



*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

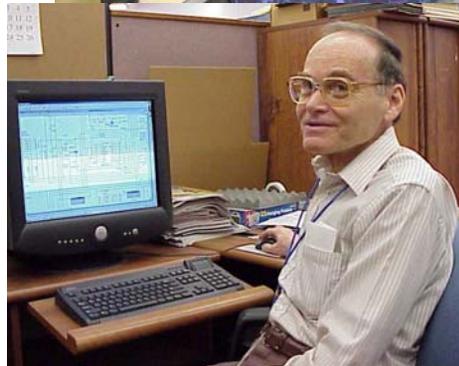
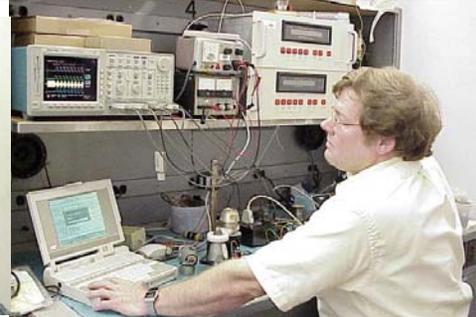
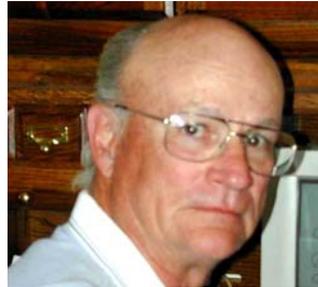
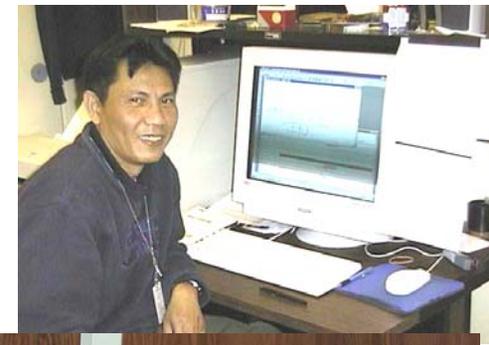
TOM WALKER
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Committed To Excellence

- 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



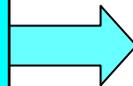
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EPIAFS

