



# Extended Range Guided Munition (ERGM) Safe & Arm Device and Height-of-Burst Sensor

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# ERGM Background

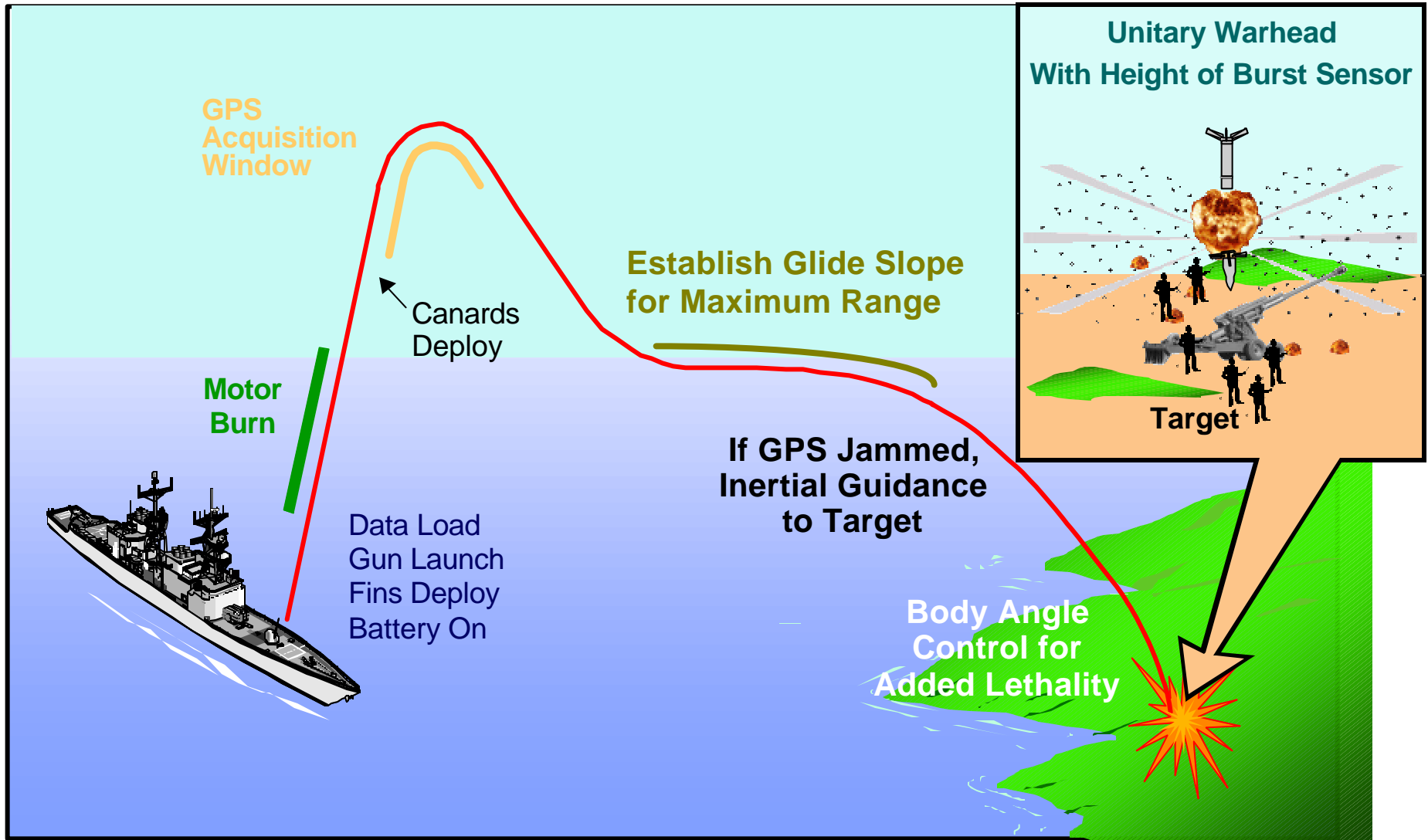
Extended Range Guided Munitions

- Designated the EX171, ERGM is being developed for the US Navy (NSWC/WD) by Raytheon
- GPS-Guided Projectile
  - Long range (15 - 50 nautical miles)
  - Highly accurate independent of range
  - Extremely effective against a variety of targets
  - Designed for use on 5” naval gun systems
  - Provides effective fire support for operations ashore



