



*Providing America
Advanced Armaments for
Peace and War*



EXCALIBUR'S GPS FUZE SETTER FOR JLW-155

PRESENTED TO THE NDIA FUZE SYMPOSIUM
APRIL 28, 2004

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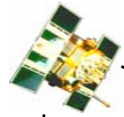
Committed To Excellence

- Sponsor: PM-CAS: COL Sledge
- PM EXCAL: LTC Wilson, Chris Grassano & Mike Burke
- System: Tom Coradeschi
- Platform Integ: Allison Marston
- User: Ft Sill
- Software
 - Andy Leshchyshyn
 - Craig Freed
 - Mike McCall
- Mechanical
 - George Eckstein
 - Jim Hartranft
- Electrical
 - Hai Pham
 - Len Goodman
 - Fred Oliver
 - Jerry Frazier
 - Tom Walker

Enhanced Portable Inductive Artillery Fuze Setter TEAM



GPS satellite



Canards Steer
Projectile



Trajectory
Optimized for
Range



Canards Deploy

GPS Acquisition and Track

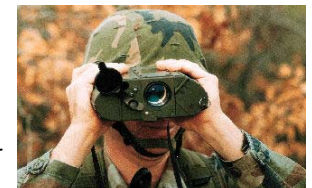


EPIAFS to Support Excalibur XM982



Target

FO



Targeting
info

Fire
Control

AFATDS



EPIAFS

Gun/Target Locations
GPS Data, Keys &
Precise Time
Power

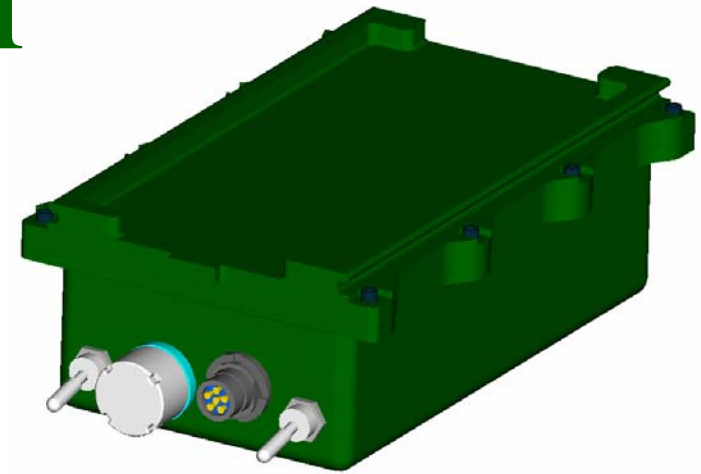
LW155 w/TAD



EPIAFS SYSTEM

- PLATFORM INTEGRATION KIT (PIK)
 - Single board computer
 - Interface circuit
- SETTER and Cable

