



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)



DSNA Facilities - CW/FP/GR



Grand Rapids, MI



Clearwater, FL



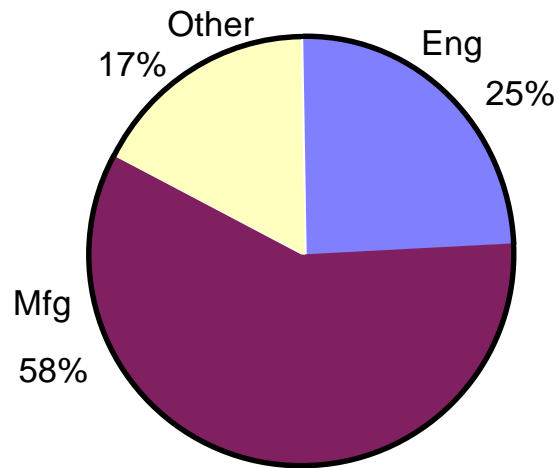
Florham Park, NJ



DSNA Space & People Distribution

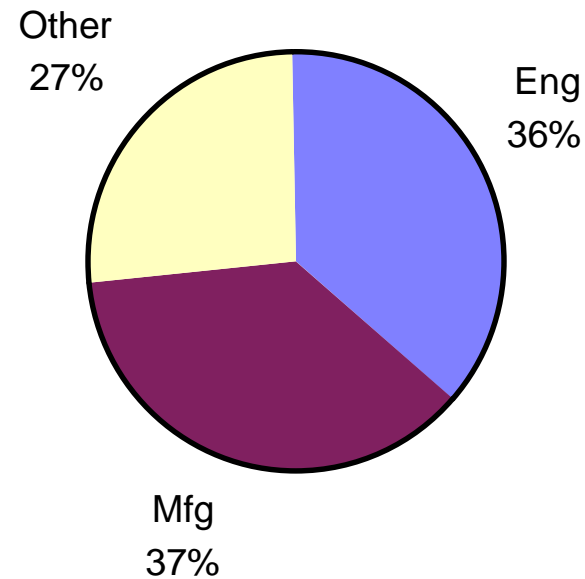
Space

Total=859,000 sq ft



People

Total=1,551 People



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)**
- **VADR™ flown on F-111C, SH-60B/J, OH-58, HH-60J, HH-65A, MH-60K, Eurocopter EC-135 in 1994-1995**
- **Integrated Data Acquisition Recording System (IDARS) selected for JPATS and C-XX**



Data Management Systems



Signal Acquisition Unit (SAU)



Voice & Data Recorder

Crash Survivable Memory Unit (CSMU)