# ERGM CONOPS

Extended Range Guided Munitions





## ERGM Background (continued)

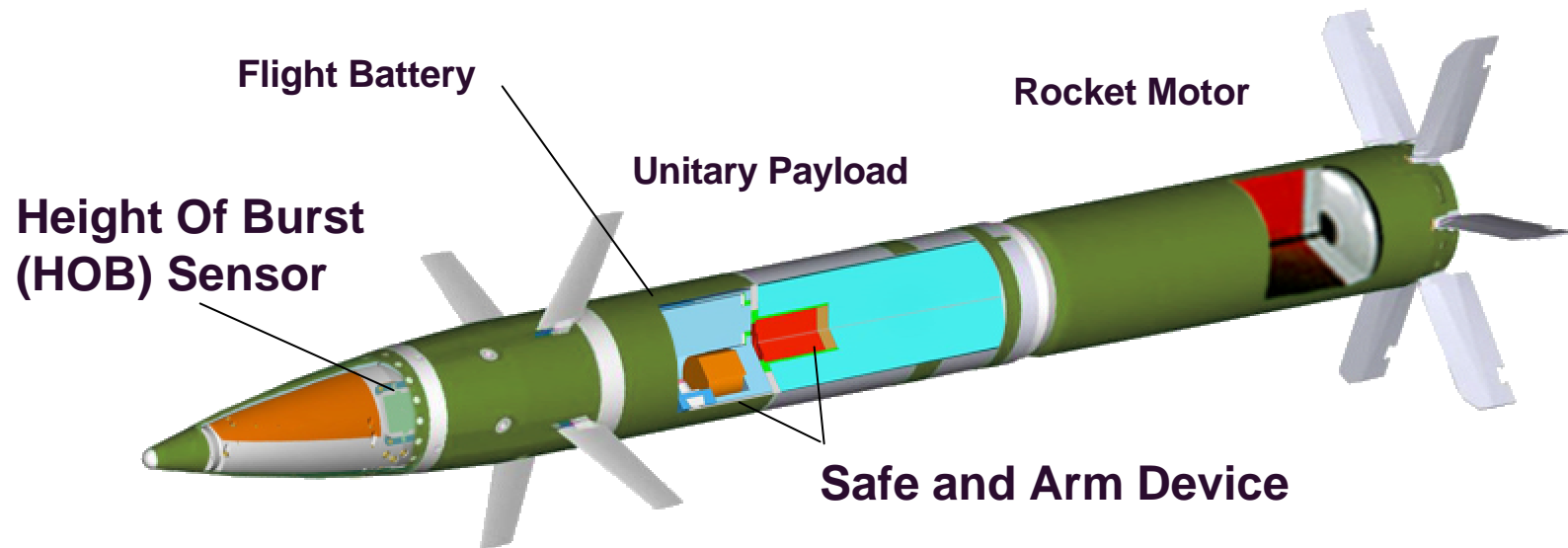
Extended Range Guided Munitions

- **Formerly DPICM -- Converted to Unitary Warhead**
  - Near vertical approach angle
  - Maximum lethality achieved with well-controlled burst height
    - Requires accurate, reliable HOB sensor
  - KDI designed S&A for DPICM round
    - Selected by Raytheon to design HOB Sensor and S&A



