



communications

KDI Precision Products, Inc.

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Affordable Weapon System



ESAF & HOB Design

John Hubert & Brian Miracle

NDIA 50th Annual Fuze Conference

May 9-11, 2006

Proprietary
www.l-3com.com

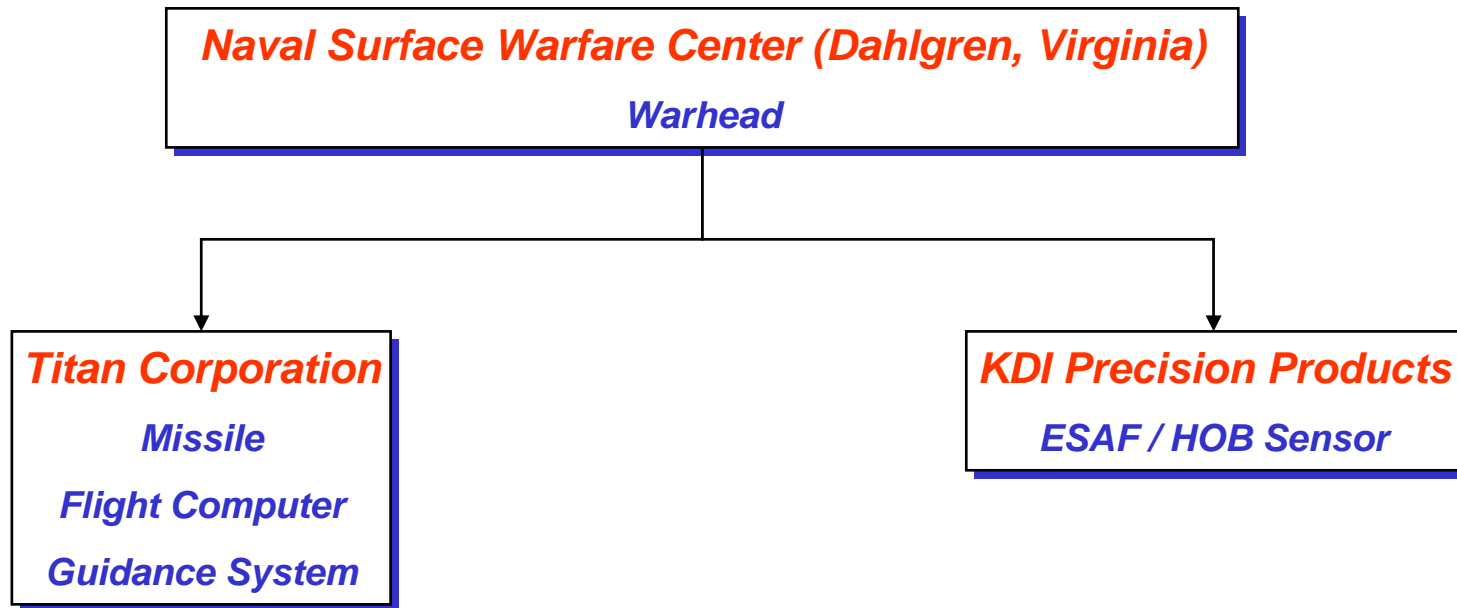
An ISO 9001 Registered Company





Affordable Weapon System (AWS) Overview

- Program Organization





Affordable Weapon System (AWS) Overview

- Features

- Dimensions:
 - Length: 155 - in
 - Diameter: 13.5 - in
 - Wingspan: 146.4 - in
- Payload 200 lb
- Range (T/O): 600 / 840 miles
- Speed
 - Stall/Max 128/220 knots
 - Cruise 150 knots
- Endurance (T/O): 4 / 6 hours
- Accuracy (CEP): ~10 meter
- Launched from surface ship





