# High Density Digital Recorder Application Study-The AN/BQH-9(V)1 Program

THIC Conference October 13, 14, 1998


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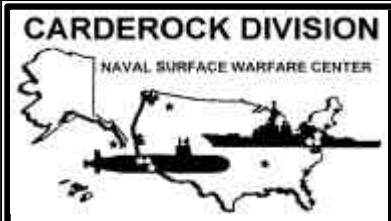
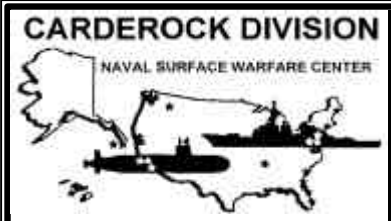



# Agenda

- Introduction
- Presentation Goals
- AN/BQH-9(V)1 System Overview
- HDDR Design Issues
- Current HDDR Operational Issues
- Future HDDR Requirements
- Summary

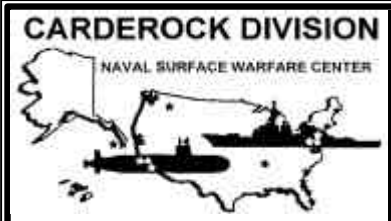



# THIC Presentation Goals

- Acquaint Industry With the Use of the HDDR as Part of the AN/BQH-9(V)1 SDRS.
- Present HDDR Design Issues
- Present Current HDDR Operational and Maintenance Requirements.
- Recommend Improvements for Future HDDR Systems.

# Introduction

- The HDDR is an integrated part of the AN/BQH-9(V)1 Signal Data Recording Set (SDRS) installed on US Navy Fast Attack Submarines.




# AN/BQH-9(V)1 System Overview

- The AN/BQH-9(V)1 Signal Data Recording Set performs the following tasks:
  - Interfaces with the submarines sonar set utilizing both digital and analog interfaces.
  - Conditions, amplifies, and records sonar acoustic data on magnetic tape in digital format for subsequent shore based laboratory analysis.
  - Records tactical support data such as ships position, course, depth, and speed for recording scenario reconstruction.

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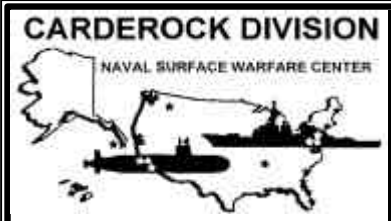
# AN/BQH-9(V)1 System Overview (Cont.)

- High Density Digital Recorder (HDDR)
  - Records Data onto the Wide Band Helical Track at Operator Selectable Data Rates
  - Records Support Data on Two Longitudinal Tracks
    - IRIG-B Time Code
    - Manchester Encoded Digital Support Data
  - Utilizes 19-mm Wide ID-1 Magnetic Tape Cartridges




# HDDR Design Issues

- Data Rates and Footprints
  - Optimization of tape usage versus bandwidth utilizing fixed rate recording.
- Environmental Concerns
  - System has to operate onboard a submarine, not the typical lab environment.

# HDDR Design Issues (Cont.)

- Data Rates and Footprints
  - The recorder interface was designed to utilize fixed recording rates. The 4 fixed data rates are as follows.
    - 26.55 Mbs
    - 50.15 Mbs
    - 100.3 Mbs
    - 200.6 Mbs

# HDDR Design Issues (Cont.)

- Data Rates and Footprints (Cont.)
  - The AN/BQH-9(V)1 is programmed with 8 “Footprints”. Each footprint records a different set of sensors based on sensor availability and the available bandwidth in the specific data rate.
  - Each footprint utilizes a unique frame configuration based on the sensors recorded in the footprint
    - Frames in the footprint are output to tape at a 3125 Hz rate
    - Frame length is varied by footprint recording rate
      - 26.55 Mbs = 8496 bit frames
      - 50.15 Mbs = 16048 bit frames
      - 100.3 Mbs = 32096 bit frames

# HDDR Design Issues (Cont.)

- Data Rates and Footprints (Cont.)
  - The frame configuration is designed to accommodate sensors with different recording bandwidths while still maintaining a constant 3125 Hz frame rate

| SENSOR (Sample Freq) | Number of 16 bit Words in Each Frame |
|---|---|
| A (3125 Hz) | 1 |
| B (6250 Hz) | 2 |
| C (31.25 kHz) | 10 |