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

LW155 w/TAD



Fire
Control

AFATDS

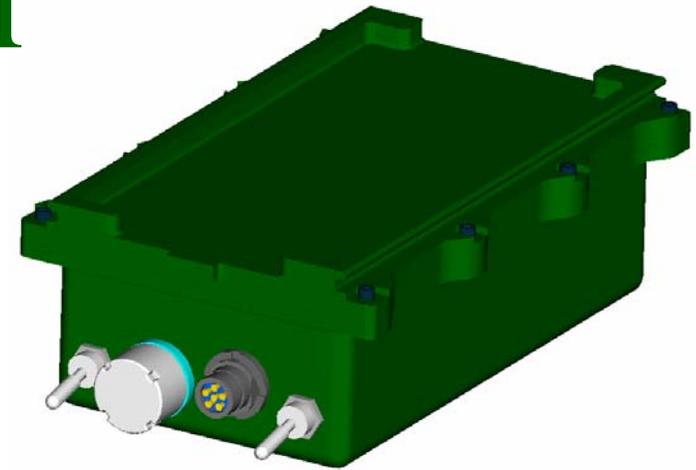
Targeting
info



EPIAFS SYSTEM

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

PIK



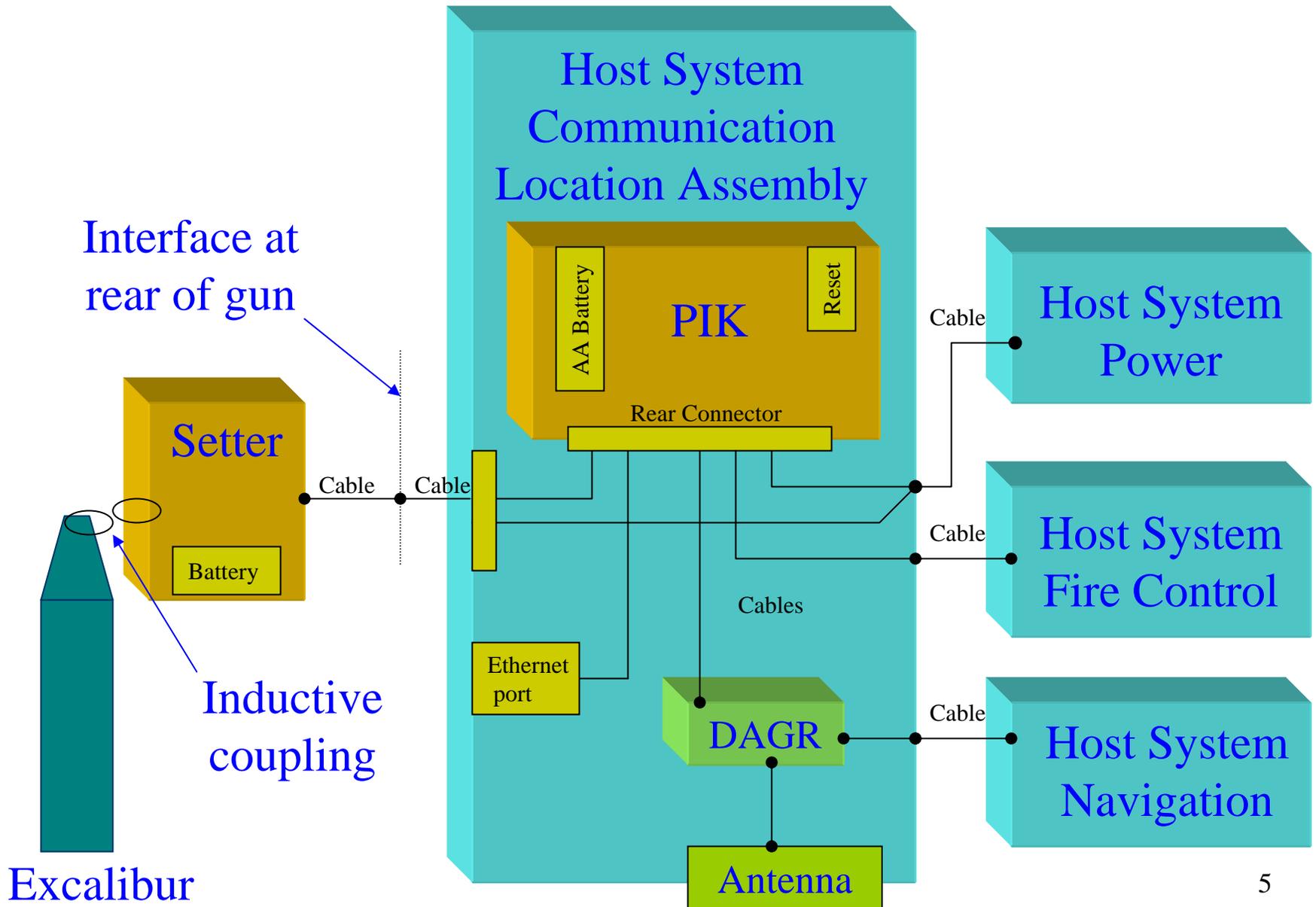
SETTER



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



BLOCK DIAGRAM OF EPIAFS on JLW-155



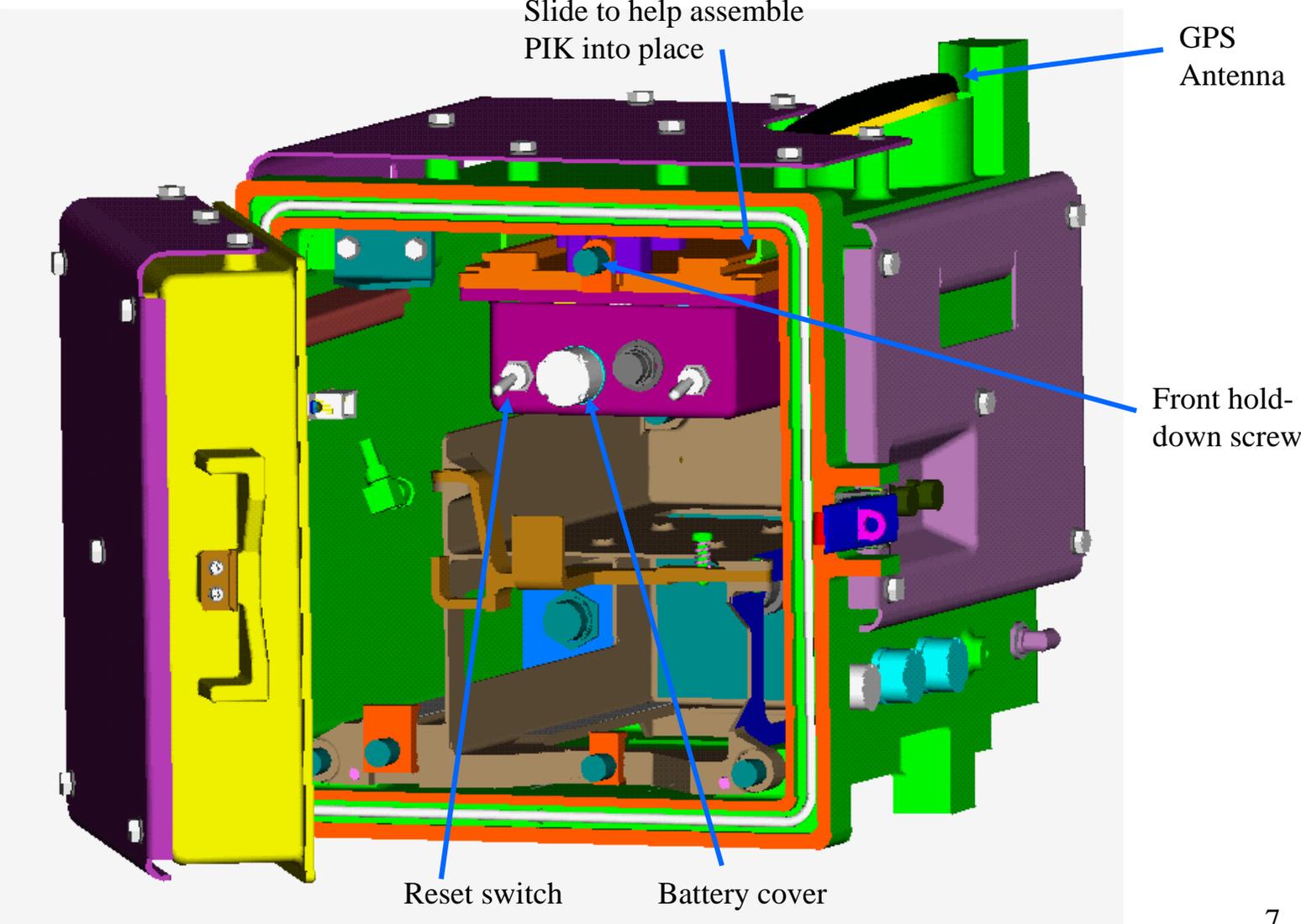
EPIAFS Host: M777E1

Communication
Location
Assembly (CLA)



