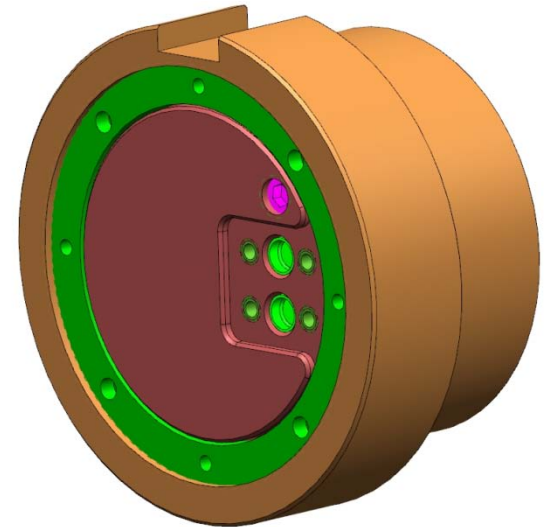


NavFire Guidance System – Integrated GPS and Mission Computer for Future Navigation Systems

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**Rockwell
Collins**

NavFire Guidance System Outline

- Precision-Guided Artillery
- NavFire Guidance System (NFGS) Design
 - Features
 - Subassemblies
- Core Functionality
- Integration
- Summary

Precision-Guided Artillery Purpose

- Increase Ground Force Effectiveness
 - Accurately hit specified target
 - Reduce (or eliminate) repeated adjustments
- Minimize collateral damage



Artillery Environment

- High velocities
- Launch shock
 - Set-back shock
 - Set-forward shock
- Canard/Fin/Wing deployment
- Rocket Boost
- Spinning Round
 - Variable depending on platform up to 350 Hz

Artillery Program Challenges

- Space limitation
 - Due to artillery round ogive
 - Smart weapons ogive contains fuze and guidance system
- Hostile Environment
- Shorter time to fielded system
 - Less time for design, implementation, integration, etc.
- Cost to win



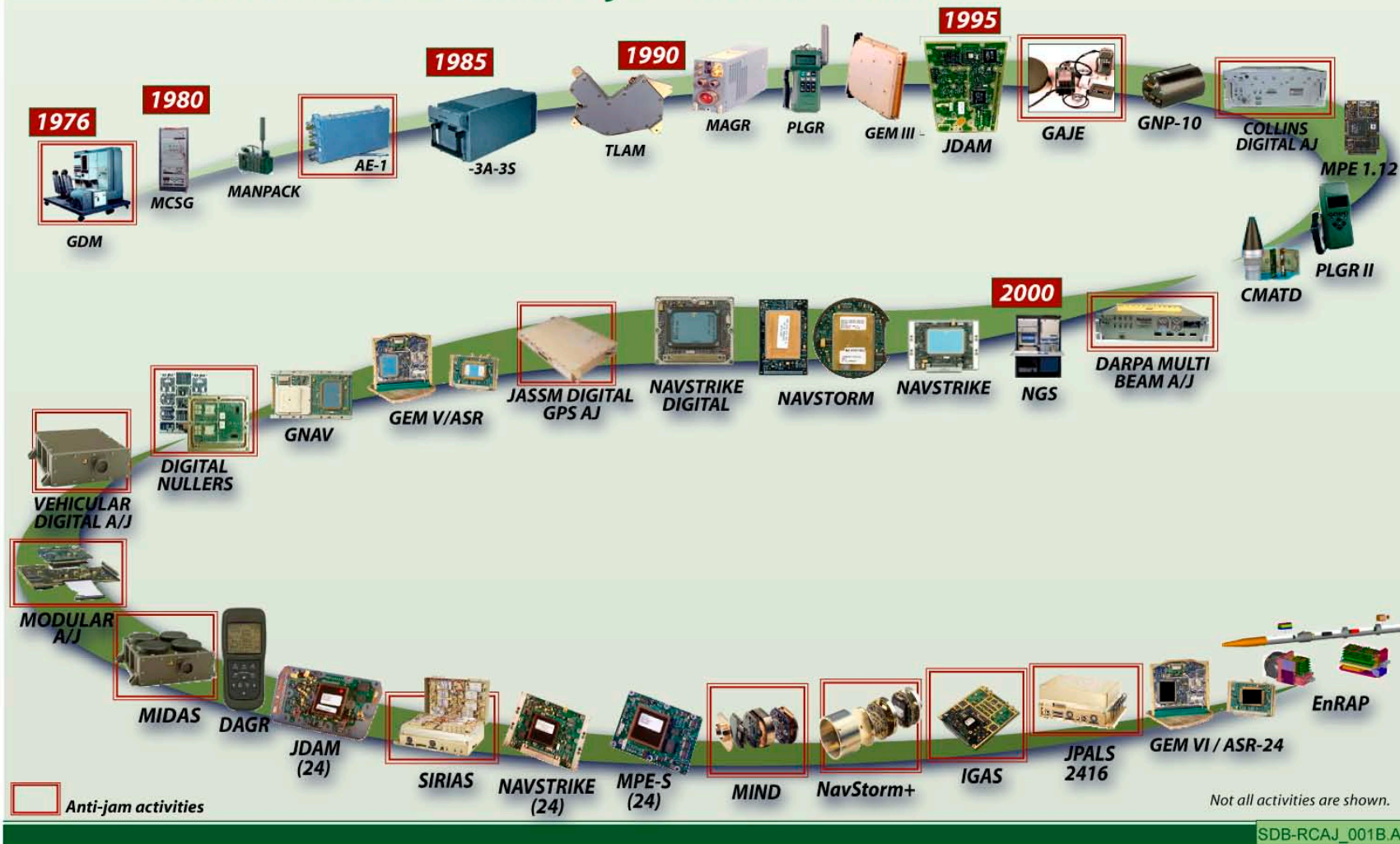
NavFire Guidance System (NFGS)

