Airborne Applications of Solid State Recorders
An Overview

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OUTLINE

• Corporate Overview
• Our History with Flight Data Recorders
• Product Lines
  – Signal Acquisition Units (SAU)
  – Crash Survivable Memory Units (CSMU)
  – Voice and Data Recorders (VADR™)
  – Integrated Data Acquisition Recording System (IDARS™)
    » Health & Usage Monitoring System (HUMS)
• Applications
  – Standard Flight Data Recorder (SFDR) for USAF
  – Crash Survivable Flight Incident Recorder (CSFIR) for USN
  – VADR™ for the USCG
  – VADR™ for the US Army
  – HUMS for the UK Chinook
Defense Systems North America

• Formerly Lear Siegler Instrument Division. Since 1987, wholly-owned subsidiary of Smiths Industries

• Data Management Systems
  – Data Transfer Devices
  – Data Recording Systems

• Reference Products
  – Gyros & Navigation Systems
  – Fiber-optic Gyros (FOG)

• Commercial Avionics
  – Flight Management Systems
  – Cockpit Voice Recorders (CVR)
  – Flight Data Recorders (FDR)
Grand Rapids, MI

Clearwater, FL

Florham Park, NJ
DSNA Space & People Distribution

**Space**

Total: 859,000 sq ft

- Mfg: 58%
- Eng: 25%
- Other: 17%

**People**

Total: 1,551 People

- Mfg: 37%
- Eng: 36%
- Other: 27%

Strong Technical Capability with State-of-the-Art Manufacturing
SI Flight Data Recorders History

- Initial development for F-16 Crash Survivable Flight Data Recorder (CSFDR) begun in 1982
- First generation solid-state Flight Data Recorder (FDR) 1984
- SI-GR awarded Standard Flight Data Recorder contract in 1988
  - Initially identified for 17 aircraft types
  - Second generation - faster, more capable
- Over 4,700 CSFDR and SFDR shipsets delivered
- SI-GR development of Voice and Data Recorder (VADR™) begun in 1992 for SH-60J (Japan)
- Integrated Data Acquisition Recording System (IDARS) selected for JPATS and C-XX
Data Management Systems

- Signal Acquisition Unit (SAU)
- Crash Survivable Memory Unit (CSMU)
- Cockpit Control Unit
- Data Transfer Systems
- Integrated Data Acquisition Recording System
- Voice & Data Recorder

Multi-Product Capability
Multifunctional Capabilities

Recorded Data

- Individual Aircraft Tracking
- Loads/Structures Data
- Engine Usage Data
- Maintenance Diagnostics
- Health Monitoring
- Ground Collision Avoidance
- Training Data
- Mishap Data
SI Flight Data Recorders

- Versatile Recording System
  - Mishap
  - Aircraft Structures Tracking
  - Engine Monitor

- Recorded Data Supports Multiple Uses
  - Mishap Replay
  - Training Replay
  - Test & Diagnostic Support
  - Maintenance
Standard Flight Data Recorder (SFDR)

- **SOLID STATE DESIGN**
  - Small, rugged, adaptable to rotary and fixed wing aircraft
  - Improved reliability and maintainability over existing recorders such as MXU-553 and AN/ASH-28

- **MULTI-FUNCTION CAPABILITY**
  - Records Structural, Engine, Tracking, and Mishap data
  - Hosts on-board diagnostics, ground collision avoidance, mission reconstruction, embedded training, etc.

- **BENEFITS**
  - Affordable
  - Low/Zero risk
Signal Acquisition Unit (SAU)

SAU Model 2865 Characteristics

Microprocessor: M68360 Software:
- Configurable software architecture
- Coded in MIL-STD-1815A Ada
- Less than 10% change required from application to application

Memories:
- Program Memory: 512 Kbytes
- Scratchpad RAM: 512 Kbytes
- BIT Non-Volatile Memory: 16 Kbytes

Auxiliary Memory Unit:
- 3 Mbytes Non-Volatile Memory

Dimensions:

- H = 7.0 in (17.8 cm)
- L = 7.25 in (11.7 cm)
- W = 6.2 in. (15.7 cm)
- Wt = 12.5 lb (6.5 kg)
Signal Acquisition Unit (SAU)

- Analog and Discrete signals received and converted to digital formats
  - Accommodations for more than 70 inputs plus Bus I/O
- Digital parameters acquired from MIL-STD-1553 or ARINC-429 data bus interfaces
  - Redundant 1553 remote terminal/Bus monitor
  - Up to 6 ARINC-429 input interfaces
- M68360 Central Processing Unit for system control
- Parameter list and on-board calculations configured in software data tables
- High speed RS-422 interface for rapid communication, download and DTM interface.
- Extensive Built-In Test (BIT)
  - Self fault isolation to failed module
Crash Survivable Memory unit (CSMU)