PIK

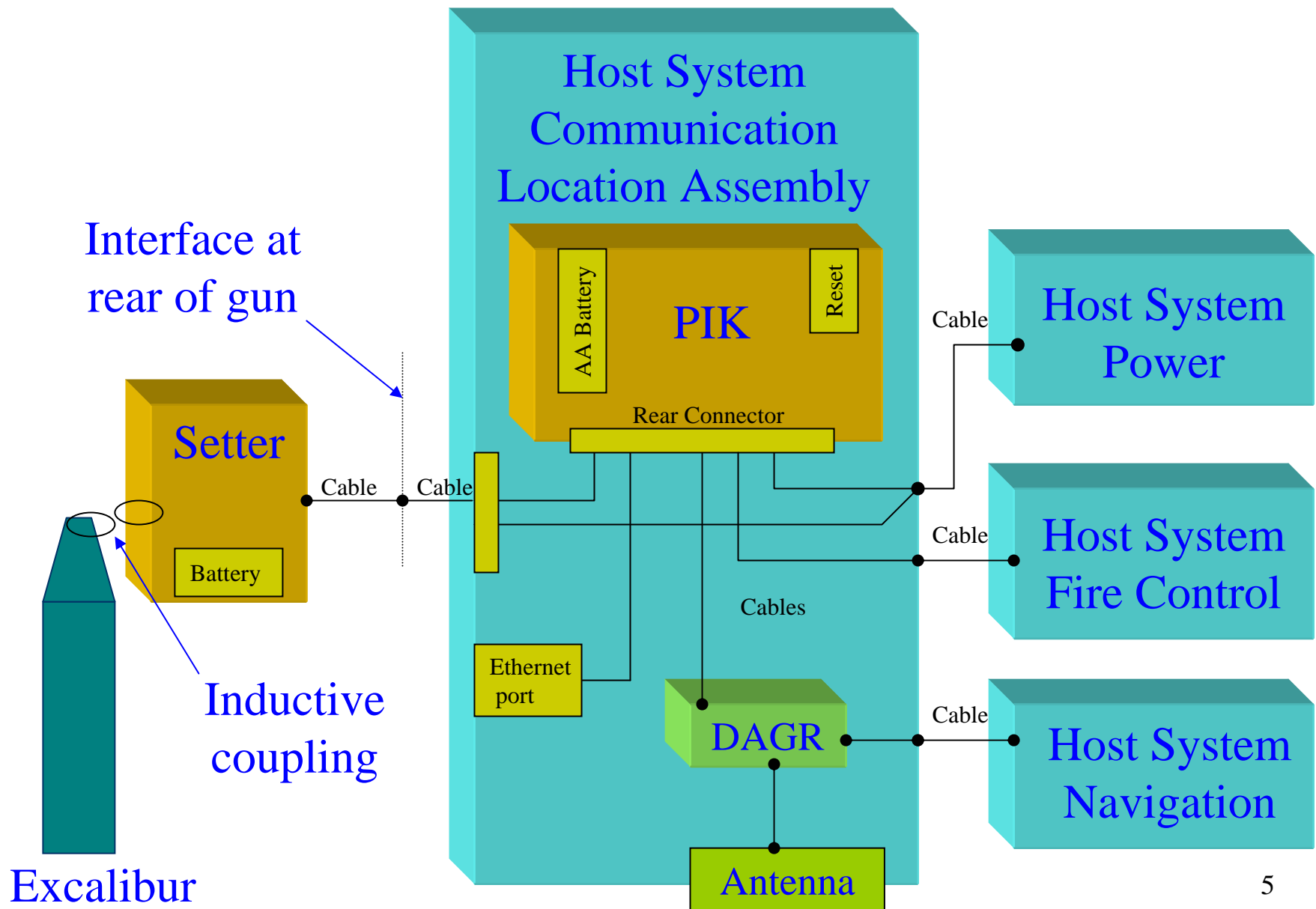


SETTER



➤ EPIAFS utilizes DAGR (Defense Advanced Global Positioning System Receiver)

