Electronics Development Corporation

Electronic Safety and Arming Device for the 105 mm STAR ATO Demonstration

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Some Definitions

- STAR = Scalable Technology for Adaptive Response
  - "Provide capability for scalable, selectable, and adaptive lethal effects against platforms and personnel while limiting collateral damage."
- ATO = Army Technology Objective
  - STAR demonstration in 250 mm (GMLRS), 105 mm, and 30 mm systems
- This talk only covers ESAD for 105 mm projectile version

105 mm STAR ESAD Topics

- Outline requirements
- 105 mm STAR system-level design
- ESAD system design concept
- Logical, electrical, and mechanical interfaces
- ESAD packaging concept

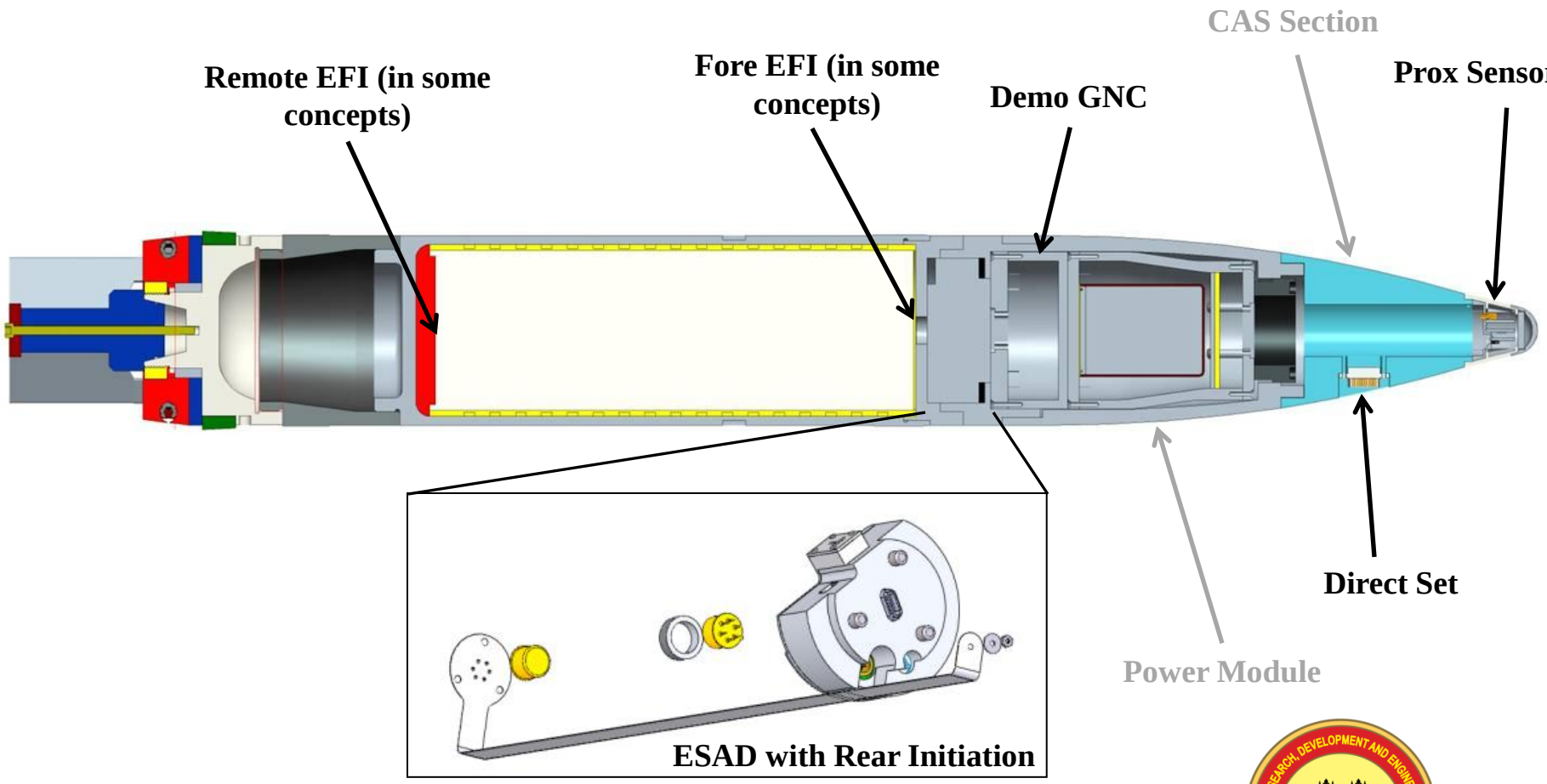
Outline ESAD Requirements

- MIL-STD-1316E and FESWG Guidelines
- Arming: Setback and spin
  - Passive setback switch
  - Mechanical spin switches
- Compatible with direct set using EPIAFS
- Pre-launch power available from setter
- Super-cap power available through launch to retain pre-launch switch states