# Overview

Extended Range Guided Munitions





# HOB Sensor Design Requirements

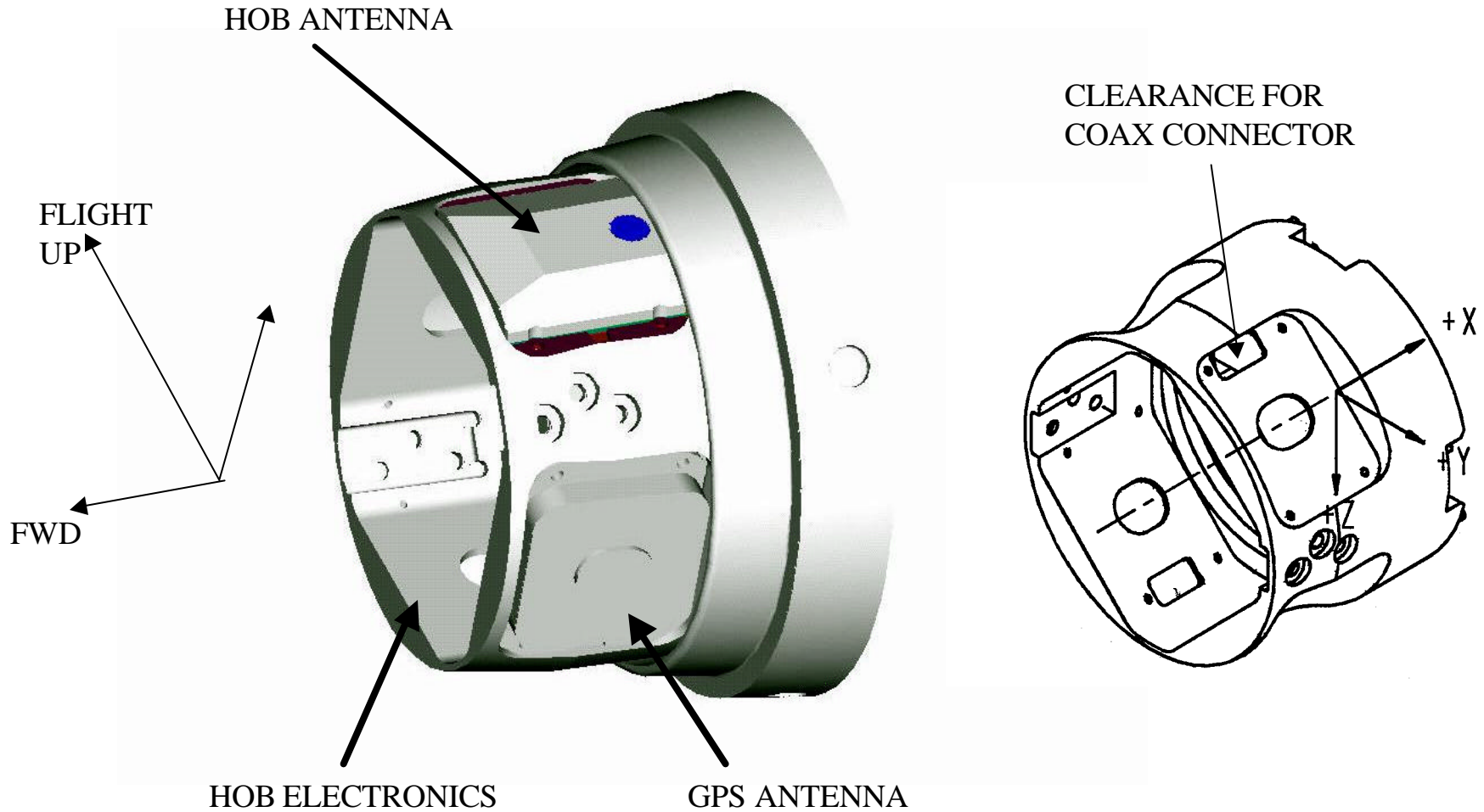
Extended Range Guided Munitions

- **Very Tight HOB Tolerance ( $10 \pm 2$  ft)**
- **Approach angle vertical  $\pm 10^\circ$**
- **Packaging Volume**
  - **HOB sensor limited to two pockets in existing casting**
    - **Signal processing module**
    - **Antenna**
- **Must Survive all ERGM Environments**
  - **Setback acceleration 10,100 g (nominal)**
  - **Balloting 2,500 g**
  - **-40°F - +145°F storage**
  - **+15°F - +146°F operating**



# HOB Sensor Packaging

Extended Range Guided Munitions





# HOB Sensor Electronics

Extended Range Guided Munitions

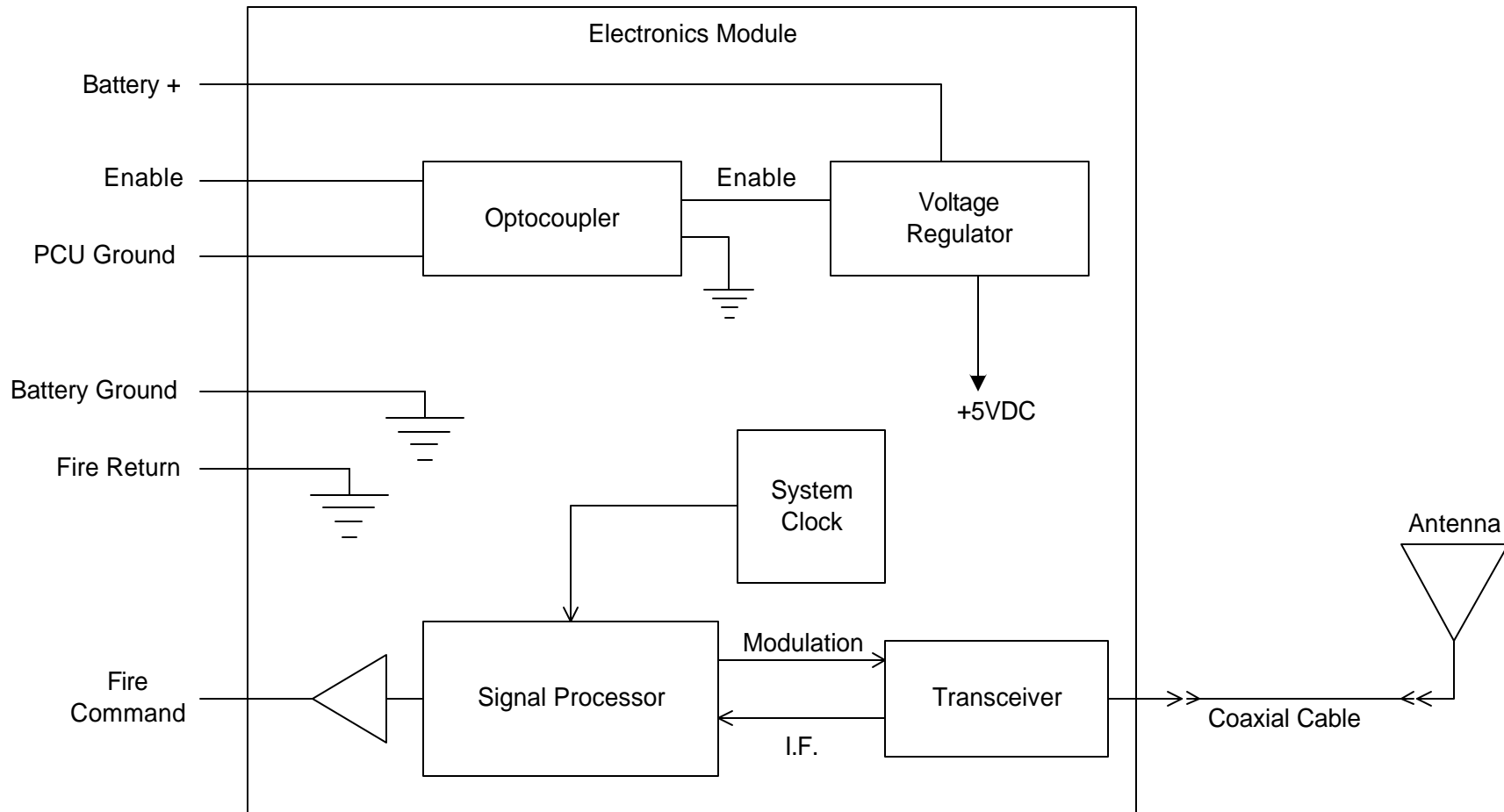
- **Directional Doppler Radar (DDR) Proximity Sensor**
- **Based on RF Transceiver MMIC and Signal Processor ASIC Developed for Multi-option Fuze for Artillery (MOFA)**
  - Performance well characterized
  - ECM resistant
  - Low risk
- **Packaged to fit within available volume**