BLOCK DIAGRAM OF EPIAFS on JLW-155



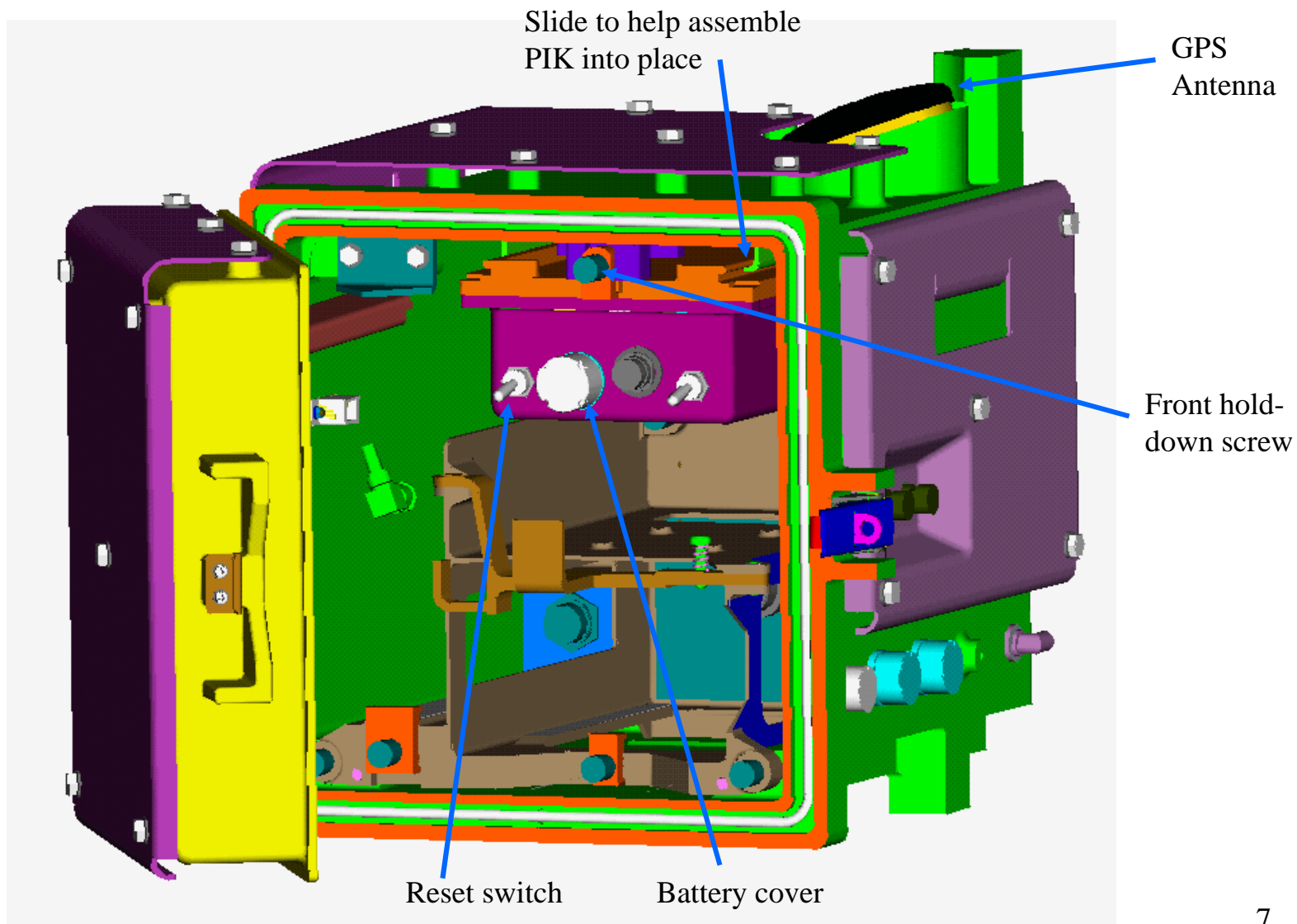
EPIAFS Host: M777E1

Communication
Location
Assembly (CLA)