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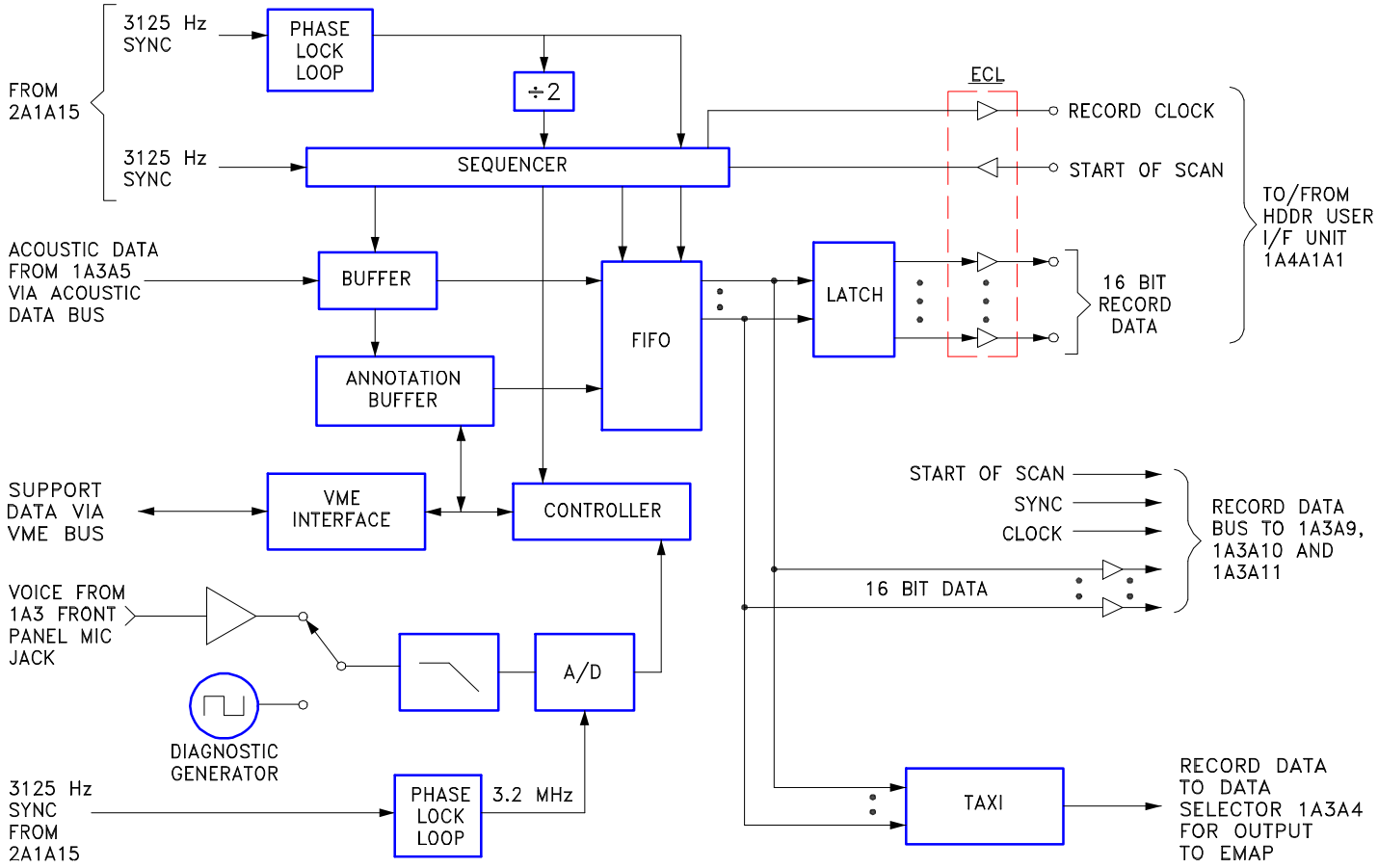
# HDDR Design Issues (Cont.)
# Record Formatter



# HDDR Design Issues (Cont.)

- Data Rates and Footprints (Cont.)
  - The operator selects between the 8 footprints depending on the specific sonar system configuration and the current operational conditions.
  - The footprint scheme allows for the optimum use of recording bandwidth for the specific operational scenario. This optimal use of recording bandwidth minimizes tape usage. Minimizing tape storage onboard submarines is a critical factor in the design of the system.

# HDDR Design Issues (Cont.)

- Environmental Concerns
  - Systems installed on US Navy Submarines have to meet stringent environmental requirements. Some examples are:
    - Airborne Noise Level
    - Electro-Magnetic Interference (EMI)
    - Shock and Vibration
    - Operating Temperature
    - Moisture Resistance

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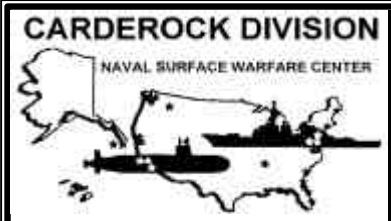
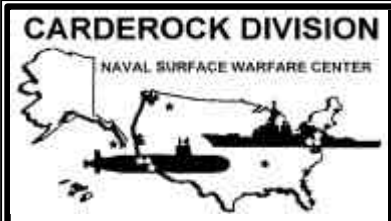
# HDDR Operational Issues