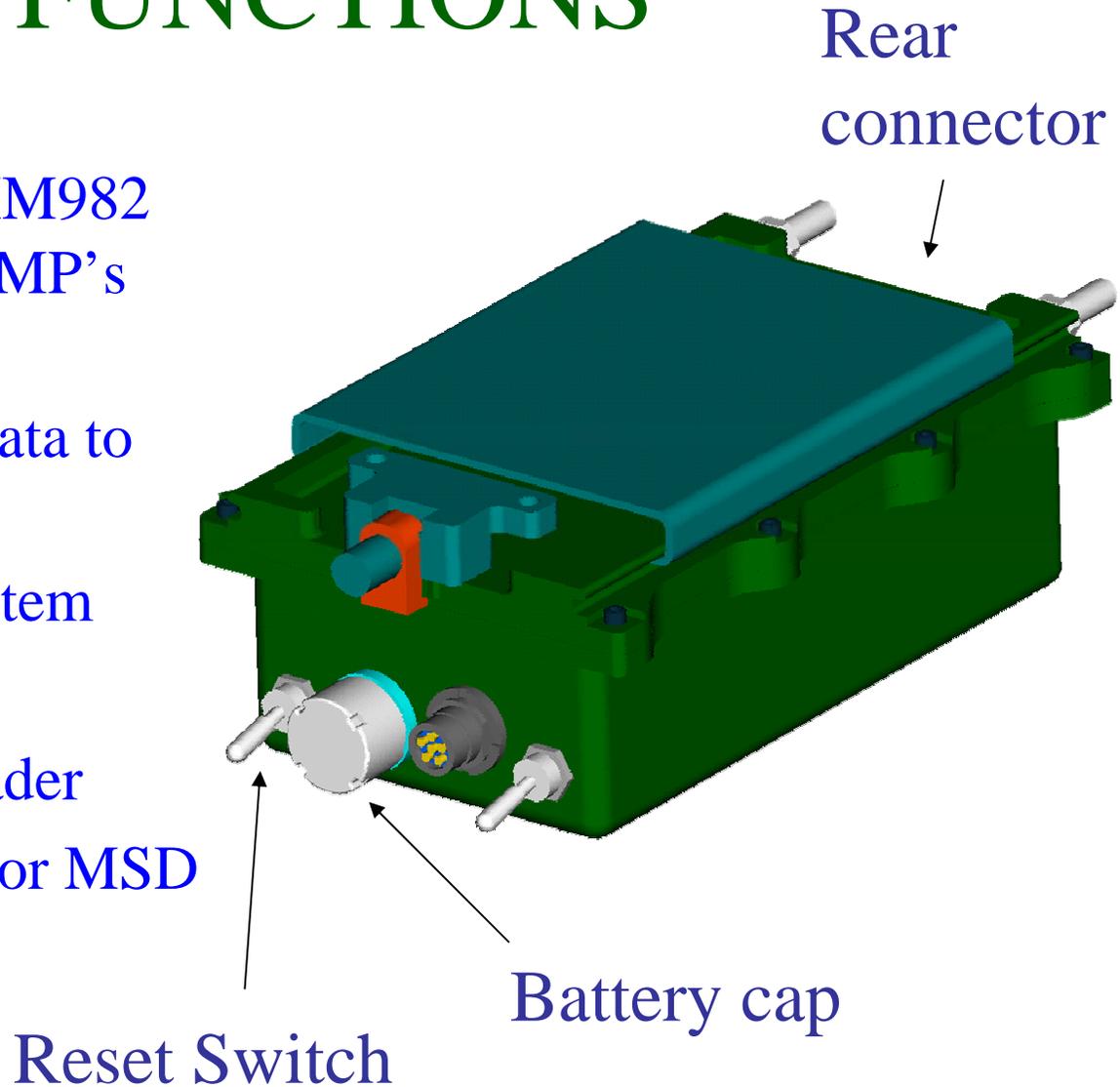
PIK
goes
here

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