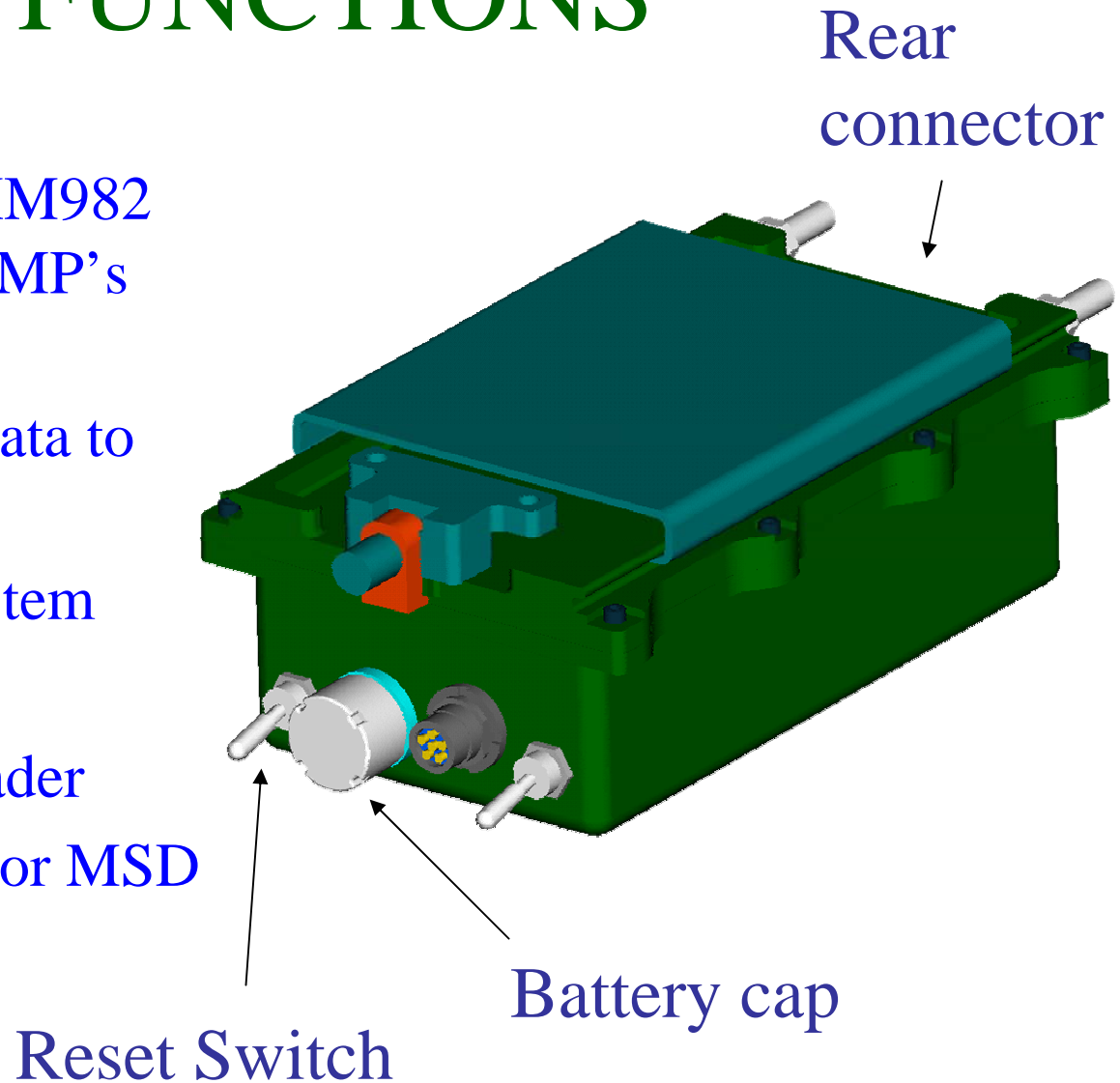
PIK
goes
here

PIK in CLA with 'Rack-and-Panel' Connector

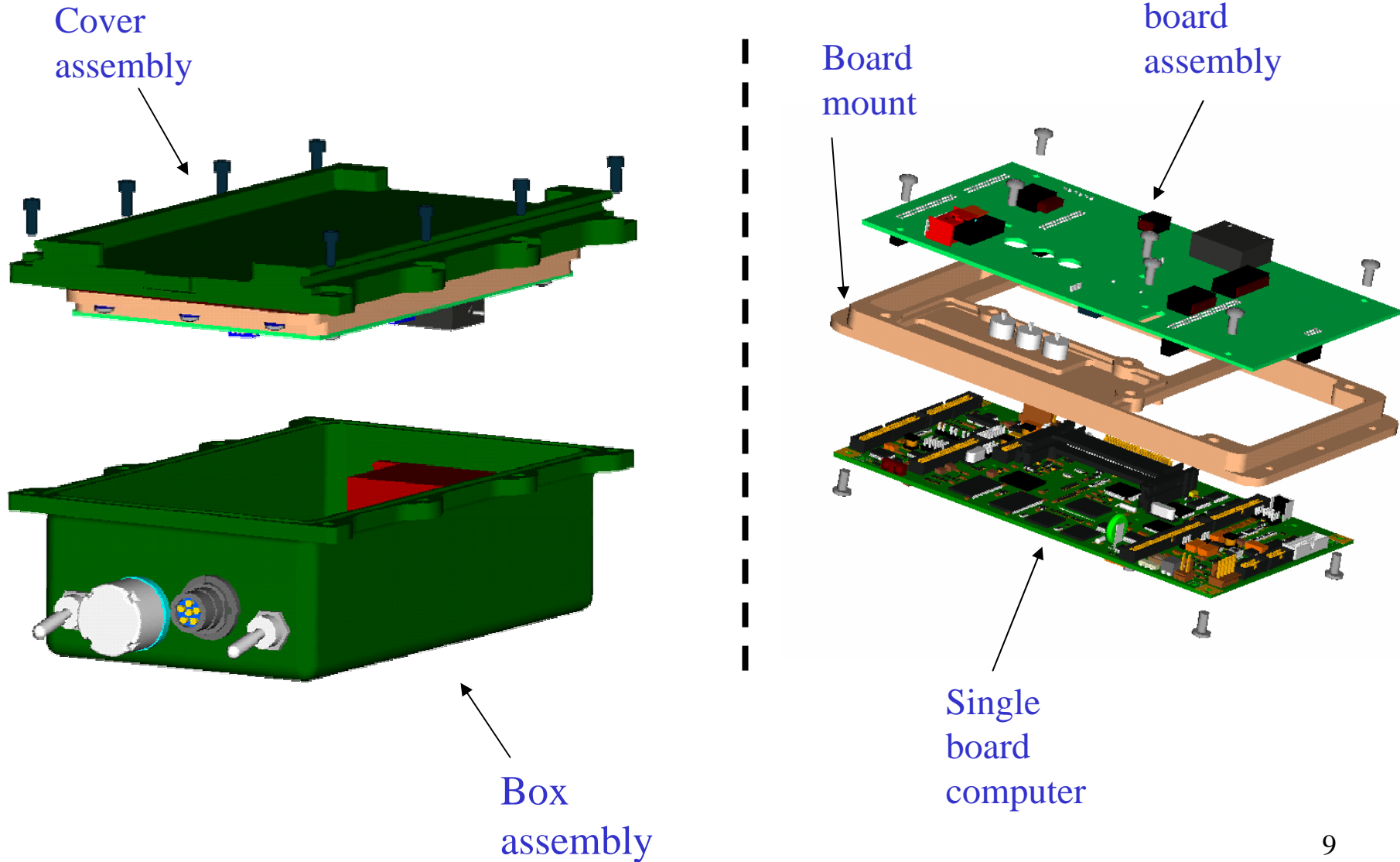


PIK FUNCTIONS

- Formats and sends all XM982 initialization data and TMP's through Setter
- Passes Standard Fuze Data to Setter
- Interfaces with Host system
- Interfaces with DAGR
- Interfaces with Key Loader
- Interfaces with SPORT or MSD