# HOB Functional Block Diagram

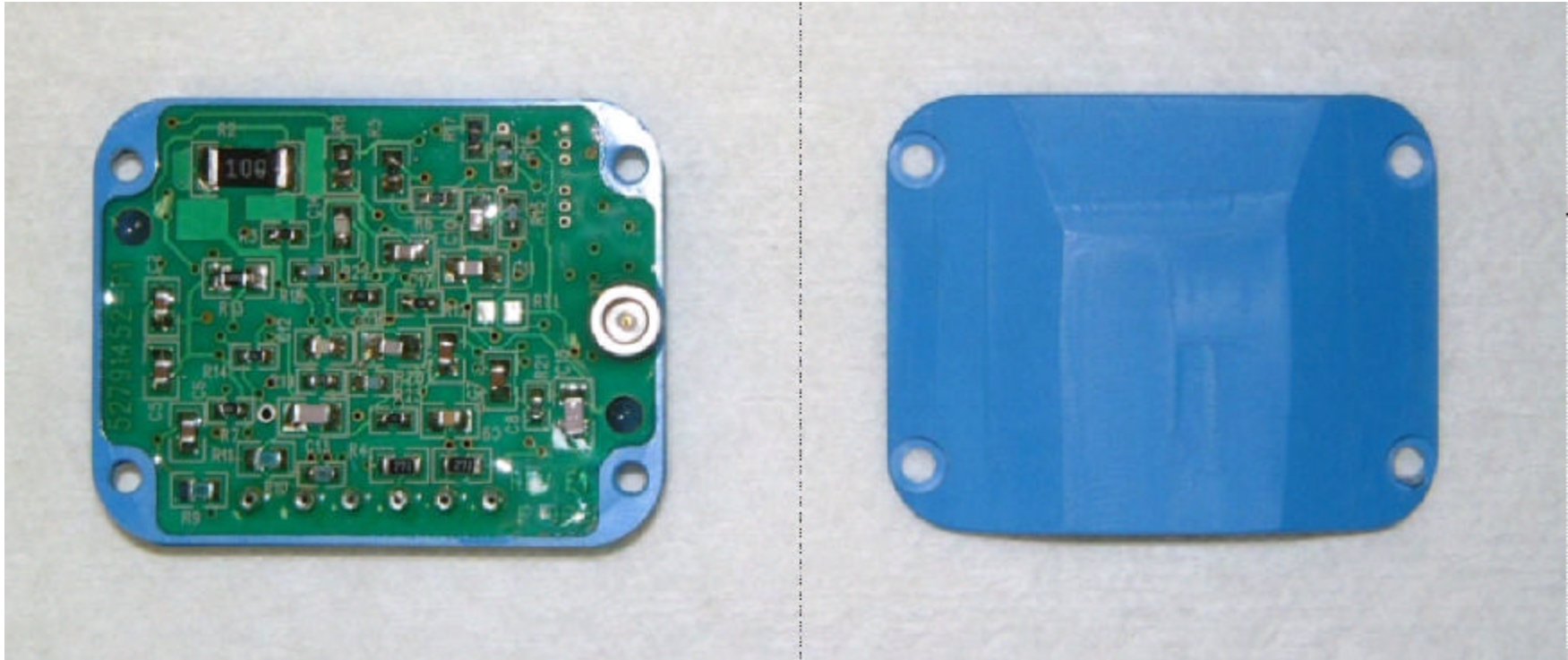
Extended Range Guided Munitions





# HOB Sensor Electronics Module

Extended Range Guided Munitions





# HOB Antenna

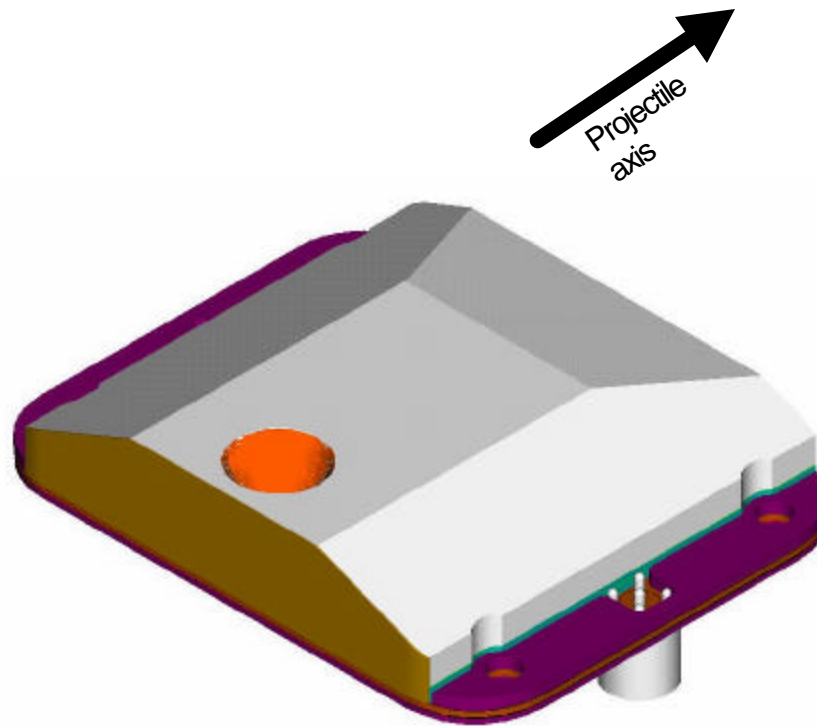
Extended Range Guided Munitions

- **Electrical Design Requirements**
  - Forward looking pattern with side-mounted antenna
  - Wide bandwidth
  - Gun rugged



