HIGH ACCURACY RADAR PROXIMITY SENSOR

48th Annual NDIA Fuze Conference

Presented by Bob Hertlein
robert.hertlein@L-3com.com
Outline

HARPS

• Background
• Application
• Features
• Design
• Program Status
Background

**HARPS**

- Conceived as an updated design to compete with the DSU-33
- KDI bid alternative design to USAF
  - Based on M734A1 technology
- Exportable version developed for FMS in conjunction with Ordnance Technologies (UK) Limited (OTL) and Electronics Development Corp. (EDC)
Current DSU-33 Prox Sensor

HARPS
Application

**HARPS**

- Fit, Form and Function replacement for existing DSU33
- Air burst capability for standard MK80 series weapons using either FMU139 or FMU152 fuzes and FZU48 and FZU55 initiators.
Features

HARPS

• Improved Height of Burst (HOB) control
• Improved resistance to jamming
• Hermetically sealed sensor electronics
  – Improved reliability
  – Extended shelf life (20yrs)
Design

HARPS

- Objectives
- Signal Processor
- Transceiver
- Antenna
- Interface
- Battery
Design Objectives

HARPS

• Improve Accuracy and Burst Height Control
• Improve ECM resistance
• Improve tolerance to Stick Release
• Improve Reliability
• Improve Storage Life
Design Objectives

HARPS

• HOB: 5 ±1 Metres over following conditions:
  • Approach Velocity from 30-500 m/sec
    – Approach Angles from 15° to 90° from horizontal
    – Target surfaces of
      • Soil (Wet and Dry)
      • Concrete (Wet and Dry)
      • Water
      • Dense Foliage
      • Desert Scrub
    – Target Reflectivity range +5dB to -16 dB
Signal Processor

**HARPS**

- Direction Doppler Ranging (DDR)
  - Original demonstrator units utilized M734A1 Signal Processor
  - Current design uses KDI-100 DDR Signal Processor
    - Fully integrated, single-chip signal processor
    - Doppler passband and reference waveforms tailored to application
Transceiver

**HARPS**

- First prototypes utilized exportable version of M734A1 transceiver
  - Fully integrated transmit and receive functions
  - Unacceptable performance variations over the wider temperature range
  - High Cost

- Current HARPS design utilizes a less integrated transceiver design
  - Oscillator separate from detector electronics
  - Parameters very stable over temperature
  - Versatile, low cost
Antenna

**HARPS**

- Circular patch mounted on extended ground plane
- Fed via hermetic feedthrough
  - Glass-to-metal seal welded to housing
- Extremely rugged
Sensor Cutaway View

HARPS

RADOME

PATCH ANTENNA

TOP PLATE

TRANSCIEVER PROCESSOR BOARD

INTERCONNECT CABLE

ANTENNA COVER

HERMETIC FEEDTHRU

INTERFACE BOARD

HOUSING

HERMETIC CONNECTOR
Interface

HARPS

- Interface PWB Supplied by OTL
- Interfaces to Initiator, battery, fuze
  - Initiitor Interface
    - +32 to +150V at 2.5mA max for 1.2 sec (FZU48 & FZU55) or
    - +195 volts or -195 volts (±4%) at <25mA for 15 - 500 ms (FFCS)
Interface

**HARPS**

- **Firing Signal Interface**
  - 30mA (min) into 470Ω for >100μsec
  - 33,000 ergs into 4Ω within 200μsec
  - Compatible with FMU152A/B, FMU55A/B, FMU139A/B, FMU139B/B & FMU139C/B

- **Electrical Connection**
  - Interfaces directly with FZU as per existing Mk80 weapon system designs.

- **Mechanical Interface**
  - Screw fit to Mk80 front fuze pocket.
Battery

HARPS

• Thermal Battery
  – Current Design uses same Thermal Battery as DSU-33
  – 32 Volt battery far exceeds power requirements for HARPS
    • Significant power dissipating circuitry required
    • Design has potential to use lower voltage battery
      – Significant cost savings possible
HARPS Cutaway View
HARPS Photo
HOB Test Data

HARPS HOB VS REFLECTIVITY

HARPS

HOB (M) vs. SURFACE REFLECTIVITY (dB)
Program Status

HARPS

• 5 Units recently shipped to French DGA
  – Trials to take place early summer
    • Ground test
      – System test with Pyrotechnic Indicator
    • Flight Testing (Mk82 Bomb system)
      – Captive Carriage
      – Inert release with Pyrotechnic Indicator
      – Live release with FMU-139B/B

• Additional International opportunities
Conclusion

HARPS

- Form, Fit, Functional DSU-33 replacement
- Enhanced Performance
  - Tighter HOB
  - Jam Resistant
- High Reliability
- Extended Storage Life
- Low Cost