Exploded View of PIK Box

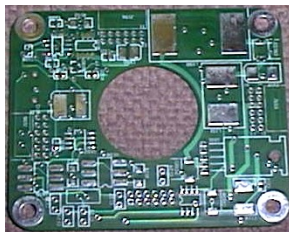


SETTER FUNCTIONS

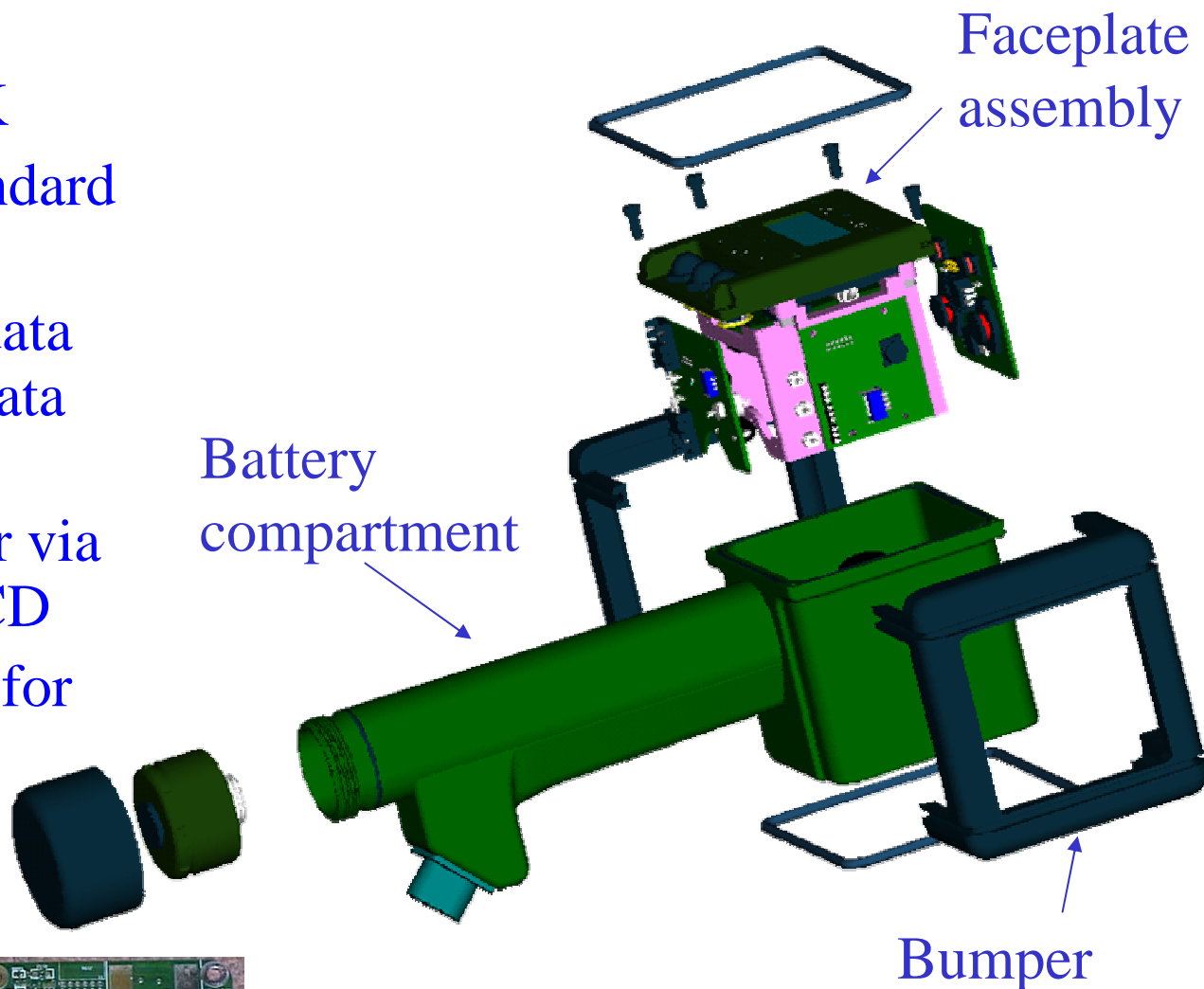
- Interface with PIK
- Interface with standard fuzes and XM982
- Convert XM982 data stream to power/data format
- Interface with user via 3 switches and LCD
- Un-cabled setting for standard fuzes