- NFGS Scope
 - Support artillery programs
 - Integrated guidance and navigation package
 - Reduce number of parts
 - More efficient design
 - Reduce user integration time

NFGS Features

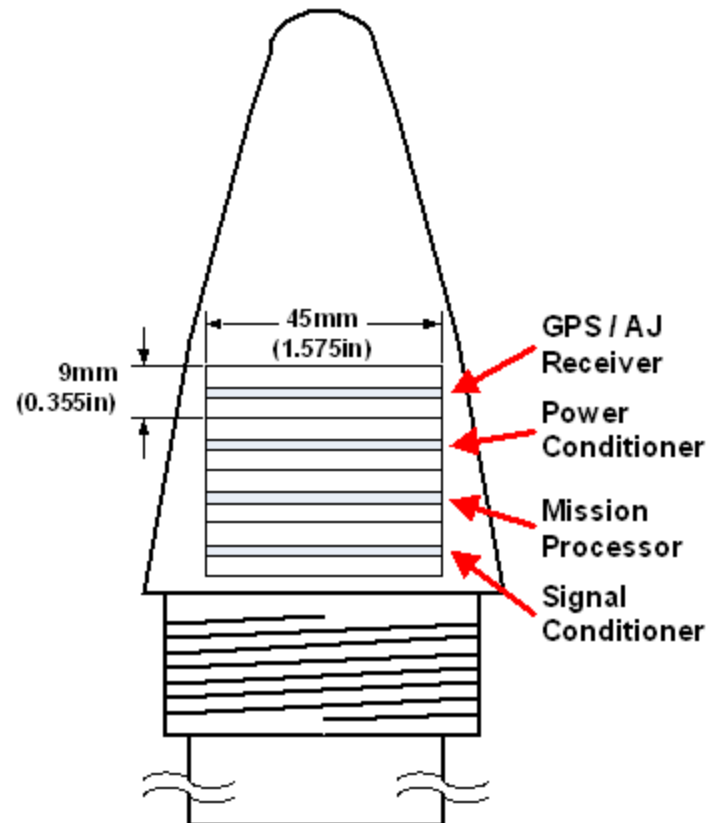
- Small Form Factor
 - 45 mm outer diameter by 40 mm height
 - 150 grams
- Low Power
 - ≤ 5 Watts, nominal operation
- Performance
 - ≤ 6.0 second Guidance Solution availability (from Power On)
 - ≤ 5.0 meters CEP (standalone GPS)
 - ≤ 2.0 m/s velocity accuracy
- Gun Hard to 20,000 G
- Integrated 2-channel Anti-Jam
- Up-finding
 - ≤ 5 accuracy
- Software configurable
- Can host user algorithms