# HOB Antenna

Extended Range Guided Munitions

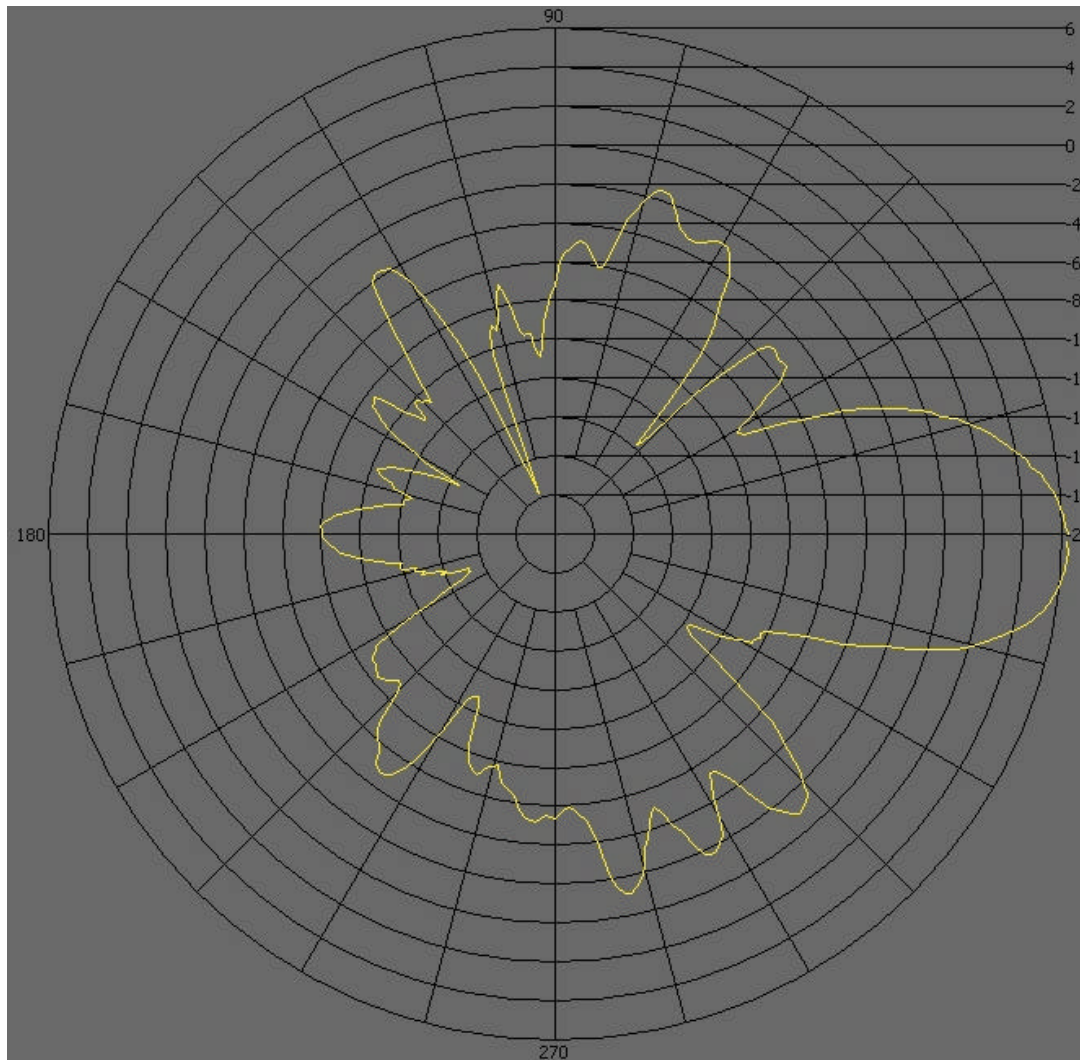


- Raytheon design
- Meets requirements with margin



# HOB Antenna Radiation Pattern

Extended Range Guided Munitions



Nose Forward





# Safe & Arm Device

Extended Range Guided Munitions

- **Electromechanical**
  - **Command-to-Arm**
  - **Setback is First Environment**
    - **3 G-Leaf Setback Sensor**
  - **Second Environment – spin switch**
  - **FPGA-Based Logic**
  - **Serial Communication with Mission Computer**