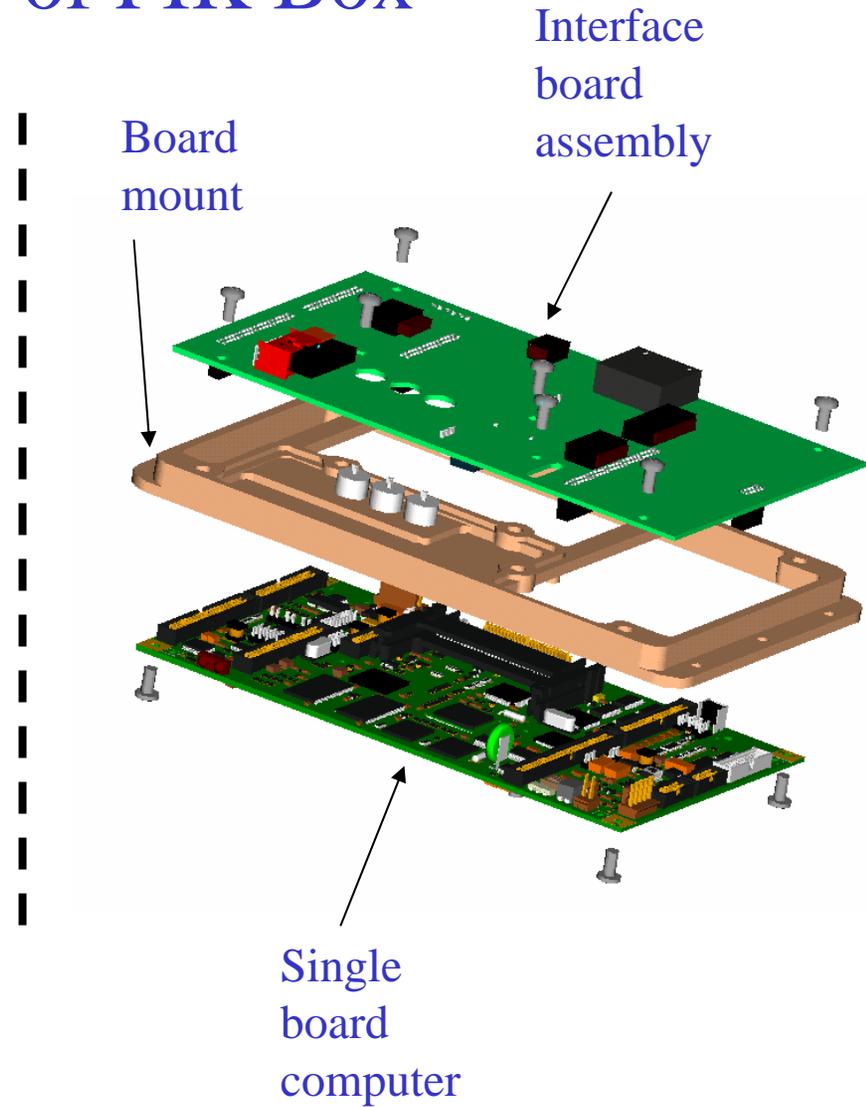
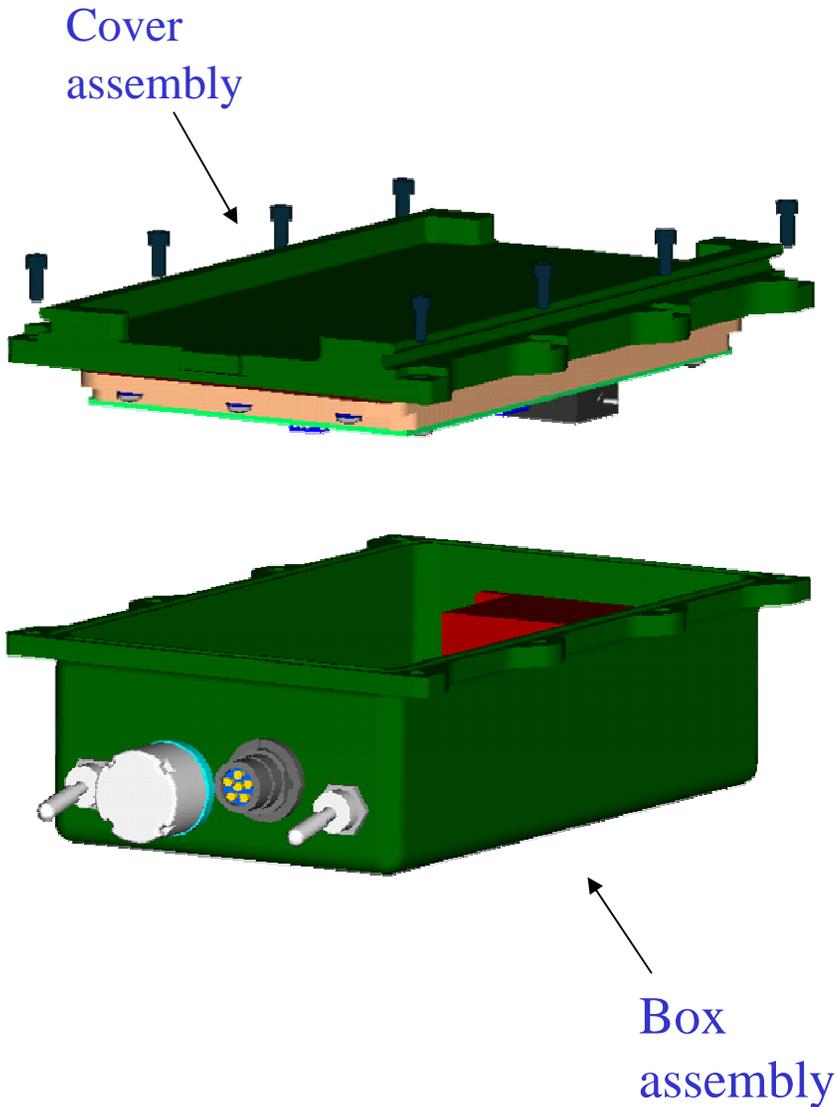