Rockwell Collins Proven GPS and Anti-jam Performance



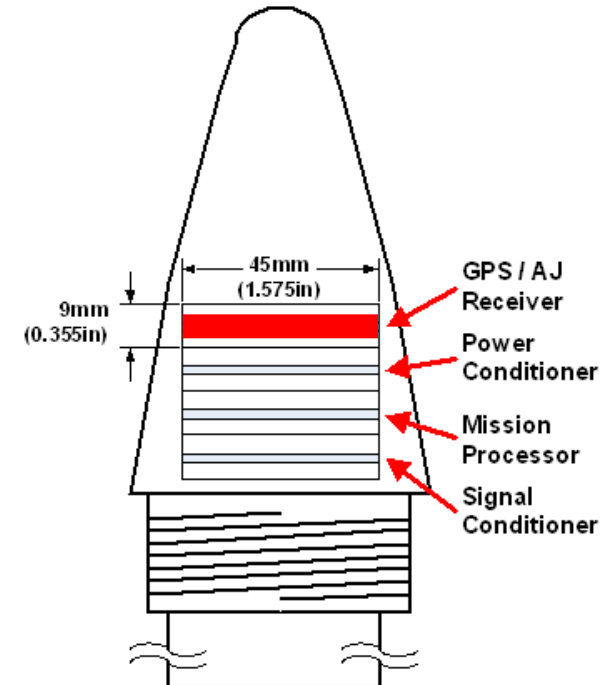
NFGS Subassemblies

- GPS Receiver
- Power Conditioning
- Mission Processor
- Signal Conditioning



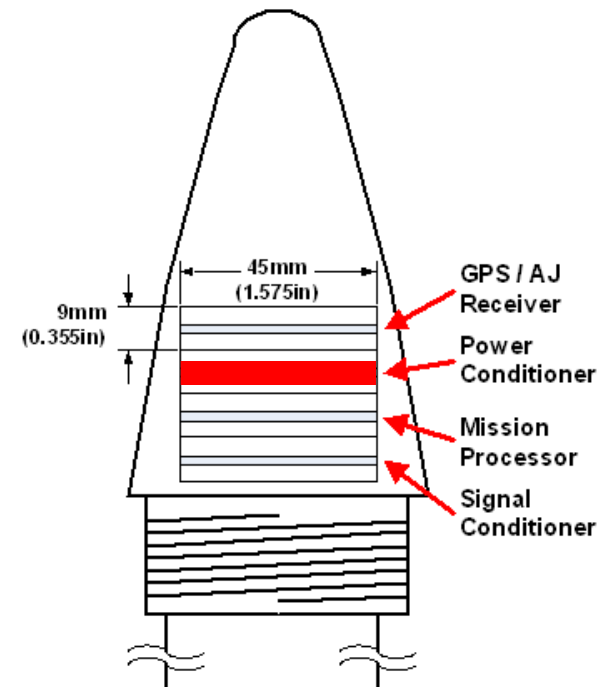
NFGS Subassembly - GPS Receiver

- NavFire GPS-AJ Receiver
 - Baselined on NavStorm™+ GPSR
 - Proven artillery GPSR
 - 2 RF Channels
 - L1 or L2 capable
 - Expandable to 4 channels
 - SAASM 3.7
 - Over 9000 correlators
 - 50% increase over previous SAASM
 - 36 acquisition, 48 tracking
 - KDP4
 - Integrated into SAASM 3.7
 - No longer separate hardware



NFGS Subassembly - Power Conditioning

- User provided power
 - 4.75 VDC – 12.0 VDC
- Condition power for NFGS
- Primary power to auxiliary power switching
 - Supports Data Hold phase
- Charging circuit
 - Supports charging a super-capacitor
 - Used for Data Hold phase