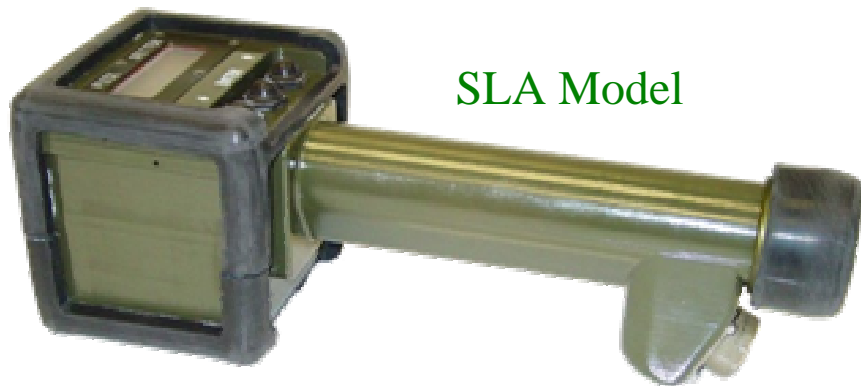
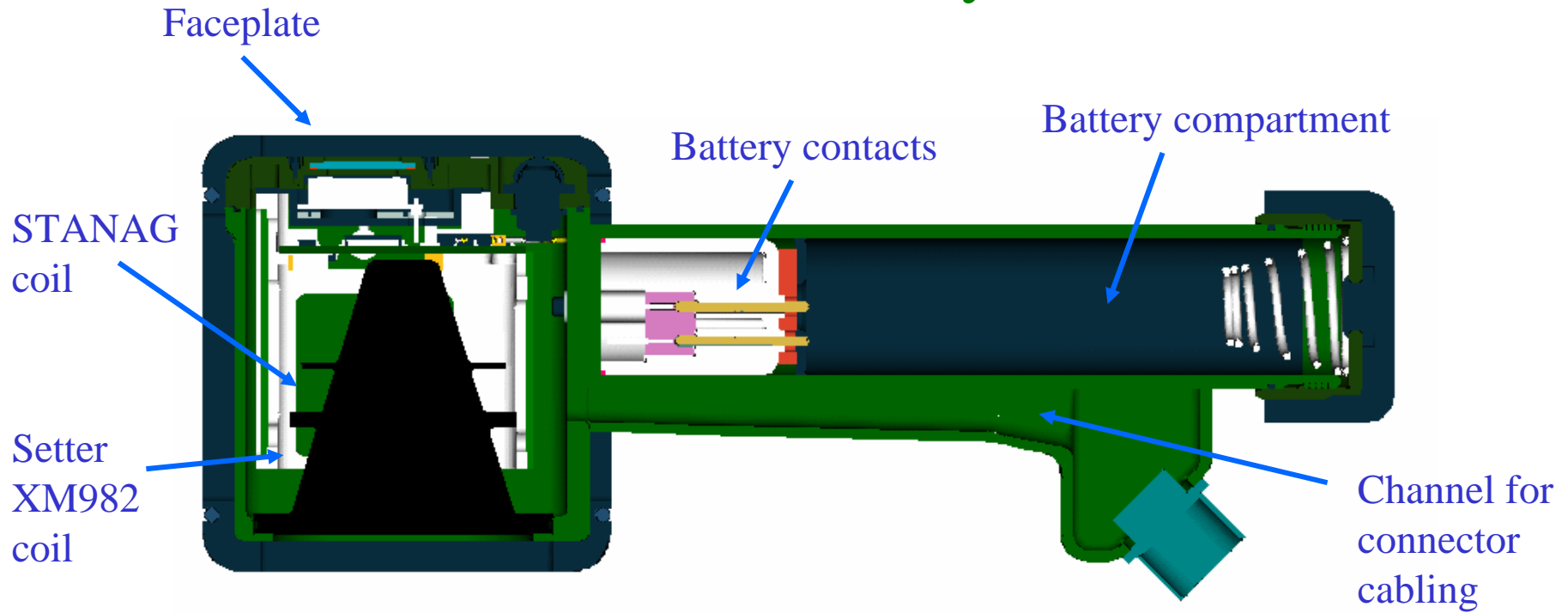
Controller pcb