- RS422 data input
- Memory: 56K to 1,024K Bytes
- Minimum Recording Time:
  - Attack/Fighter/Trainer Aircraft
    - 15 Min. Active Flight
    - 1 Hour Normal Flight
  - Transport Aircraft
    - 25 Hours
- Weight: 3.6 Pounds (1.64)
- Size:
  - H = 3.0 in (7.6 cm)
  - W = 3.0 in (7.6 cm)
  - L = 4.6 in (11.7 cm)
- Power Dissipation: <4 watts
- Underwater locatable acoustic beacon available
CSMU Characteristics

• **Operational Requirements:**
  – Hard mountable in any location, any orientation
  – No external cooling required
  – Memory options for up to 25 hours of retained flight data
  – Non-proprietary RS-422 interface for communication and download

• **Survivability: (TSO-C124 Compliant)**
  – Impact: 1700g 6ms and 200g 15ms each face
    (3400g 6ms, 14.5g-sec - TSO)
  – Penetration: 500 lb. pin dropped 10 feet, each face
  – Crushing force: 5,000 lbs, 5 minutes each axis
  – Fire: 1,100°C. for 30 minutes
  – Seawater immersion: (20,000 ft. for 30 days - TSO)
  – Contact, immersion: Jet fuel, hydraulic & lubricating oil, etc.
Voice & Data Recorder (VADR™)

- Solid-State Crash Protected Memory
- Meets TSO-C123/C124 and EUROCAE ED-55/ED-56
- Data Input
  - 1553B
  - RS-422 from SAU
- Connects Directly to Audio Systems
- Recording Time
  - Audio: 4 channels, each 30 min
  - Data: 25 hours
- Power: 28 VDC, <9 watts
- Size: 3.4 in (H) x 5.07 in (2) x 6.5 in (D)
- Weight: 8.4 lbs max. with beacon
- Locatable Acoustic Beacon
Voice & Data Recorder (VADR™)

• Multi-Function Crash Survivable System
• Design is based upon our successful Crash Survivable Memory Unit (CSMU), which is now in service on many types of aircraft around the world.
• No Scheduled Maintenance
• MTBF of over 20,000 Hours (at +40°C., continuous operation).
• Supports two level maintenance
• Designed for both civil and military applications, and is inter-changeable with existing CSMU’s.
• SI Funded Development
• In production
• Available on GSA Schedule
VADR™ Characteristics

• Connects directly to aircraft intercom systems and cockpit area microphone

• No special ground support equipment required

• Bus data input via RS-422, ARINC-717 and MIL-STD-1553 (Growth for ARINC-429)

• Digital Solid State EEPROM Storage medium

• Recording Duration
  – Voice and Cockpit Audio: one to four channels, 30 minutes (minimum) each channel
  – Data: 25 hours, minimum
VADR™ Characteristics

• Memory Capacity: 10 to 36 Mbytes (customer selectable); near term growth to 112 Mbytes

• Recorded Audio Frequency Response:
  – Three channels from 150 to 3,500 Hz and one channel from 150 to 6,000 Hz
  – High fidelity audio recording - harmonic distortion: 6% at 1 kHz; recorded signal to noise ratio: 35 dB; dynamic range: 60 dB

• Analog Rotor Tachometer Input

• Input Power: +28 VDC, <9 Watts

• Hard Mountable; No cooling air required

• Underwater Locatable Acoustic Beacon available

• Cockpit Control Panel and Area Microphone available.
Model 3253 VADR™

Smallest, Lowest Weight CVR and FDR Available
Model 3255 IDARS™

- Meets FAA TSO-C123/C124 and EUROCAE ED-55 & ED-56A
- Data Input: ARINC 429, RS-422 & ARINC 717
- Connects Directly to Audio Systems
- Recording Time
  - Audio: 4 channels, each 30 min.
  - Data: 25 hours
- Power: 28 VDC
- Size: 1/2 ATR ARINC 404
- Weight: <15 lbs
- Capabilities:
  - Analog, discrete, 1553 data acquisition
  - Data Processing & Recording
  - Data Transfer System Interface
Integrated Data Acquisition Recording System
(IDARS™)

• Multi-Function Data Acquisition, Processing, Recording and Crash Survivable System

• Design based on the successful VADR™ and SFDR Programs

• Selected for the JPATS and C-XX aircraft

• Provides multi-use as a:
  – Cockpit Voice Recorder (CVR) only
  – Flight Data Recorder (FDR) only
  – Combined CVR and FDR
  – Can include acquisition and processing for analog, discrete and digital signals
  – Extensive growth capability, including HUMS
Model 3255 IDARS™

• Offers full functionality of current SAU
  – Ada software
  – Motorola 68360 processor
  – On-board memory for ASIP, ENSIP, BIT, and Maintenance functions
  – Full analog capacity
  – ARINC-429, MIL-STD-1553, RS-422 interfaces

• Includes Voice and Data Recorder (VADR™)
  – Common Crash Protected Memory (CPM) proven in VADR™ applications
  – Offers voice recording growth to 2 hours per channel