PIK FUNCTIONS

- 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

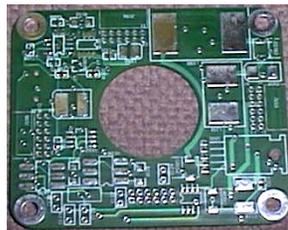


SETTER FUNCTIONS

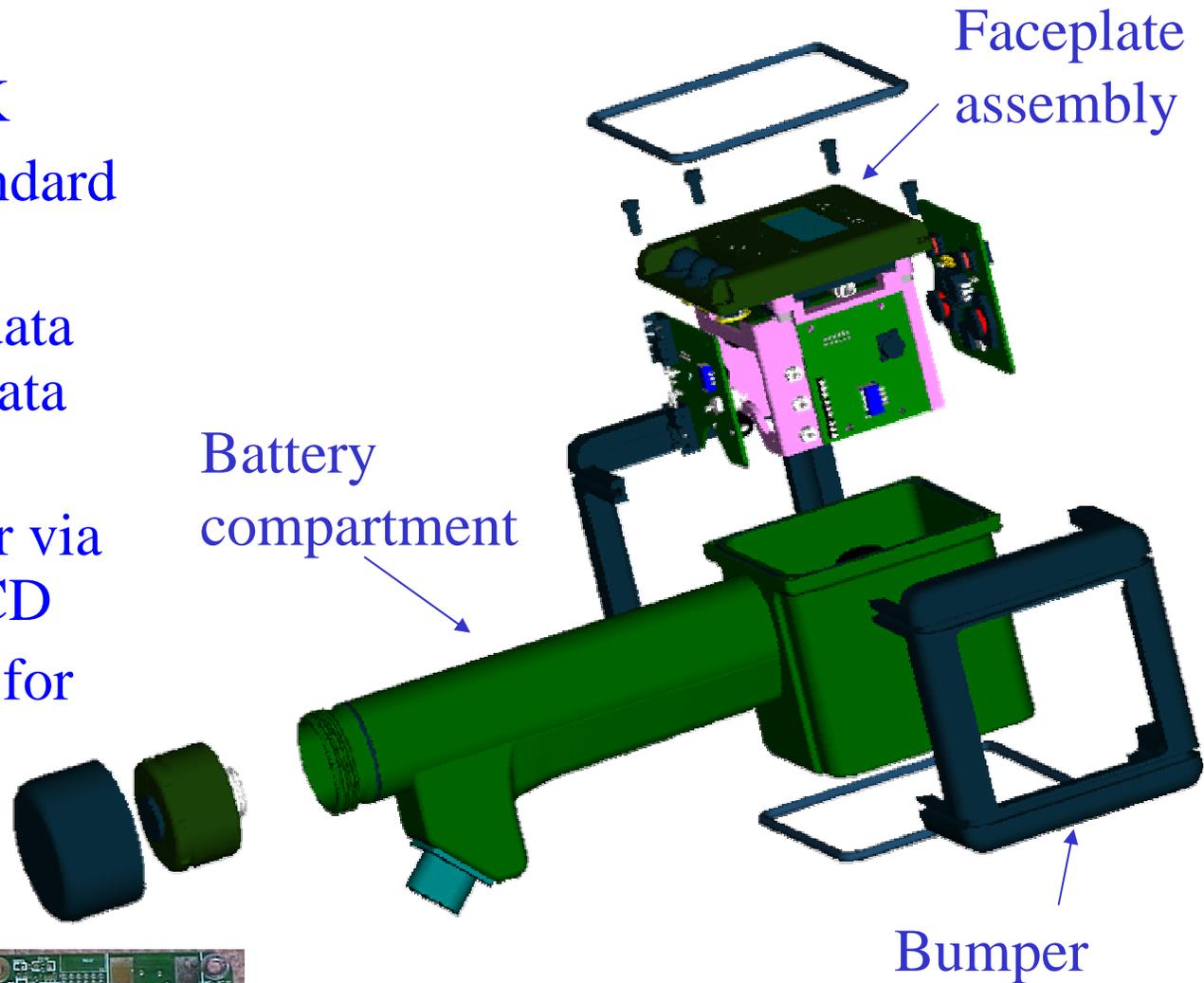
- Interface with PIK
- Interface with standard fuzes and XM982
- Convert XM982 data stream to power/data format
- Interface with user via 3 switches and LCD
- Un-cabled setting for standard fuzes



