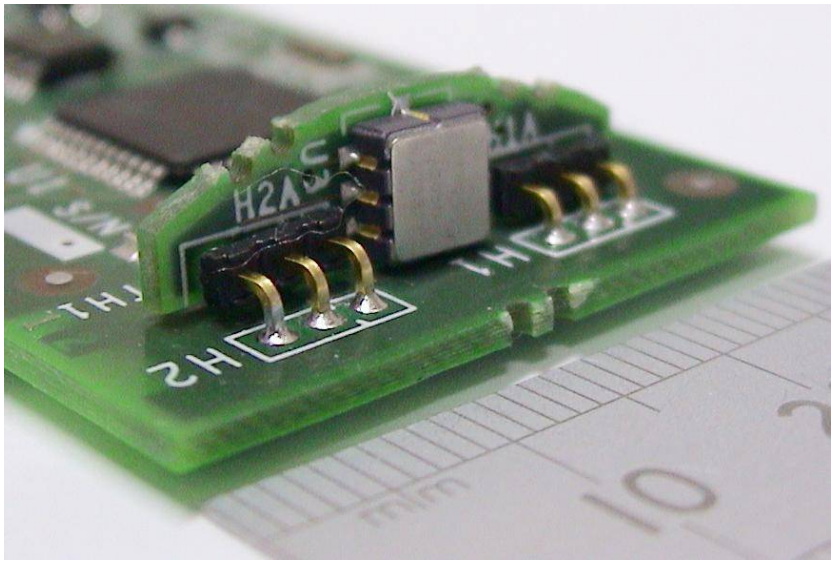
- Validate performance over the spread of component tolerances and temperatures against the actual aircraft & credible accident scenario's

- Use actual recorded data from aircraft
- Generate data for credible accidents
- Validate model against hardware in simulated environment

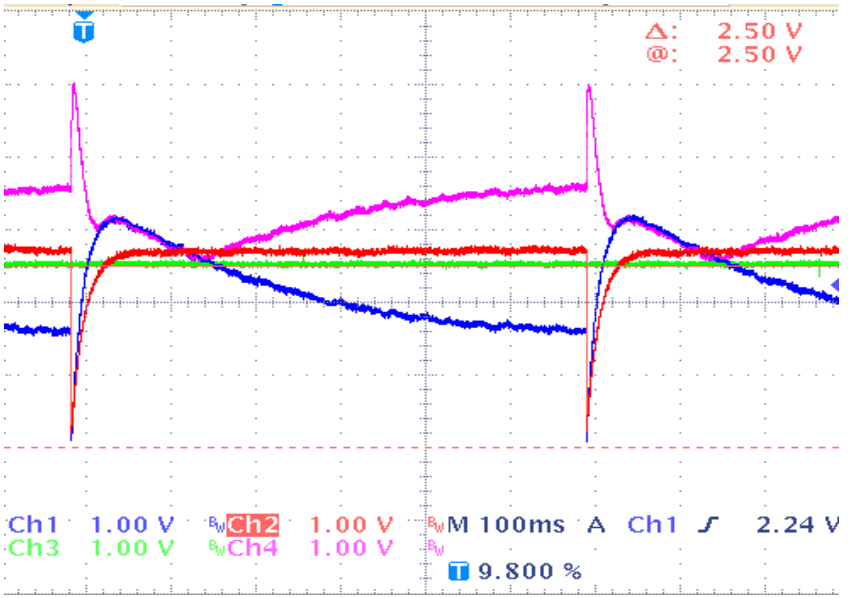
Model of the sensor and circuit

- Include Sensor parameters
  - ➔ Sensitivity
  - ➔ Linearity
  - ➔ Offset
  - ➔ Cross axis coupling
- Include component & circuit variability's
  - ➔ Component tolerances
  - ➔ Temperature variations
  - ➔ Noise
  - ➔ Calibration

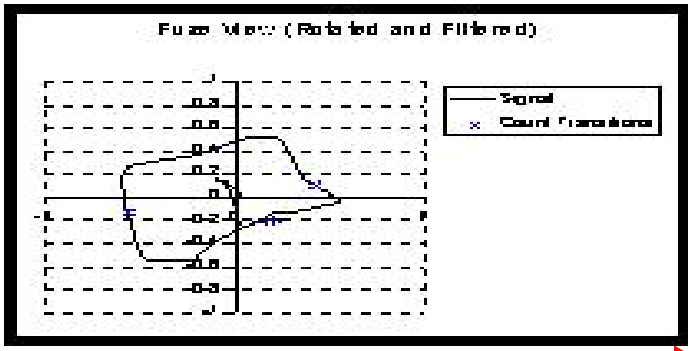




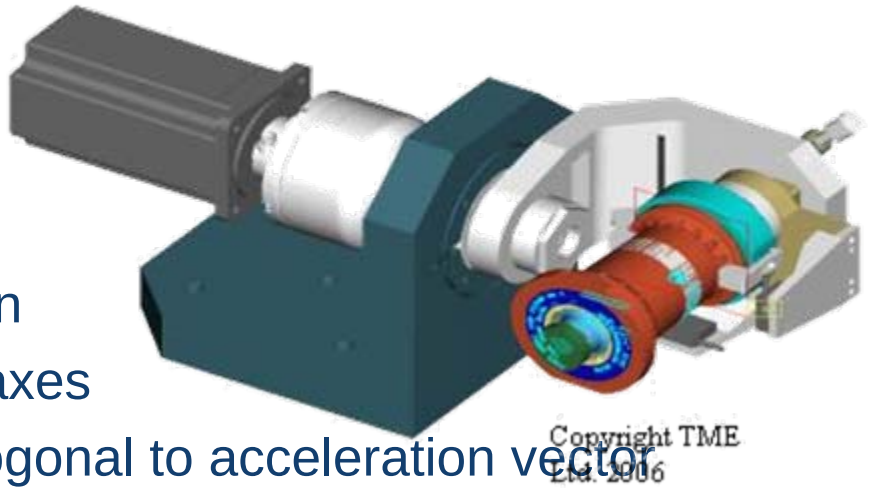
Model Benefits



- Fast Run-times
  - ➔ Enabled multiple runs
  - ➔ Good statistical analysis
- GUI front end – easy to use
- Parameters can be tuned in real time
- Enabled understanding of design and its limitations
- Enabled difficult trajectories to be easily identified and investigated
- Allowed performance of intent to be assessed without circuit being implemented



Centrifuge testing of assembly



- Centrifuge can simulate the actual weapon environments
- Two axis positioner allows acceleration produced to be vectored into difference axes
- Aligning fuze's two sensing axes orthogonal to acceleration vector enables the fuze to detect zero "g"
- Dynamic testing with Start command" followed by vectored acceleration allows representative BWAM to be applied to fuze
- Aircraft type data can also be applied. Selection of data close to the decision threshold achievable
- Incorrect inputs to prove no arming of system

Proved BWAD performance - Safe & Suitable for service

Aurora accepted into UK service

- DOC trials at China Lake

Paveway IV deployed with UK Armed Forces

Successfully fired in combat

- Against a range of hard & soft targets

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