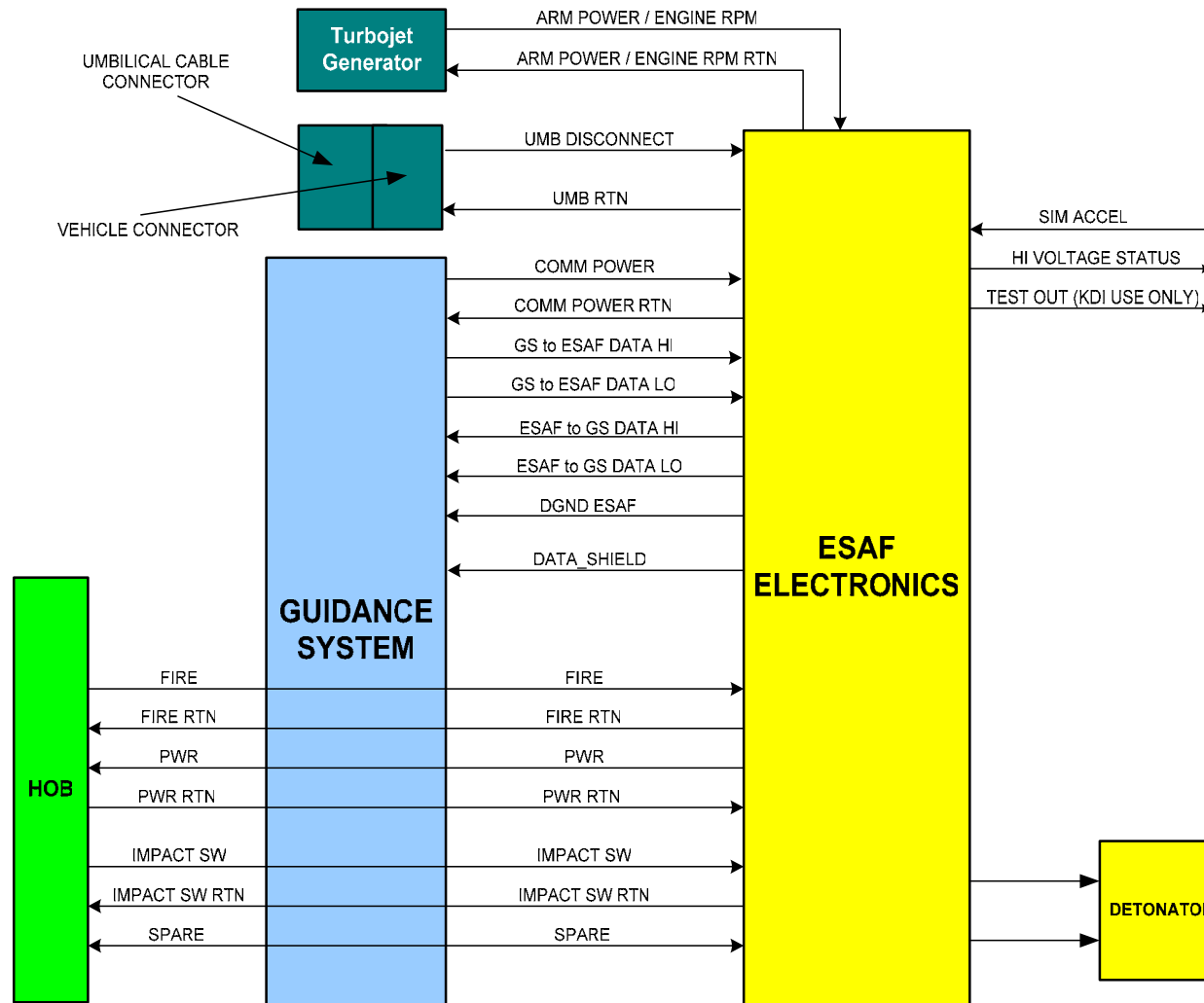
AWS ESAF/HOB Major Design Goals

- ESAF compliant with MIL-STD 1316
- ESAF/HOB to utilize existing technologies to rapidly prototype
- ESAF to initiate with HOB command, HOB impact with target, or ESAF internal impact (backup)
- HOB to initiate warhead at 6 feet above surface or upon impact (primary firing modes)