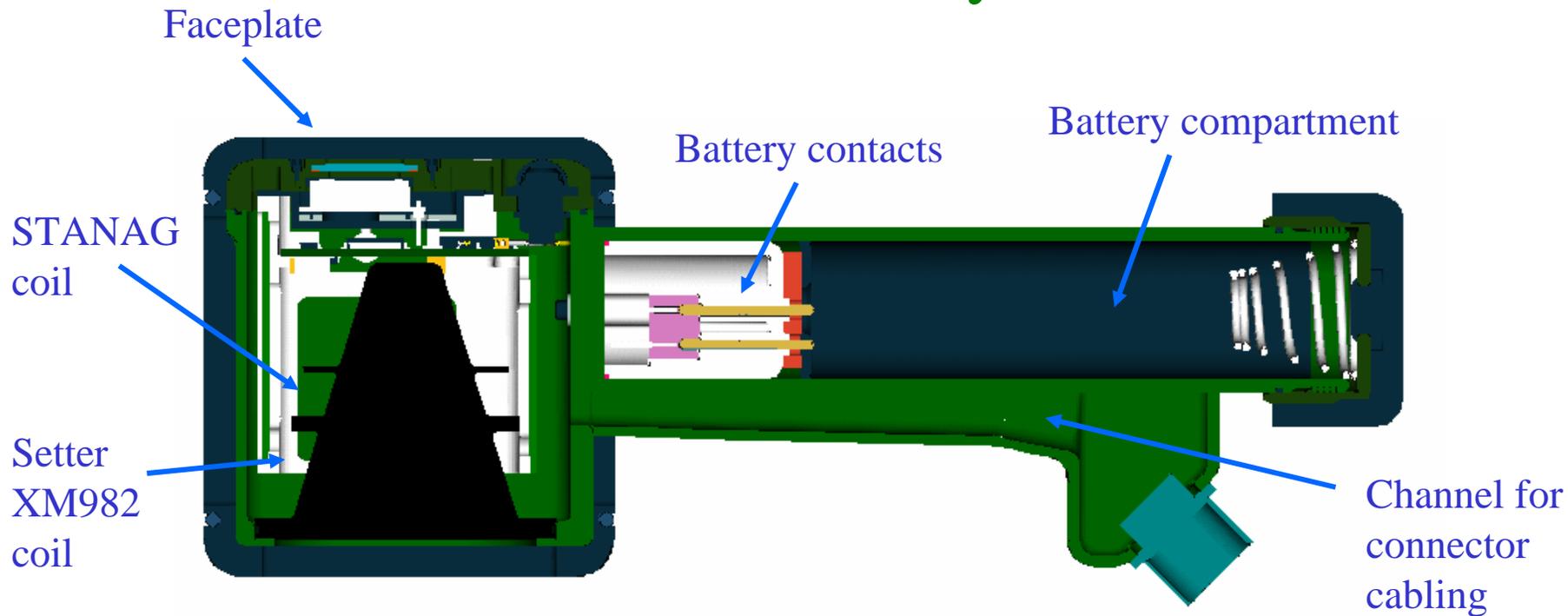
Controller pcb



Mod/Demod pcb

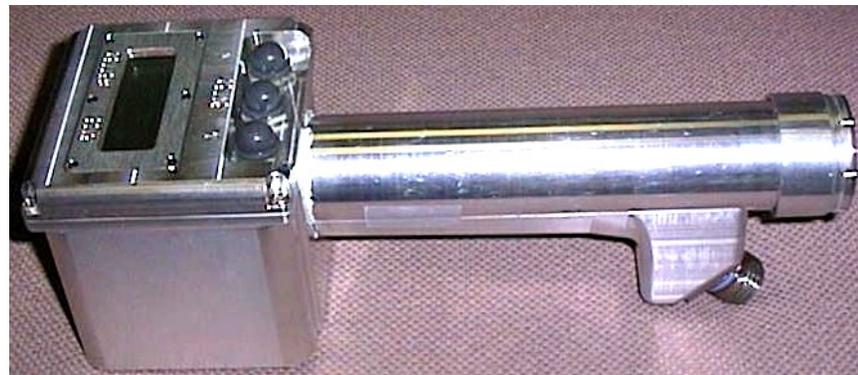


SETTER Cutaway View



SLA Model

Setter Prototype



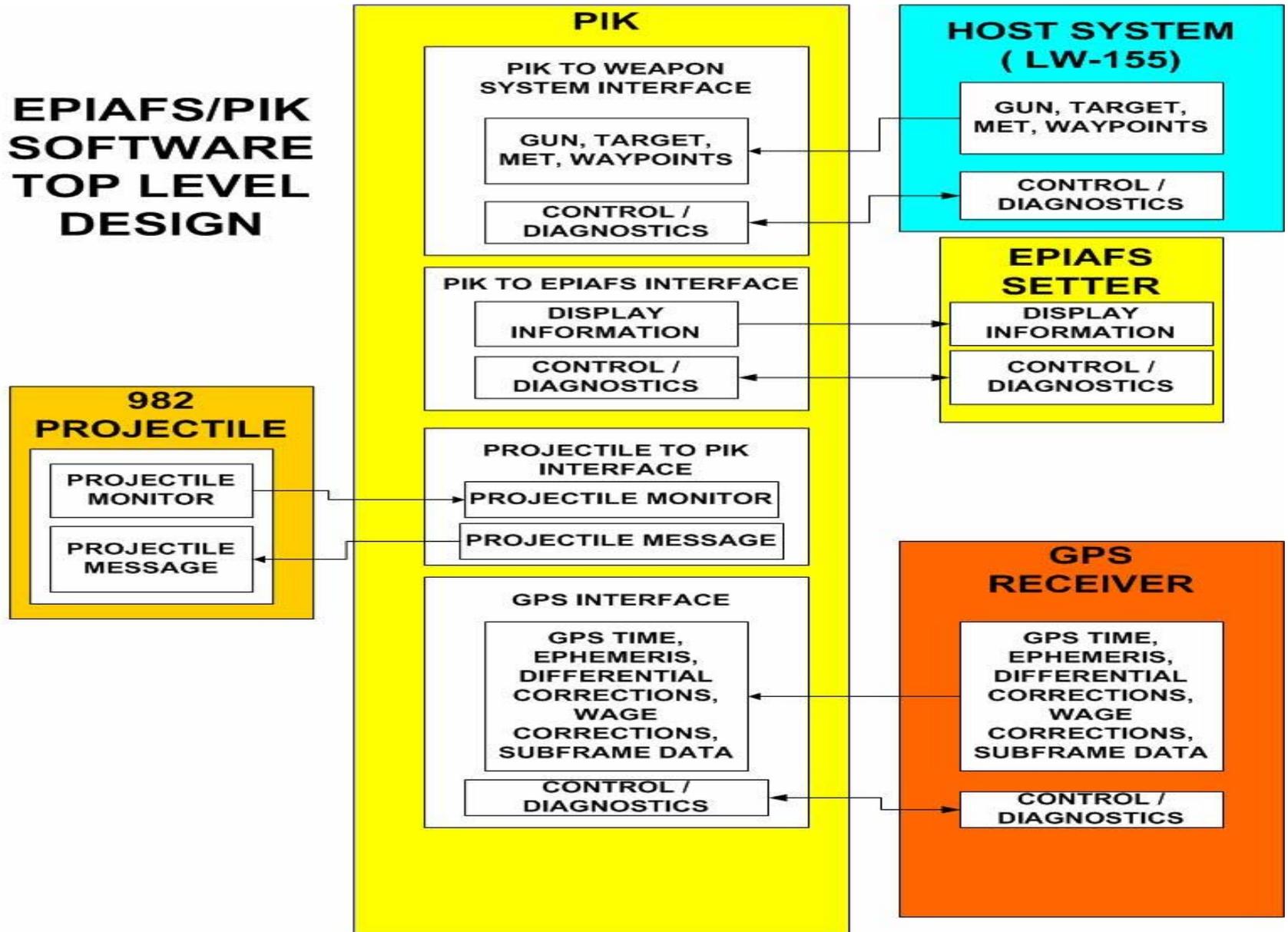