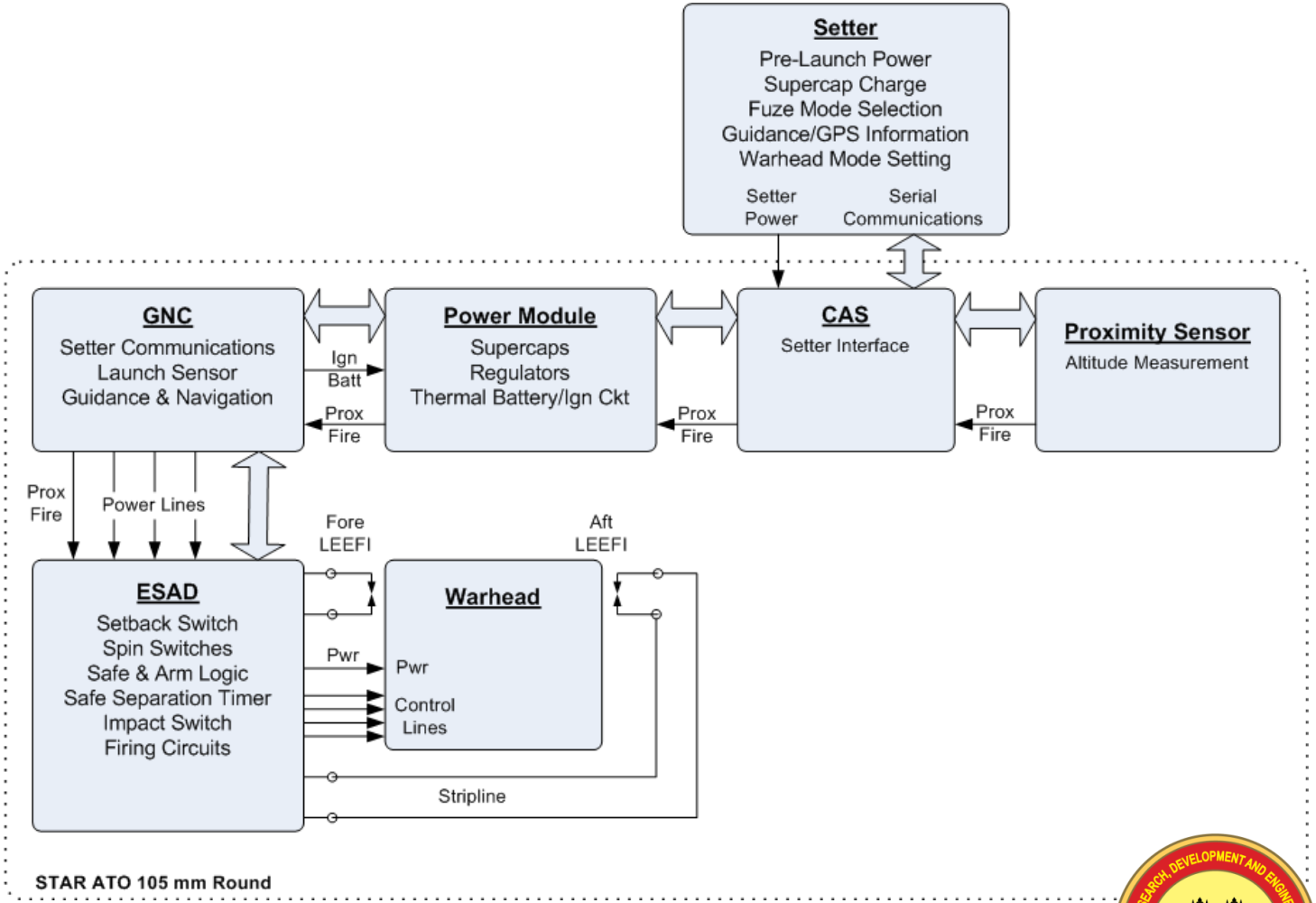
Outline Requirements, Continued

- Selectable firing modes
  - Prox, impact or delay
  - Selectable delay after impact
- Selectable fore and aft firing points
  - Fore, aft, or both
  - Selectable delay between aft and fore
- Compatible with multiple warhead configurations
  - Complex “keep-out” restrictions
  - Drive circuitry and connector for clocked rings motor

STAR 105 mm Projectile



Simplified System Block Diagram



Arming Logic Partitioning

- Complex logic device:
  - Anti-fuse FPGA (Actel eX128)
  - Monitors setback and spin switches
  - Retains BIT and pre-launch switch states (volatile RAM)
  - Sequence and arming delay timer
  - Generates dynamic arming signal