NFGS Subassembly - Mission Processor

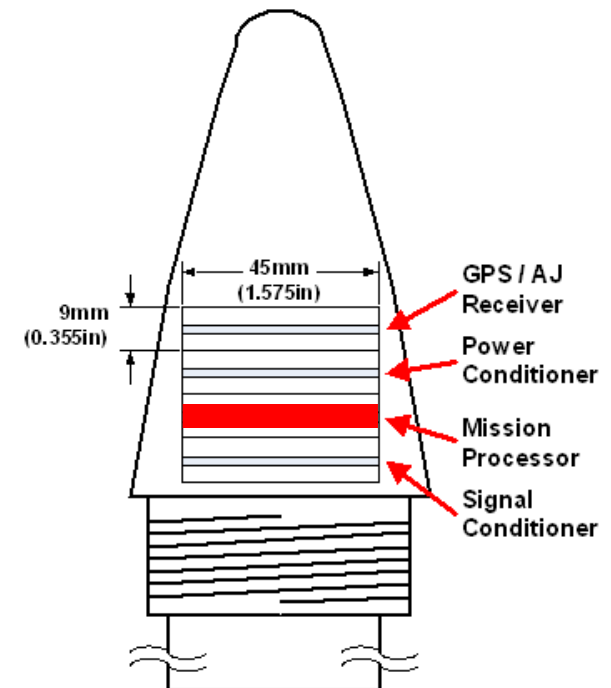
- Driven by GPSR oscillator
 - Common time reference

- Microprocessor
 - Supports PoP Memory

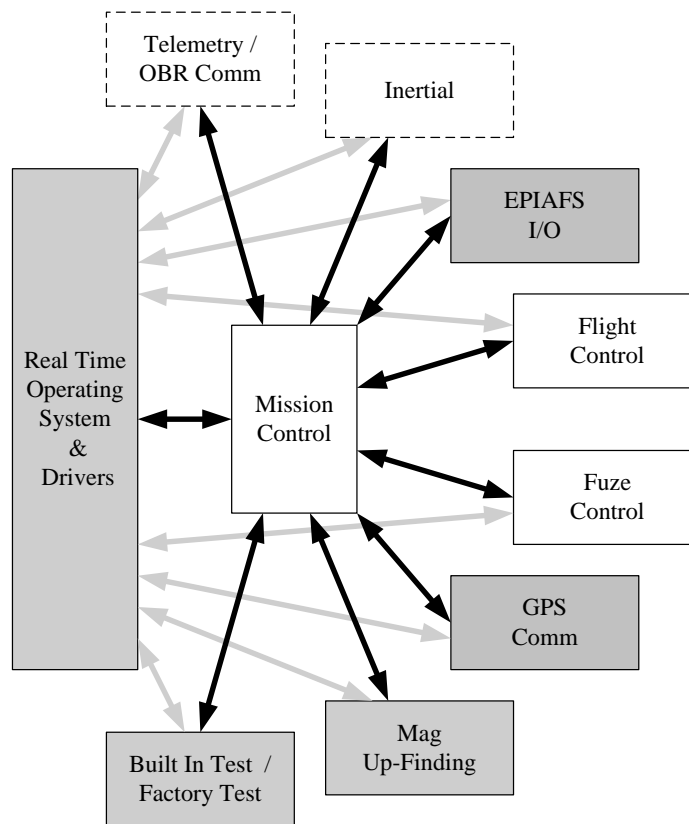
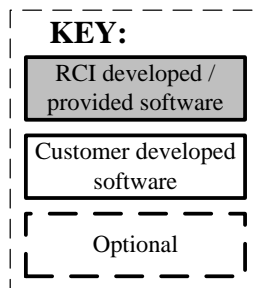
- Real Time Operating System
 - VxWorks
 - POSIX-compliant
 - Portable to other RTOS