ACCOMPLISHMENTS

- 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

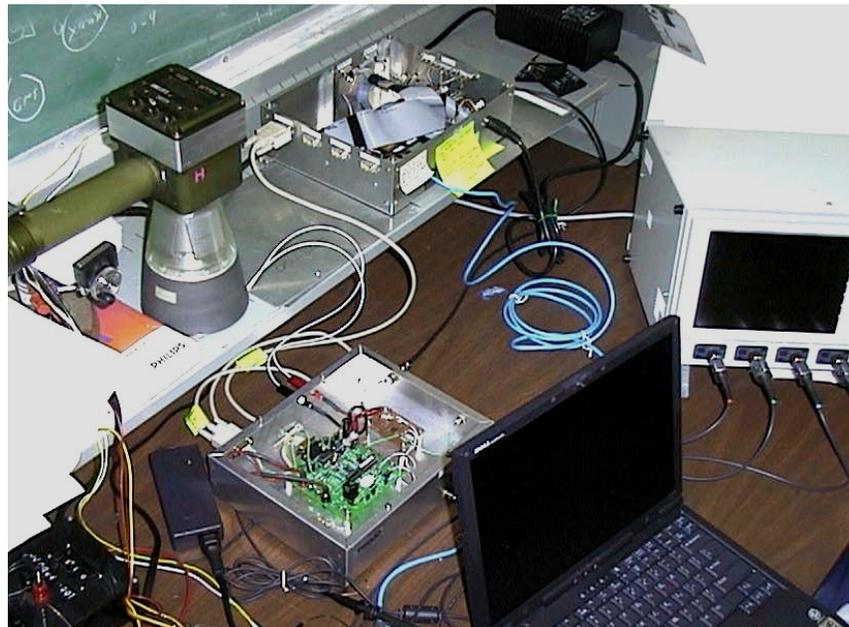


EPIAFS Software

- 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