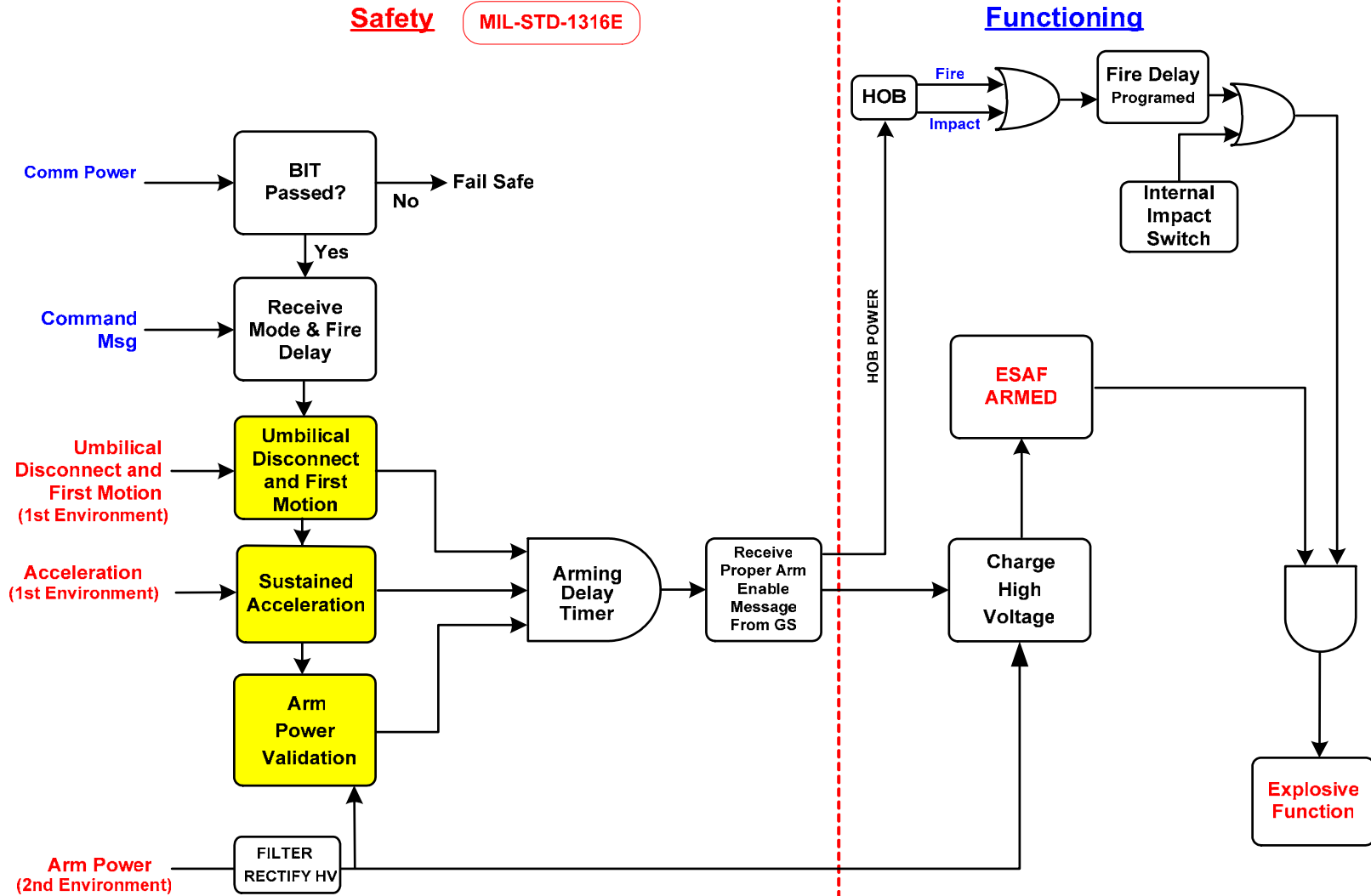


AWS System Block Diagram





AWS ESAF Functional Block Diagram



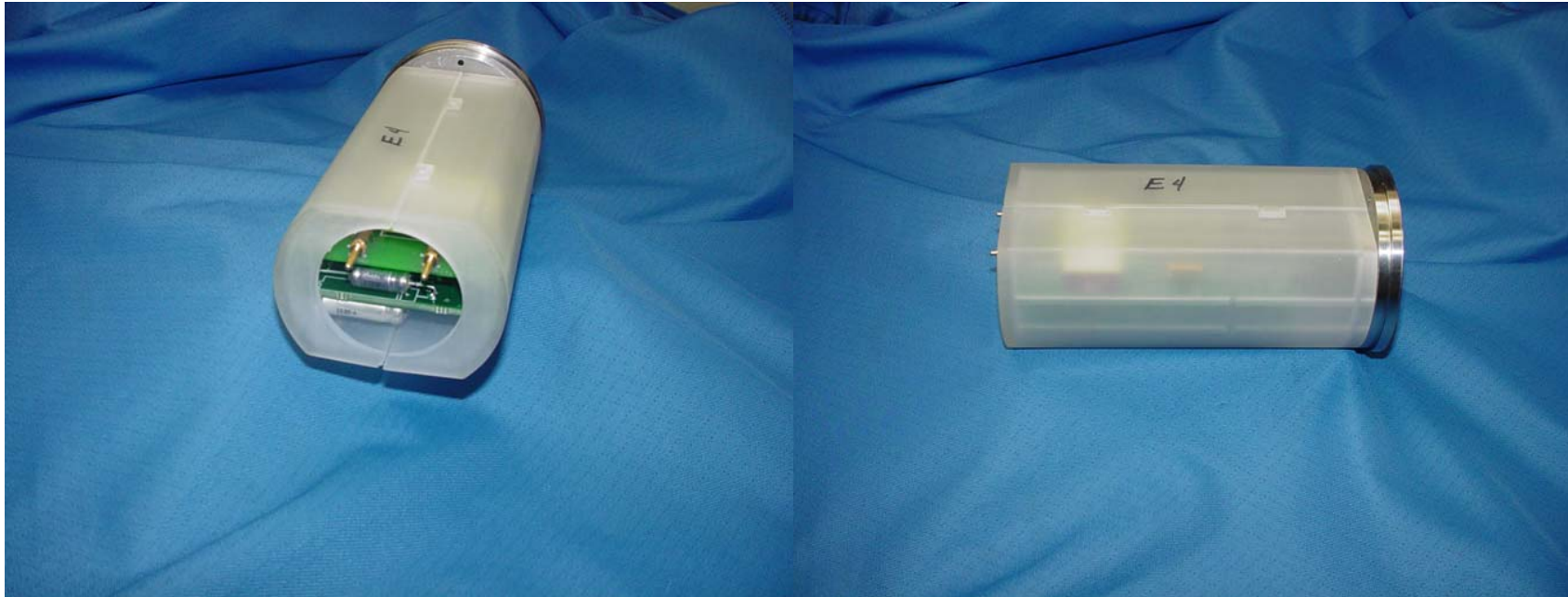


AWS ESAF



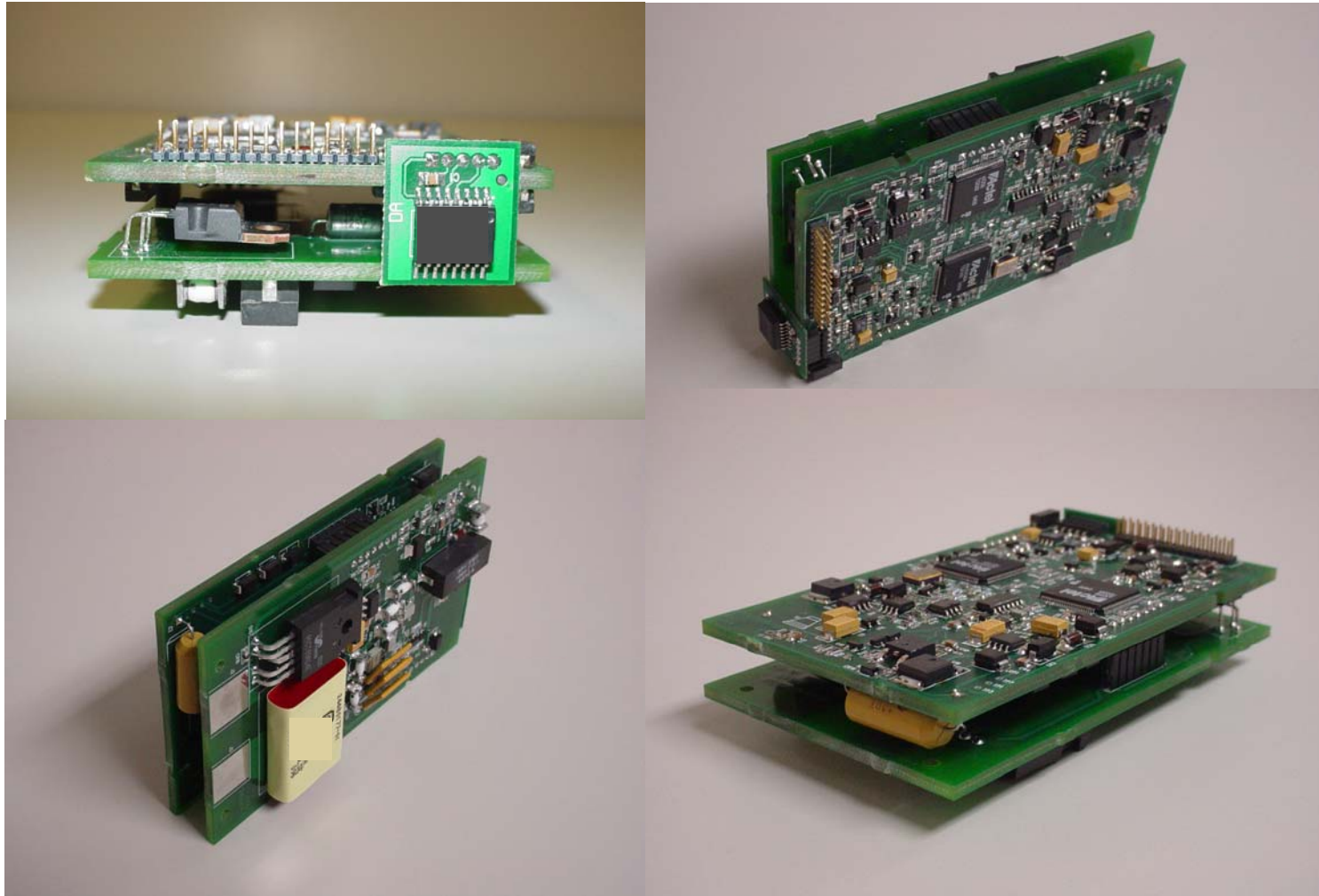


AWS ESAF Electronics Assembly





AWS ESAF Circuit Card Assembly



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AWS Challenges

- Program
 - Low development budgets
 - Accelerated schedule
- Technical
 - Limited technical specifications at program onset
 - Adapt existing technology to meet program requirements





AWS Program Challenges

- Low development and unit budgets / Accelerated schedule
 - Utilize existing “Off The Shelf” technology
 - Package Form Factor
 - PWB Form Factor / Layout
 - Circuit Architecture
 - Common Parts
 - Risk
 - Low
 - Modifications to existing technology





AWS ESAF/HOB Design Challenges

- ESAF
 - Wide arming voltage input range over temperature vs. design target of “off the shelf” design
 - Addition of accelerometer to “off the shelf” design
 - Limited environmental safety signatures (ESAF)
 - Umbilical
 - Acceleration (minimal)
 - Arming Power
 - HOB
 - Incorporate impact switch into existing design
 - Input voltage range
 - Packaging
 - Radome shape
 - Interface cabling
-