- Interfaces to guidance sensors

- Provides Status and Control



NFGS Subassembly - Mission Processor Software

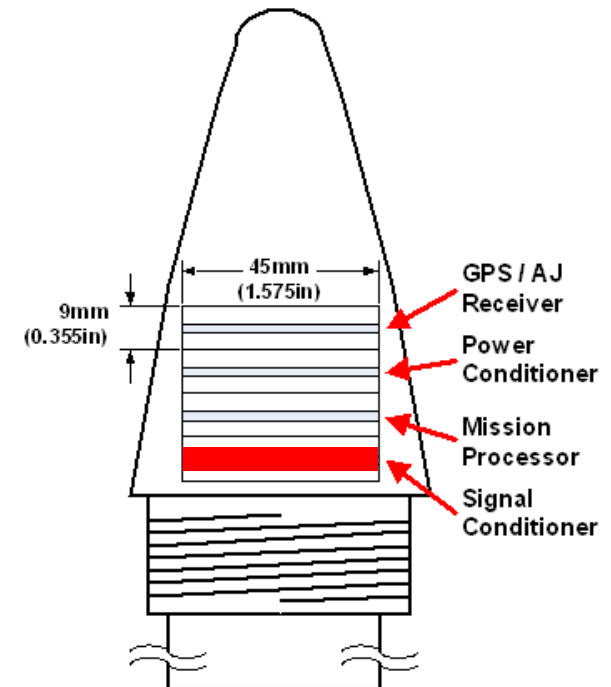


NFGS Subassembly - Signal Conditioning

- Provides all interfaces for the NFGS
 - Configurable for unique interfaces

- Common interfaces supports
 - RS-422/485
 - USB
 - DS-101
 - 1PPS/TimeMark
 - Pulse Width Modulated (PWM)

- Artillery specific interfaces
 - FUZE
 - Enhanced Portable Inductive Fuze Setter (EPIAFS)





EPIAFS

- Inductive Interface
 - Provides Power and Data
 - Eliminates need for external interface connection
- Data interleaved with power pulses

Core Functionality

- Built-In Test
 - Performs BIT and provides results for all available sensors
- Provides Up-finding
- Provides GPS solution
 - Pseudorange and Delta range (PR/DR)
 - Position, Velocity, Time (PVT)
- GPS Interface
 - Provides GPS data in user-friendly format
 - Handles GPS message format and protocol
 - Handles GPS cryptokey data

Core Functionality (cont.)

- Interfaces with EPIAFS
- Interfaces with additional navigation sensors
- Flexible message protocol
 - User defined messages
 - NFGS and user application share memory
 - Common, defined memory locations for all internal data
 - NFGS defined messages
 - GPS data, BIT results, NFGS status, etc.
 - All data in NFGS defined messages available to user
- Supports user guidance algorithms
 - Hosted on NFGS Mission Processor

NFGS Up-Finding

- Required for precise guidance
- Determine roll angle and roll rate
- Magnetometer
 - Determines up based on Earth's magnetic vector
- Advanced Spinning Vehicle Navigation (ASVN)
 - Developed and patented by Rockwell Collins
 - Determines when antenna system is facing the sky
 - Applicable for very high rotation rates
 - Successful field tests

NFGS Integration - EPIAFS

- NFGS interfaces with EPIAFS
 - Routes power to super-capacitor charging circuit
 - Routes data to Mission Processor
- NFGS performs all EPIAFS communication
 - Handshaking, status, etc.
- Mission Processor parses EPIAFS-provided data
 - Places parsed data in common memory location
 - Data in IEEE format

NFGS Integration

- Reduces user integration time
 - Combines GPSR, Mission Processor, signal and power conditioning
 - Handles GPSR I/O interface
 - Provides GPS data to user via memory location
 - User does not need to interact with the GPSR message protocol
 - Handles EPIAFS inductive interface
 - Charges super-capacitor
 - Parses and routes data
 - Handles I/O to guidance sensors
- User defined messages
- User's integration focus
 - Guidance, Navigation, and Control (GNC)
 - Fuzing

Summary

- NFGS developed as an integrated GPS and Mission Processor
- NFGS designed for precision artillery market
 - Small form factor
 - Gun hard
- Reduces user integration time
 - Users focus on GNC and fuzing
 - NFGS handles I/O to/from sensors
 - Up-finding built in

Questions?