# S&A Key Performance Requirements

Extended Range Guided Munitions

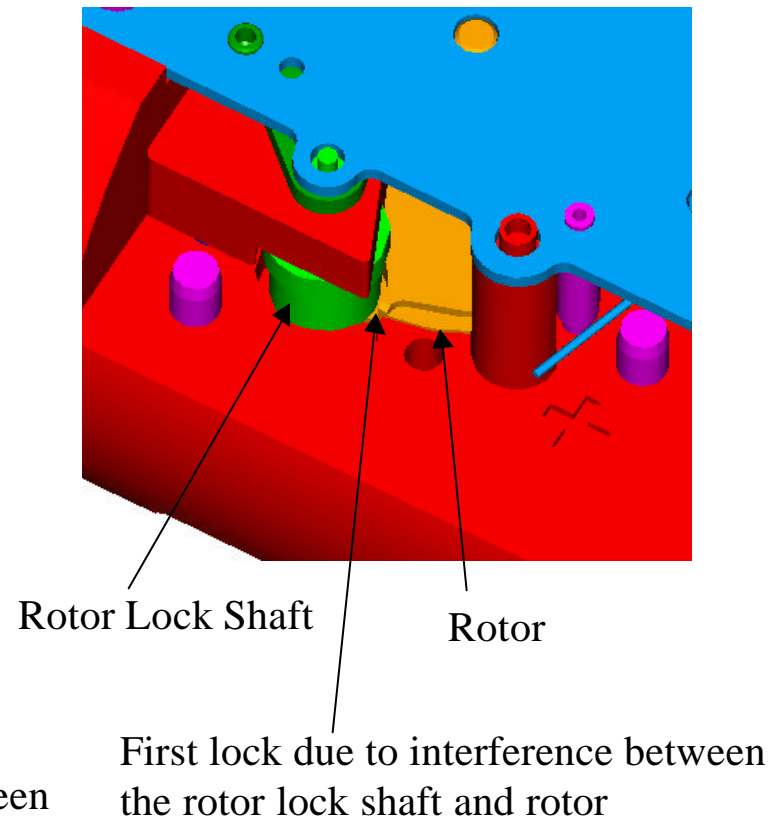
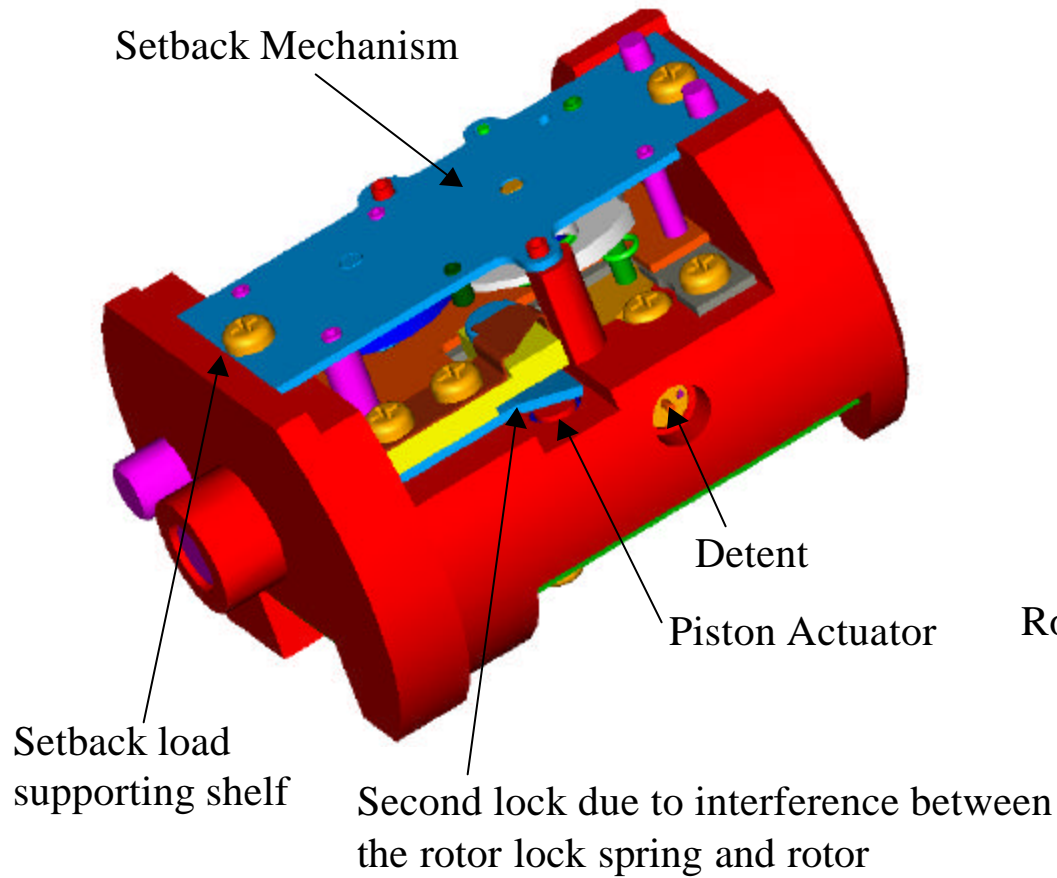
| <b><u>Topic</u></b>         | <b><u>Value</u></b>   |
|-----------------------------|-----------------------|
| – <b>Setback (proof)</b>    | <b>12,000 g</b>       |
| – <b>Setforward</b>         | <b>2,500 g</b>        |
| – <b>Ballotting</b>         | <b>2,500 g</b>        |
| – <b>Power Supplied</b>     | <b>14.25 - 15.75V</b> |
| – <b>Weight Elec. Assy.</b> | <b>(Total 1 Lb.)</b>  |
| – <b>Weight Mech. Assy.</b> | <b>(Total 1 Lb.)</b>  |