Multi-Product Capability

Data Transfer Interface Unit

Data Transfer Systems

Cockpit Control Unit

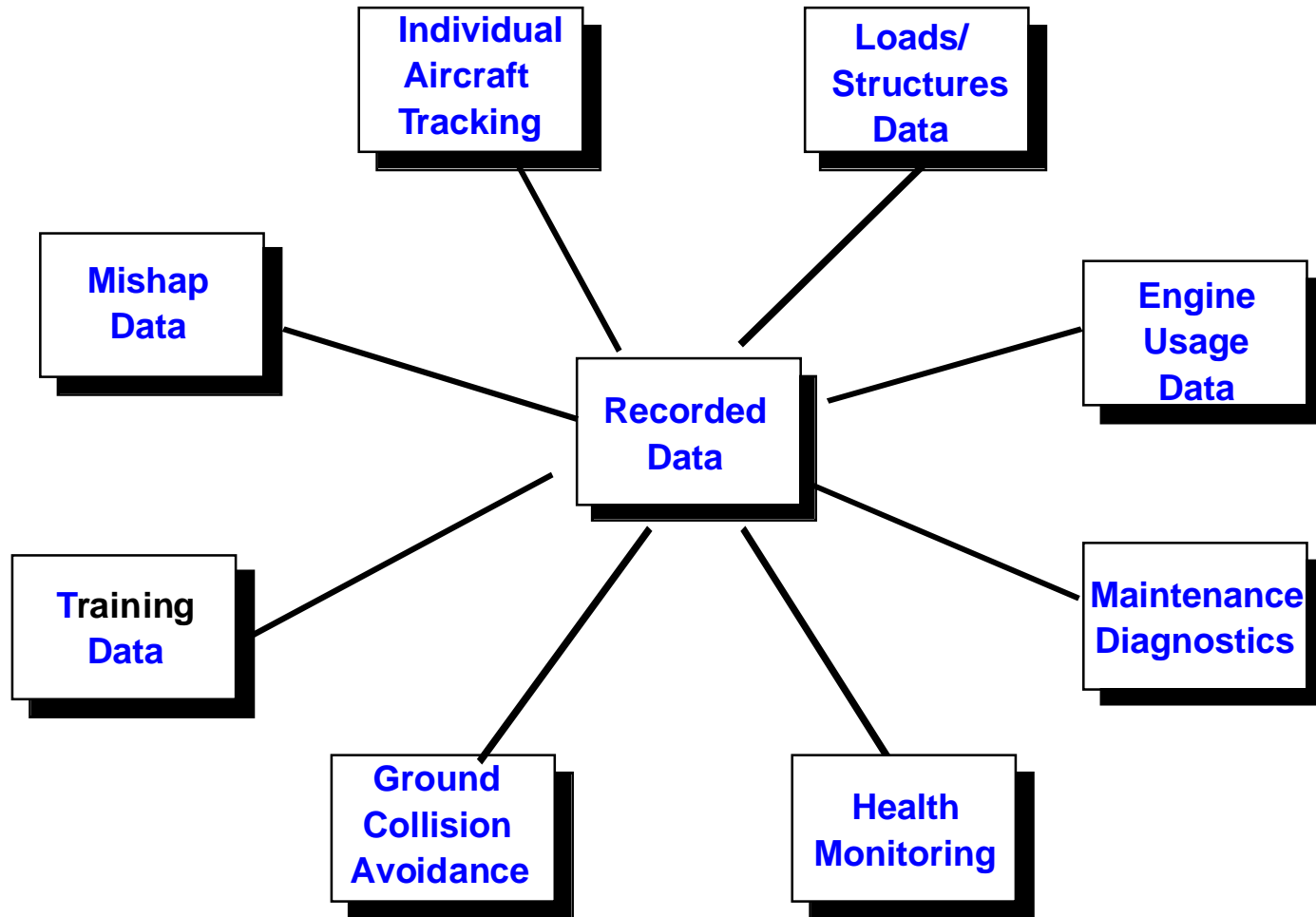


Integrated Data Acquisition Recording System





Multifunctional Capabilities





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**