  - Cannot arm the ESAD by itself
- Discrete circuitry:
  - Detects closure of passive setback switch(s)
  - Independent arming delay timer
  - Necessary for arming

ESAD Microcontroller

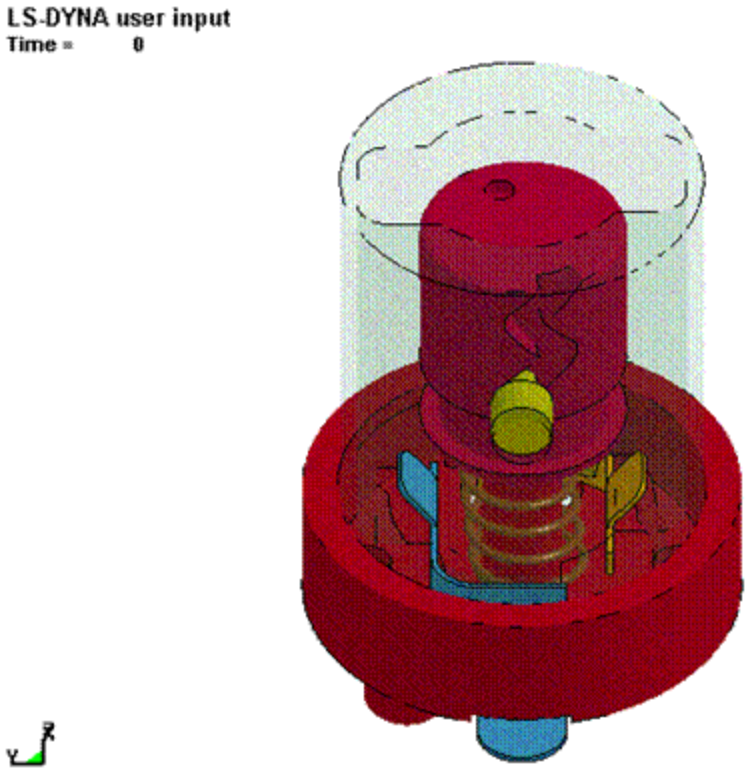
- Microchip PIC16-series
  - Flash memory
  - Very low power (runs through delay after impact on capacitors)
- No direct safety functions
  - Mission data, mode, and TM communications
  - Tells FPGA which channel(s) to charge (fore, aft, both)
  - Passes arm enable from GNC to FPGA
- Generates fire signals at appropriate time
  - Receives fire signal from prox sensor
  - Monitors impact switch
  - Generates delay after impact if that mode is selected
  - Generates delay between channels if that mode is selected