# S&A Internal Arrangement - Mechanical Details

Extended Range Guided Munitions

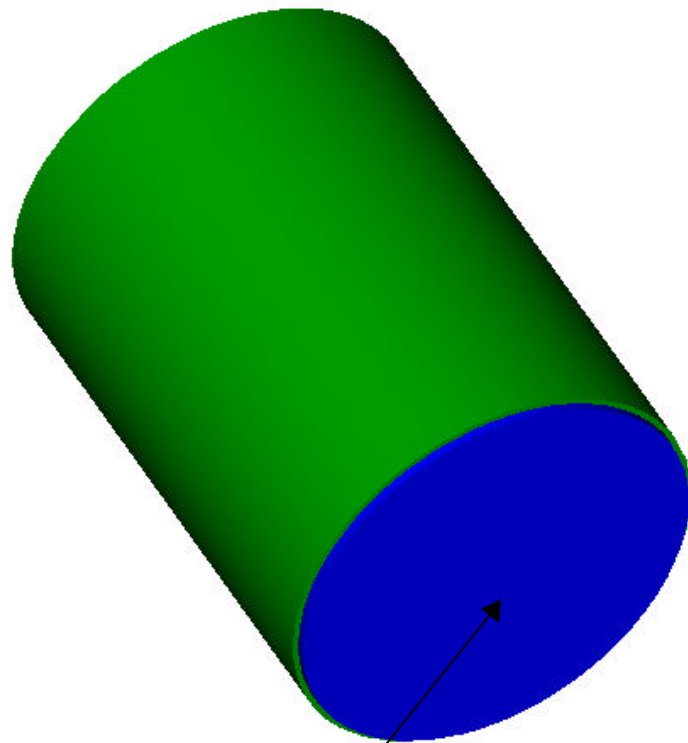




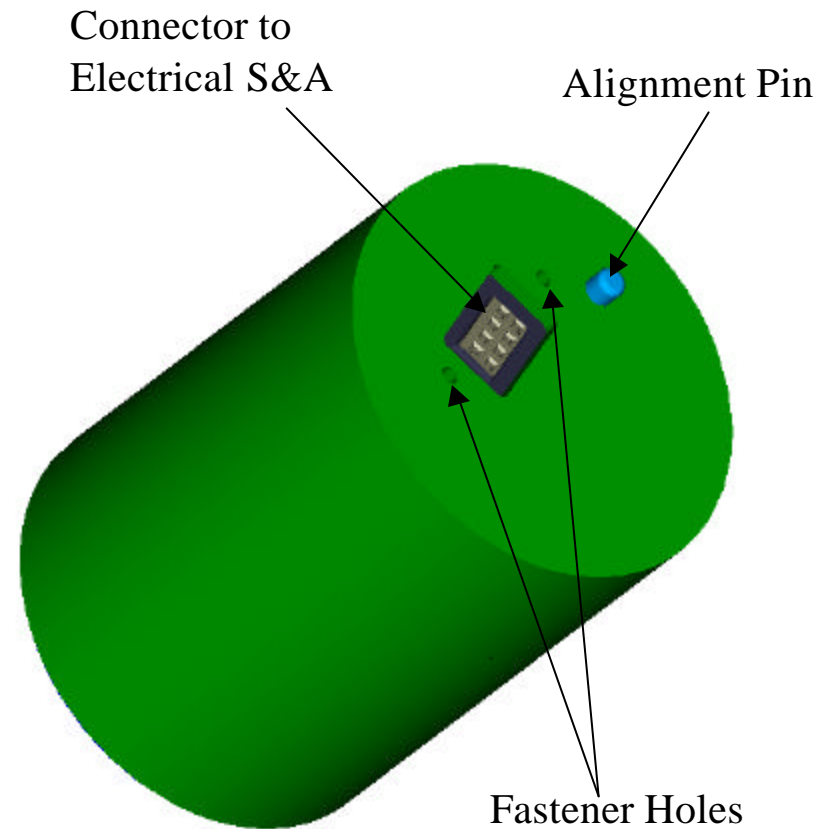


# S&A External Interface Illustration Mechanical Assembly

Extended Range Guided Munitions



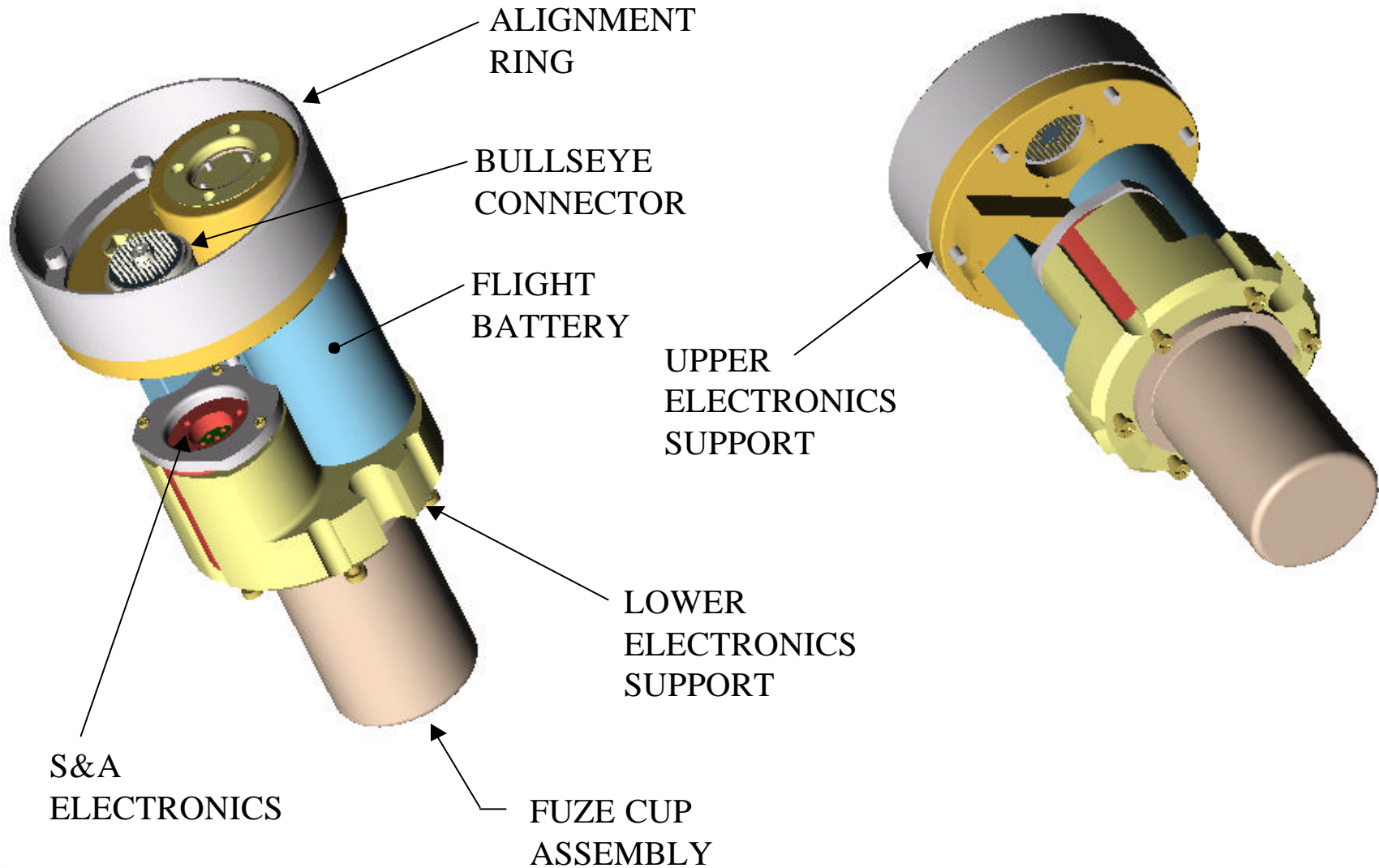
Explosive Output (aft face)