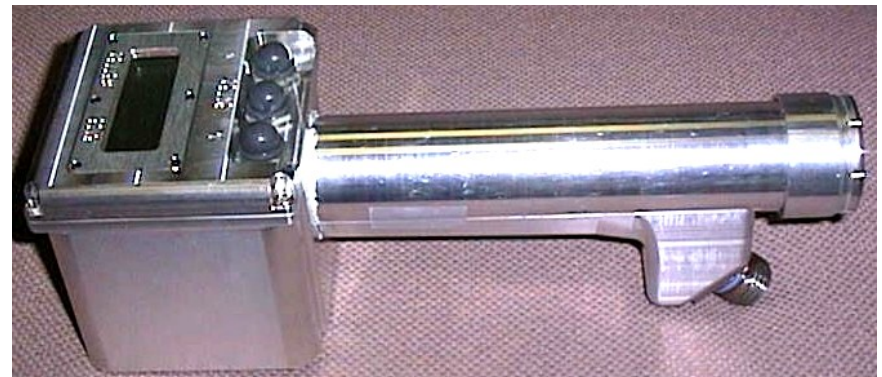
Mod/Demod pcb



SETTER Cutaway View



Setter Prototype



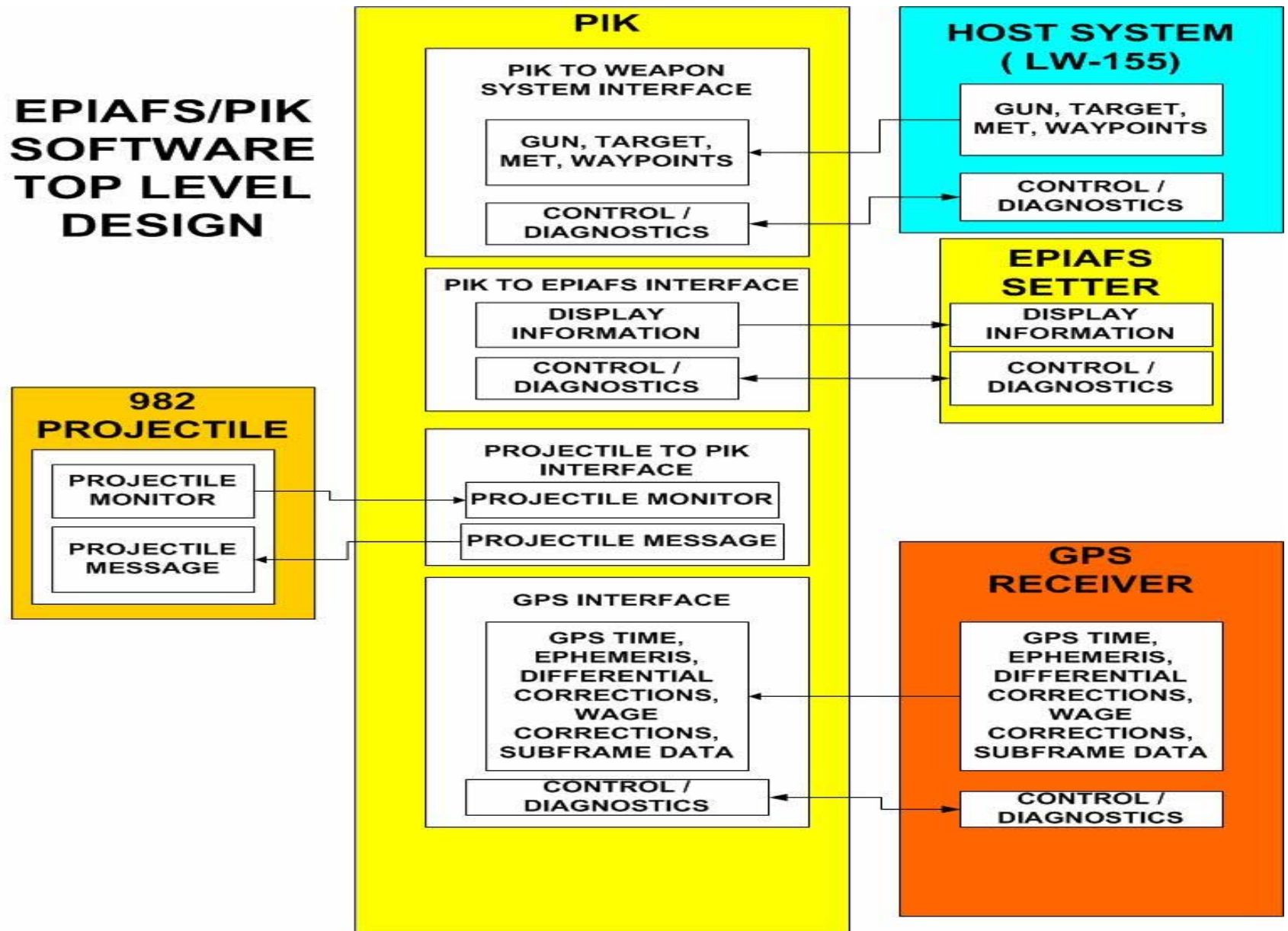
ACCOMPLISHMENTS

- PIK Temperature test: May 03
 - GM failed below -30° C
- JLW GPS Antenna Test: June 03
 - 15° mount good GPS reception
 - Weibull radar activated
- EPIAFS SRR: June 03
- Draft Software Reqmts Spec: July 03
- EPIAFS brass-board: Nov 03
- Convert to DAGR: Jan 04
- EPIAFS PDR: Feb 04
- Draft ICD's : March 04
 - PIK to SETTER
 - EPIAFS to HOST
- Draft CONOPS: April 04
- Fab Prototype PCB's: April 04

CONCERNS

- Setter display
- Backward compatibility with standard fuzes
- TMP jitter (< 100 ns)
- Fit all electronics in Setter housing