• All packaged in a single LRU / WRA
Model 3255 IDARS™ Cutaway

- ARINC 404 1/2 ATR Chassis
- CPM I/O Controller
- Voice Processing
- Backplane
- Connector
- Flexible Interconnect
- Underwater Locator Beacon (Option)
- Smart Analog Subsystem CCA
- Crash Protected Memory (CPM)
- Digital Data Processing Unit
New Data Transfer System

- **Next Generation DTS:**
  - Retains current DTM form factor
  - Processor managed DTM receptable
  - 10 - 140 Mbyte DTM today, 1 Gbyte DTM by 1998

- **Status**
  - Four production contracts received in 1993/1994
  - Flight-worthy hardware now and productionization funding received

- **Increased memory capacity and lower cost** (40 Mbyte DTM approximately same cost as current 1 Mbyte (DTM))

- **Software programmable receptable for easy modification/update**

- **Addresses new large memory capacity applications:**
  - Digital map/world DTA bases
  - Digital image recording
  - Maintenance databases
Data Transfer Module

- **Capacity:** 16K to 140 Mbyte
  - Growth to 1 Gbyte
- **Standard Serial Interface**
- **Size:** 6 in. x 3.3 in. x 0.75 in
- **Weight:** 0.75 pound
- **Reliability:** 78,000 hours
- **Environmental Performance:**
  - Temperature: -54 to +70°C.
  - Shock: 20G's
  - Vibration: 5G's
  - Crash Safety: 40G's
  - Humidity: 100%
**Data Transfer Module Receptacle (DTMR)**

- **DTMR Characteristics**
  - Receives data from SAU and IDARS
  - Stores data in memory cartridge
  - Memory capacities:
    - Supports 1-40 megabyte memory cartridges
  - Dimensions:
    - Height: 1.13 in
    - Width: 5.75 in
    - Length: 5.23 in
    - Weight: <1.0 lbs
Data Transfer Interface Unit (DTIU)

- **DTIU Characteristics**
  - Receives data via RS-422
  - Stores data in memory cartridge
  - 8 character display
  - User interface/data entry switches
  - Memory capacities:
    - Supports 1 Mbyte memory cartridge
  - Dimensions:
    - Height: 3.0 in (7.6 cm)
    - Width: 5.0 in (12.7 cm)
    - Length: 7.5 in (19.1 cm)
    - Weight: 6.0 lbs (13.2 kg)
    - Power: 12 watts (28 VDC)
SFDR Configuration 1988 - Present

1553       Analog       Discrete

Data Transfer
Interface Unit
(Optional)
VADR™ Configuration 1995 - Present

- MIL-STD 1553 Bus
- Rotor Tachometer
- Pilot Audio
- Co-Pilot Audio
- Sensor Operator Audio
- Cockpit Area Microphone

U.S. Coast Guard: HH-60J & HH-65
U.S. Navy: VH-3 & VH-60
2nd VADR™ Configuration 1996 - Present

U. S. Navy: Common Flight Incident Recorder
C-2, C-130T, UP-3 & VP-3
IDARS Configuration 1997

Signal Acquisition Unit

Integrated Data Acquisition and Recording System (IDARS) (Crash Survivable Voice and Data)
Aircrew Tactical Training System
Aircrew Tactical Training System

- Low Cost, Self Contained Training System

- Core System in Production for USAF & USN
  - Embedded Growth Capability
  - Airborne Element - Data Acquisition Unit
  - Ground Element - Graphical Replay Animation System
  - System Architecture Supports Unlimited Aircraft Types

- ACMI - like Debriefing / Training

- Applicable To All Smiths Industries Flight Data Recorder Equipped Aircraft
Data Acquisition Unit

- Data Acquisition Unit Compliant with
  - FAA TSO-C123 and EUROCAE ED-56 for CVR Performance and Crash Survivability
  - FAA TSO-C124, EUROCAE ED-55, SAE AS 8039 and MIL-STD-2124 for FDR Performance and Crash Survivability
- Connects Directly to
  - Aircraft ICS
  - MIL-STD-1553 Data Bus as a Bus Monitor
- No Peculiar Ground Support Equip. Req’d.
- Memory Capacity: 36 Mbytes; Near Term Growth to 72 and 144 Mbytes
- Hard Mountable in High Vibration Areas
Key Display Capabilities

- Color Presentation
- Overall Scene Viewed From Any Azimuth, Elevation, Proximity
  - True Perspective Presentation
  - View From Pilot’s Perspective
  - Zoom In / Zoom Out
  - Freeze Frame and Forward / Reverse Viewing
- Numerical Data or Cockpit Instrument Overlays
- Video Cassette recording of ATTS Replay
- Provides for AVTR Projection Potential
  - With growth capacity to integrate video with ATTS Replay
ATTS Direct Benefits

• More Effective Training - Augments ACMI Training
• Increased Pilot Proficiency by Immediate Review of Mission Just Completed (FOQUA)
• Promotes Increased Pilot Safety Awareness
• Available Daily in Flying Unit
  • 80% of Training is Done Here
• Supplements / Reinforces Formal Training
• **Bonus** - Aircraft Maintenance
• **Bonus** - Accident Investigations
• **Bonus** - Individual Aircraft Tracking