# S&A Integration

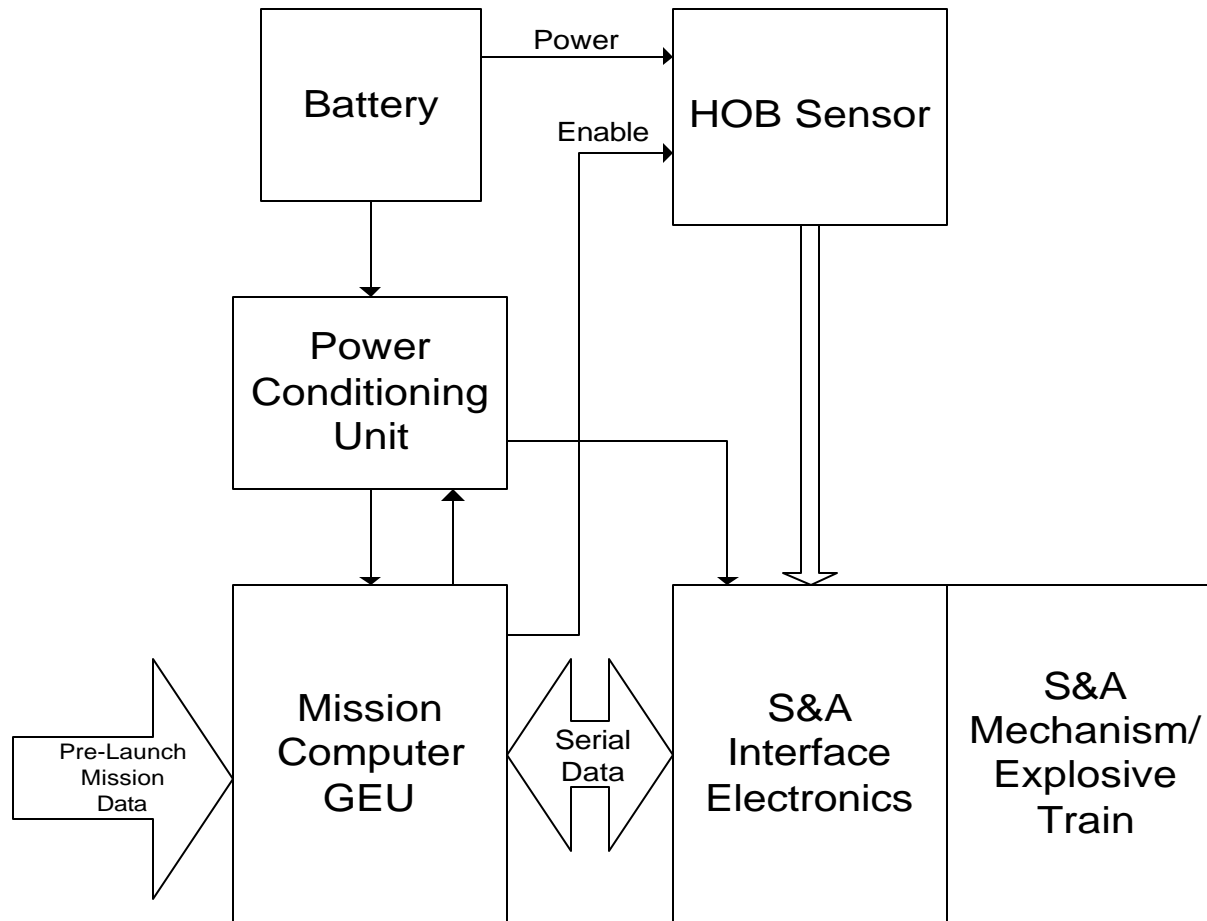
Extended Range Guided Munitions





# S&A/HOB Functional Block Diagram

Extended Range Guided Munitions





# Design Status

Extended Range Guided Munitions

- **HOB Sensor**
  - Lab testing shows excellent performance
    - Tight HOB over expected target variations
    - Significant sensitivity margin
  - Gun-hardness proven in Canister Test
- **Safe & Arm Device**
  - Successfully passed HAST
  - Mechanism qualified on DPICM round
  - Gun-hardness proven in Canister Test



# Summary

## Extended Range Guided Munitions

- **Mature System Concept**
  - HOB sensor and S&A based on qualified designs
    - Low Risk
    - Maximum Reliability
    - Rapid Development
  - Meets all System Requirements
  - Team work essential part of success



Successful ERGM Guided Flight Test  
4m accuracy

**EX171 Meets or Exceeds User Needs!**