Passive Setback Switch

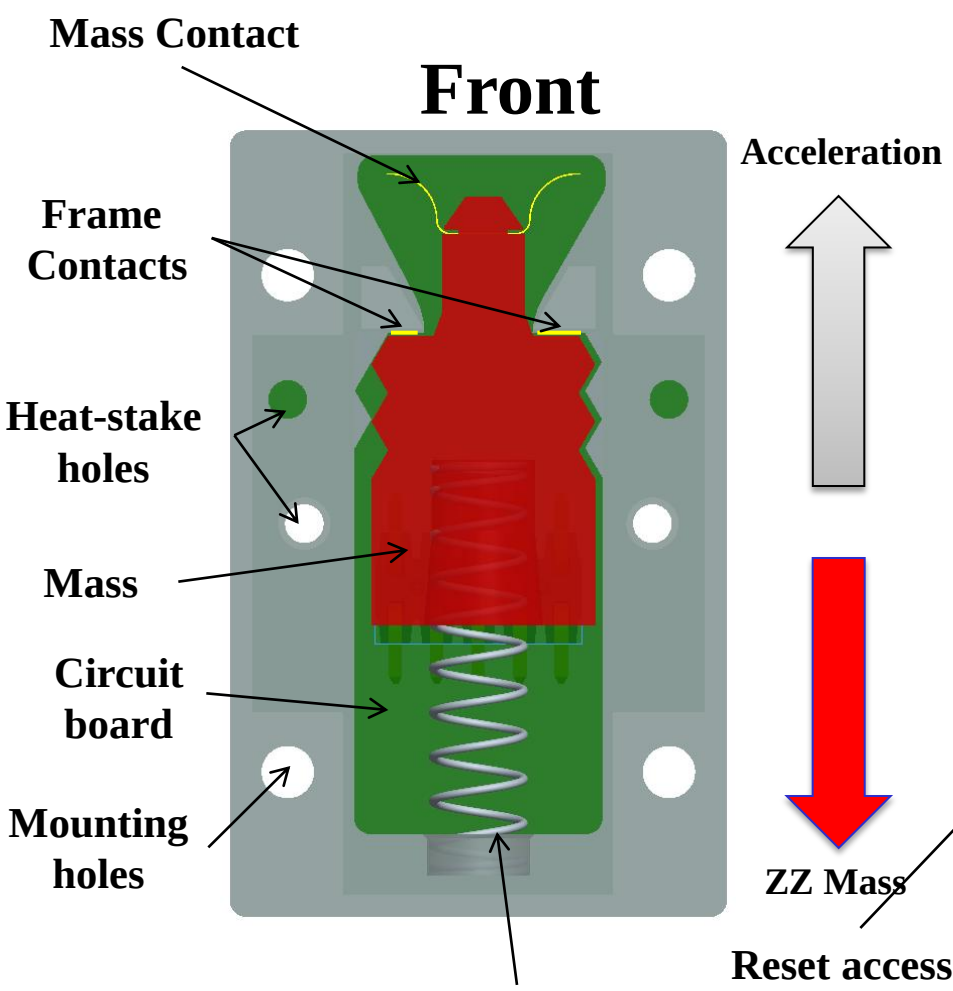
- Passive = no power during launch
- Pre-launch switch status verified and remembered
- Arming power passes through setback switch
- Redundant switches for risk mitigation
  - Cylindrical zigzag switch
  - Planar zigzag switch

Cylindrical Setback Switch

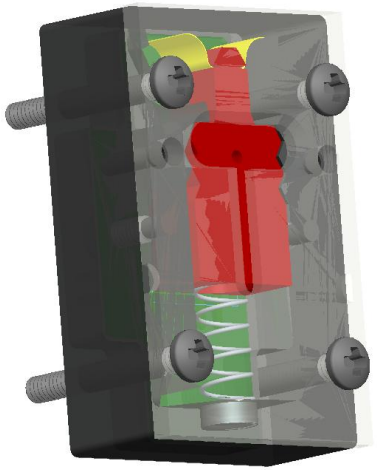
- Simple spring-mass system
- Multi-stage zigzag (drop safe)
- Pre-biased
- Resettable
- Built by L-3 FOS