EPIAFS/PIK SOFTWARE TOP LEVEL DESIGN

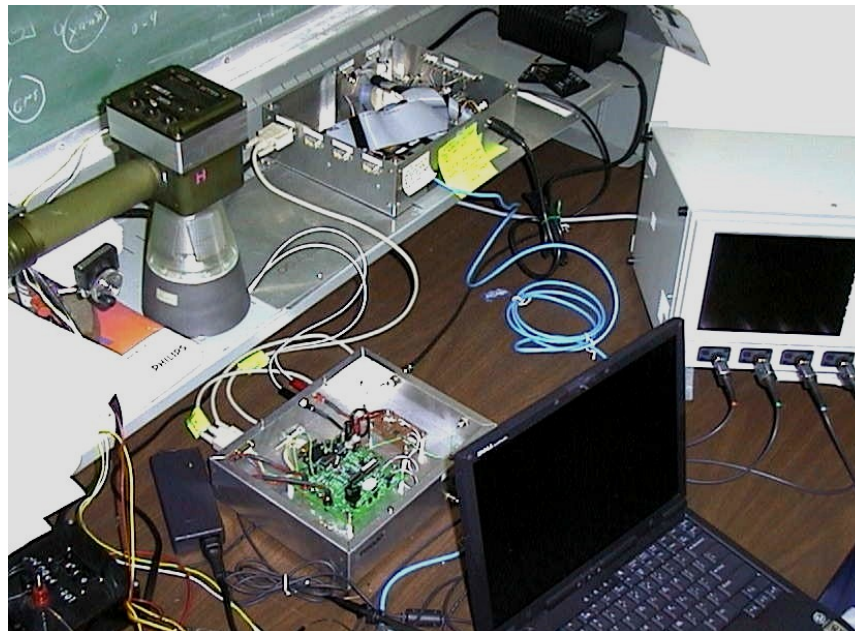


EPIAFS Software

- PIK :
 - Software runs on a Linux based single board computer and consists of a script and application
 - Handles communication with GPS receiver, JLW - Host, setter, SPORT, and projectile
- Setter:
 - Software runs on a microcontroller
 - Is an upgrade to the PIAFS software, adding GPS fuze setting capability
- Reset Microcontroller:
 - Triggers the reset line when the SBC is in sleep mode and serial data is sent from the JLW-Host.

EPIAFS Software

- Host Interface Tester:
 - Software running on a laptop allowing us to test the “PIK to Host” interface without having a host
- Projectile Interface Tester:
 - Software running on a laptop allowing us to test the “PIK to Projectile” interface without having a projectile



EPIAFS PIK

- Single Board Computer
 - Moved from StrongArm to Xscale
 - ADS AGX Single board computer utilization
 - 5% of the CPU is being used
 - 35% of available flash being used
 - 10% of RAM is being used
 - 6 of 7 serial ports being used
 - 20118 lines of code
- Operating System
 - Standard Linux 2.4.19 kernel which so far meets timing requirements, allows portability, and provides memory protection
 - Scripts provide basic fault tolerance
 - Stable performance

EPIAFS PIK

- Application
 - Coded in C++ (GNU compiler)
 - Round robin service loop, single process (one program), no threads
 - Interrupt driven response to Time Mark Pulse
 - Script starts PIK application and monitors return code when PIK program terminates, can restart application if improper termination
 - Uses polled serial port access
 - Modular design
 - Gets target and gun information from the host (interface tester)
 - Sets a projectile (interface tester)
- Planned activity
 - Move to 2.6.x kernel
 - Test with a real projectile mission computer
 - Test with a real host computer

EPIAFS SETTER

- Microcontroller
 - Replaced PIAFS's Motorola MC68HC08AZ60 (16 % remaining program memory, 10% RAM remaining) with the Microchip PIC18F8720 (35% remaining program memory, 45% RAM remaining)
- Application
 - Started with PIAFS software as code base
 - Coded in C (Microchip PIC C compiler)
 - Converted software drivers from Motorola to Microchip
 - Modified to handle display of GPS projectile setting and interrogating information
 - Created a “EPIAFS PIK to Setter” communication protocol
 - 11429 lines of code
- Planned activity
 - Test with all available standard artillery fuzes and an XM982 Guidance and Navigation Unit

Other EPIAFS Software Accomplishments

- Host Interface Tester and Projectile Interface Tester code written and used to demonstrate PIK's ICD compliance
- Completed drafts of :
 - Software Development Plan
 - PIK Software Requirements Specification
 - Setter Software Requirements Specification
 - PIK to Setter ICD
 - PIK to Host ICD

EPIAFS PLANS

- Fabricate EPIAFS prototypes
- Test EPIAFS with XM982 GNU
- Test EPIAFS with JLW-155 DAGR and Talin
- Assist EPIAFS integration in JLW-155
- Environmental test EPIAFS
- Substitute coil H-drive circuit
- Update EPIAFS design
- Fabricate EPIAFS Engineering units
- Support Paladin upgrade to Excalibur and EPIAFS