- Tape Cross-Play Between Recorders
- Maintenance and Testing
- Tape Handling and Storage




# Current HDDR Operational Issues (Cont.)

- Cross Play
  - Tapes recorded in the field must cross play on shore based analysis systems
  - Currently, the program is utilizing an HDDR from one manufacturer. This will change in the future, thus requiring cross play between recorders
    - Program has been participating in NCITS B5 Ad Hoc ID-1 Instrumentation Group meetings to participate in the development of an ANSI ID-1 Cross-Play Calibration Tape




# Current HDDR Operational Issues (Cont.)

- To Ensure Cross Play Between Systems, the Following Steps are Undertaken on All Recorders
  - Prior to installation, the Bit Error Rate (BER) of each HDDR is verified using a Bit Error Rate Tester (BERT).
  - A Test Tape is recorded on the Primary HDDR and reproduced on the Backup HDDR to verify cross play.
  - After installation a Test Tape is recorded and then reproduced at a shore based analysis facility to further verify cross play.

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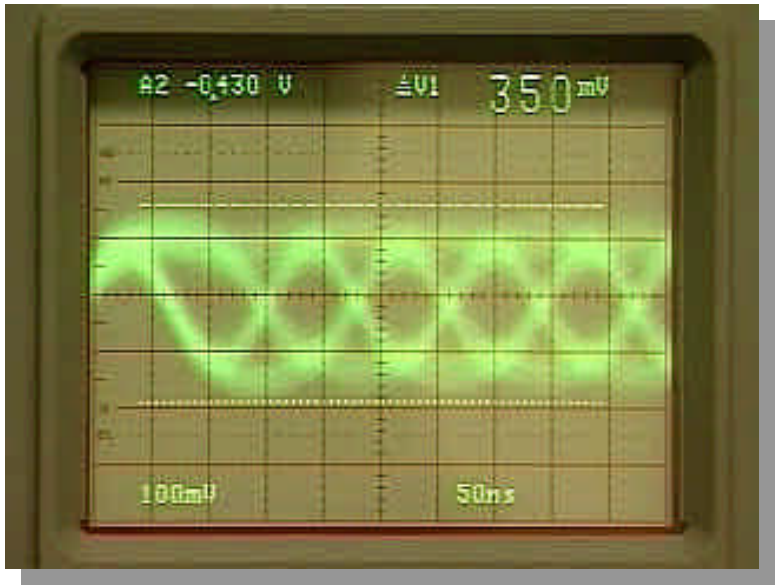
# Current HDDR Operational Issues (Cont.)

- Maintenance and Testing
  - Computer Based Training material has been developed to enhance HDDR maintenance and testing.
    - These two screen shots illustrate HDDR Gain and Phase adjustment while monitoring the output signal on an oscilloscope

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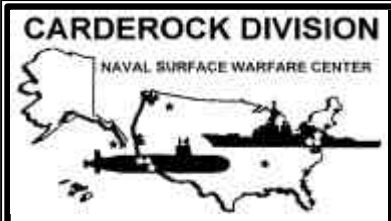
# Current HDDR Operational Issues (Cont.)

- Tape Handling and Storage
  - All Tapes are cleaned and demagnetized
  - Hub locking mechanisms are installed
  - Tapes are then serialized and repackaged in smaller boxes
  - Temperature and humidity sensors are placed in boxes
  - Tapes are finally stored in a temperature and humidity controlled environment.

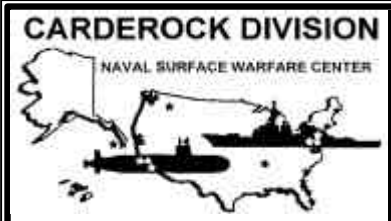



# Future HDDR Requirements

- Higher Reliability
- Lower Cost
- Simplified Maintenance

# Future HDDR Requirements (Cont.)

- Higher Reliability
  - Currently 2 recorders are installed on each platform for redundancy.
  - Future plans are to install only 1 recorder per platform if a much higher reliability rate can be demonstrated.




# Future HDDR Requirements (Cont.)

- Lower Cost
  - As in any program, cost is a major factor in the selection of a product.
  - Future HDDRs will have to be more cost effective
  - If improved reliability can be demonstrated, 1 recorder will be installed in place of the current Primary and Backup recorder scheme requiring less recorders to support the same number of missions.

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# Future HDDR Requirements (Cont.)

- Less Maintenance
  - Less maintenance means lower overall cost to the program.
  - Future HDDRs should require virtually no Field Service or alignment.

# Summary

- Development of the ANSI ID-1 Cross-Play Calibration Tape is Critical for Utilizing HDDRs from Multiple Manufacturers Within a Program
- Future HDDRs Should Emphasize
  - Lower Cost
  - Simplified Maintenance
  - Higher Reliability