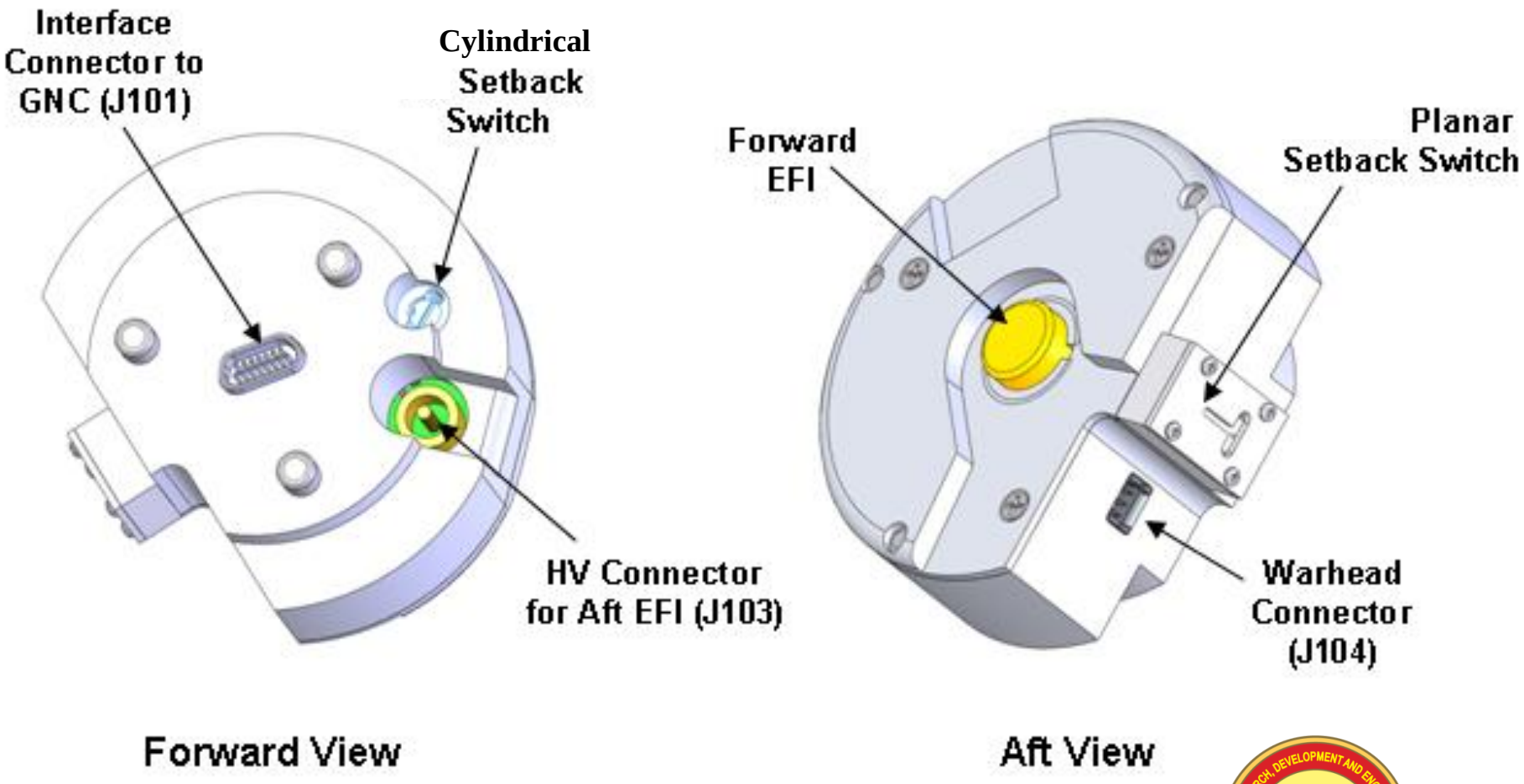
Planar Setback Switch



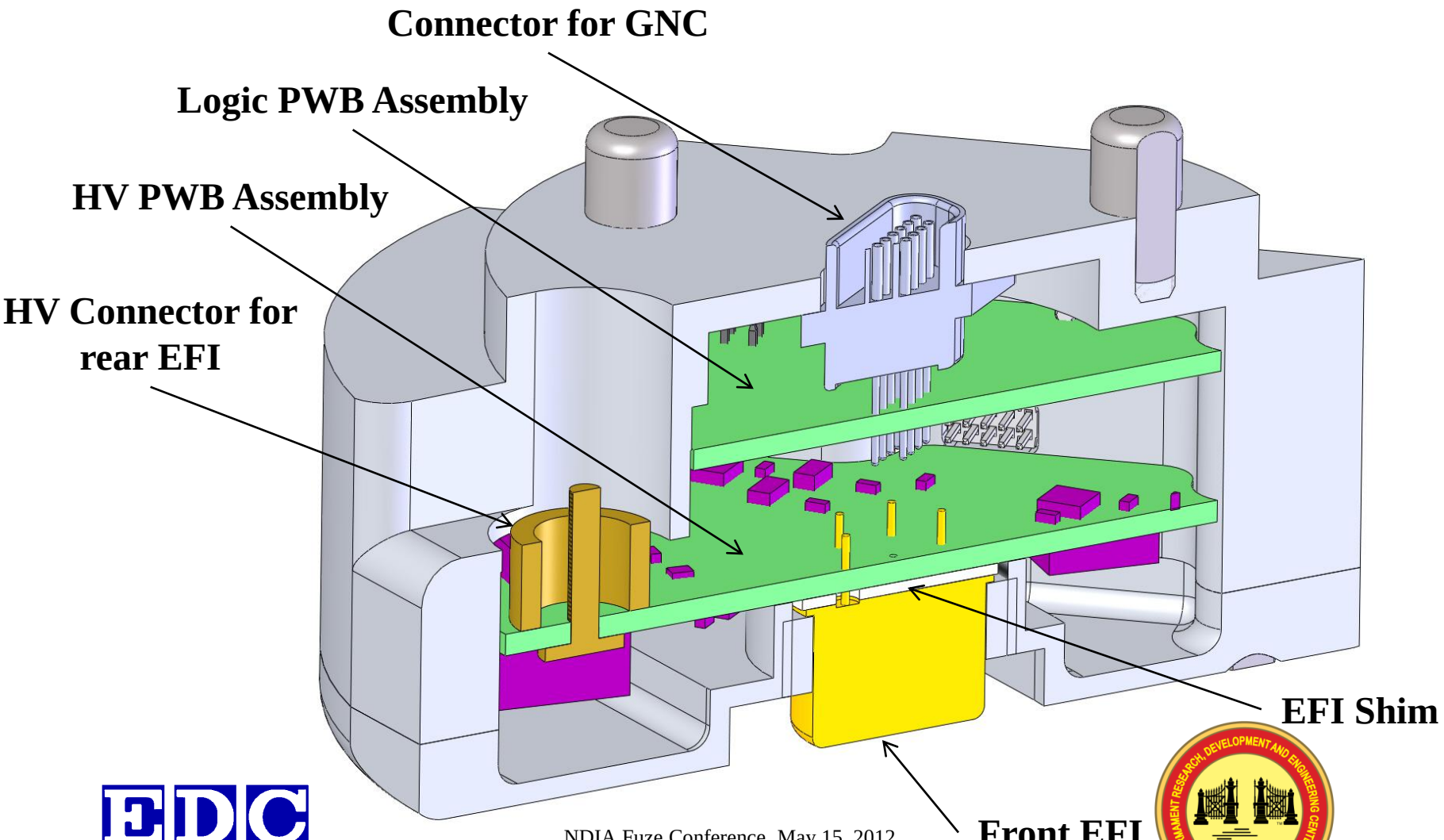
- Simple spring-mass system
- Multi-stage zigzag (drop safe)
- Solder-less contacts
- Pre-biased
- Structural elements all plastic
- Easy assembly
- Resettable
- Built by ARDEC



ESAD Configuration



ESAD Packaging Concept



STAR 105 mm ESAD Status

- Approximately 25 prototypes built
- Laboratory tests for functionality
  - Operation of logic for valid and invalid inputs
  - Operation and characteristics of fire set
  - Programmable delay after impact
  - Programmable delay between channels
  - Proper firing through longest EFI cable
- Field tests
  - Soft catch (SCat) gun for ruggedness
  - 9-shot HE demonstration at YPG December, 2011