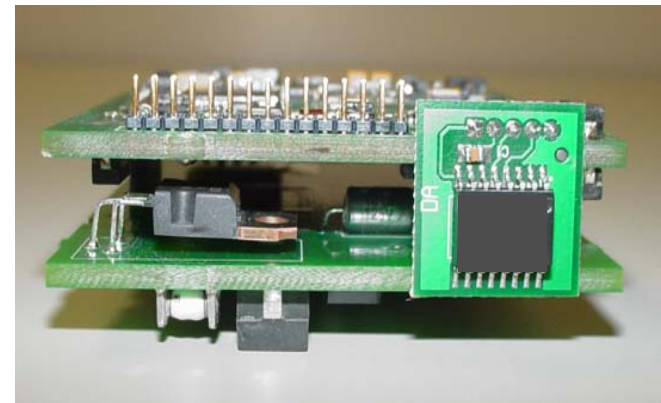
AWS ESAF Design Challenge

- Wider and lower arming voltage input range
 - Utilize existing high voltage generation circuit
 - Circuit originally designed for a much higher/regulated voltage over temperature versus the lower and wider voltage range for the AWS.
 - AWS arming power is derived from a turbine generated AC voltage and is rectified to a DC level.
 - Component changes to accommodate wider and lower arming power voltage
 - Dynamic clock optimized to achieve HV regulation within specified time frame



AWS ESAF Design Challenge

- Accelerometer required
 - Low acceleration levels
 - Limits available COTS accelerometers
 - Ship motion may be a significant factor
 - Launch angle offset must be accounted for
 - Packaging/Orientation
 - Addition of small circuit board
 - Limited choice of available devices featuring the acceleration level and orientation required





AWS Height of Burst Sensor





AWS Height of Burst Sensor

- Based on DDR proximity detection technology used in the highly successful M734A1 Multi-Option Fuze for Mortars (Over 750,000 units delivered)
- Uses a highly integrated single-chip signal processor
- KDI-designed low-cost transceiver
- Extremely robust patch antenna with integrated transceiver circuitry





AWS HOB Design Challenges

- Incorporate impact switch into design
- Modify mechanical package to interface with AWS nose section
- PWB and cable modification to provide required signals
- Cabling and connector to meet space constraints
- Modification of design to meet lower input voltage requirement





AWS HOB Design Challenges

- Impact switch required
 - Picked existing normally closed impact switch used on other programs.
 - Mounted between power and processor PWBs
- Modify mechanical package to interface with AWS nose section
 - Modified existing Ogive radome to current design





AWS HOB Design Challenges

- PWB and Cable Modification to Provide Required Signals
 - Modified power PWB to provide additional signals, including interface to impact switch
 - Selected off the shelf cable to incorporate additional signals
- Cabling and Connector to Meet Space Constraints
 - HOB cable interfaces to AWS Using MS27473 Plug with 90 degree backshell that meets limited space requirements between missile wall and socket.





AWS HOB Design Challenge

- Modification of Design to Meet Lower Input Voltage Requirement
 - Lowered series resistance value on power board
 - Meets input voltage range of 8 ± 1 VDC across temperature range of -40 to +70 °C.





AWS HOB Design Test Results

- Current design meets height of burst requirement of 6 ± 3 feet at reflection coefficients ranging from 0.2 to 0.8 and temperatures ranging from -40°C to $+70^{\circ}\text{C}$.
- Functions acceptably after exposure to AWS in-flight environments.





AWS HOB Design Test Results





AWS ESAF/HOB Program Status

- **ESAF**
 - Breadboard unit delivered for system integration
 - First design iteration successfully tested for explosive output after exposure to AWS in-flight environments
 - Delivered Inert and Live prototype units for test purposes
 - Second design iteration started
 - Construction Of IM and Test units started
- **HOB**
 - Successful height of burst shot with flash charge
 - Delivered prototype units for testing purposes





Conclusion

- KDI successfully provided a timely and cost effective solution for the AWS program by:
 - Adapting a common and proven 3” architecture/form factor
 - Adapting a proven, high volume, HOB design
 - Closely working with the customer
 - Regularly scheduled meetings
 - Written status reports by program management
 - State of the art manufacturing