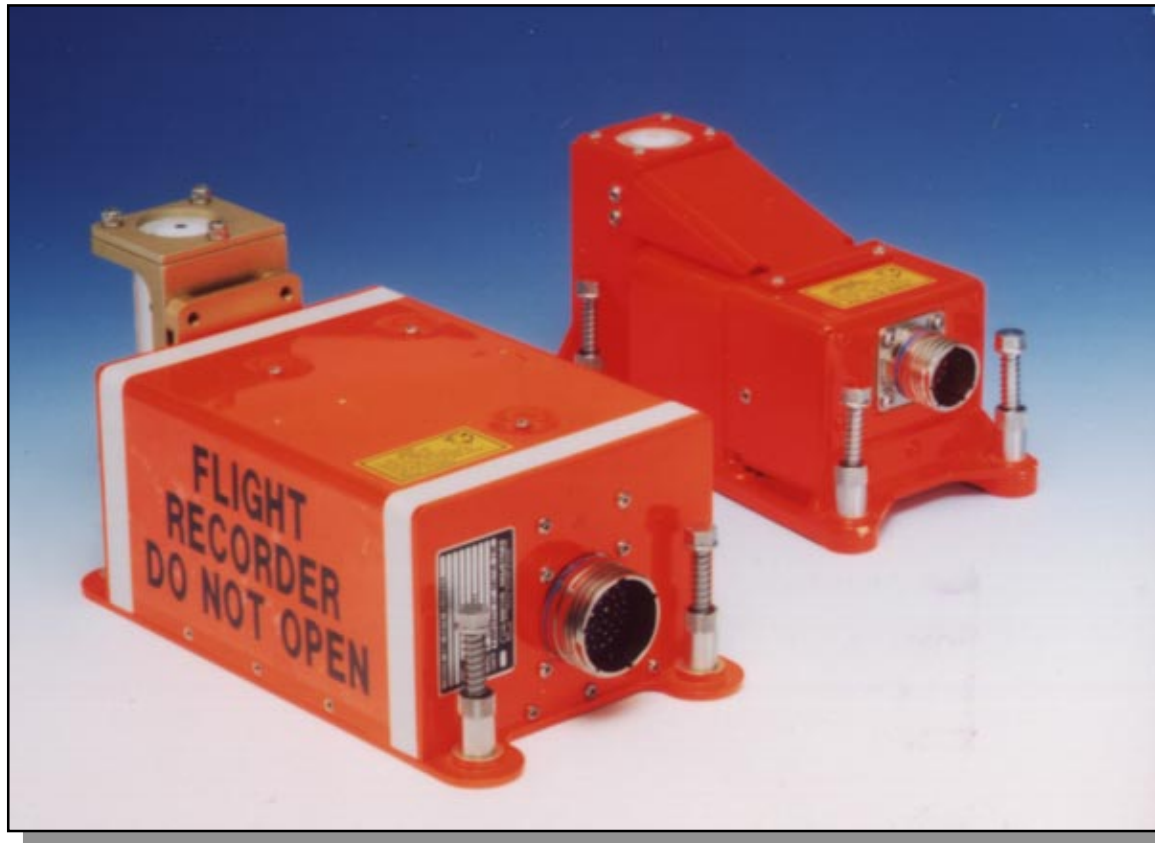


CSMU Characteristics

- **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™) Family





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**

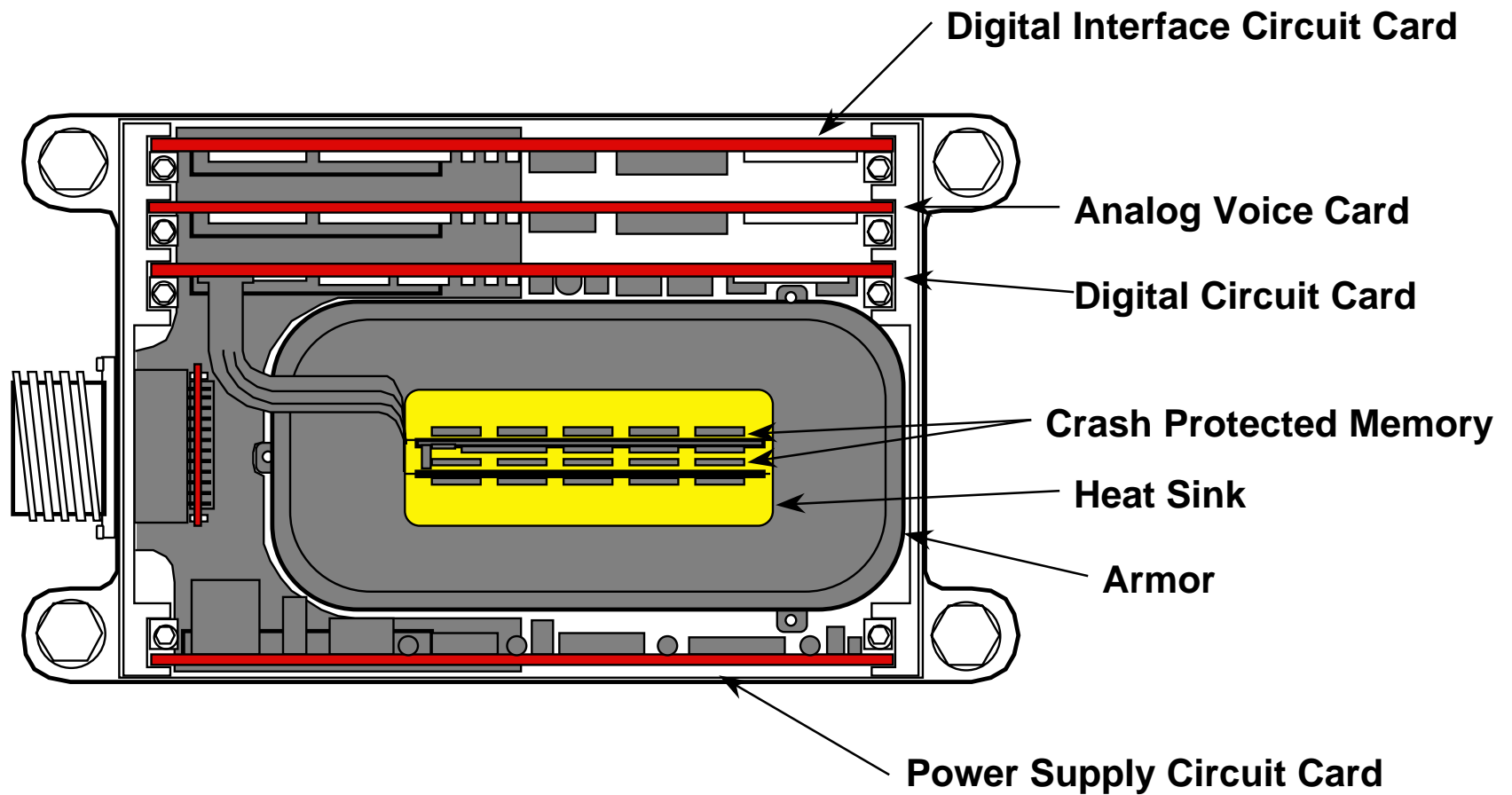


VADR™ Characteristics

- **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**

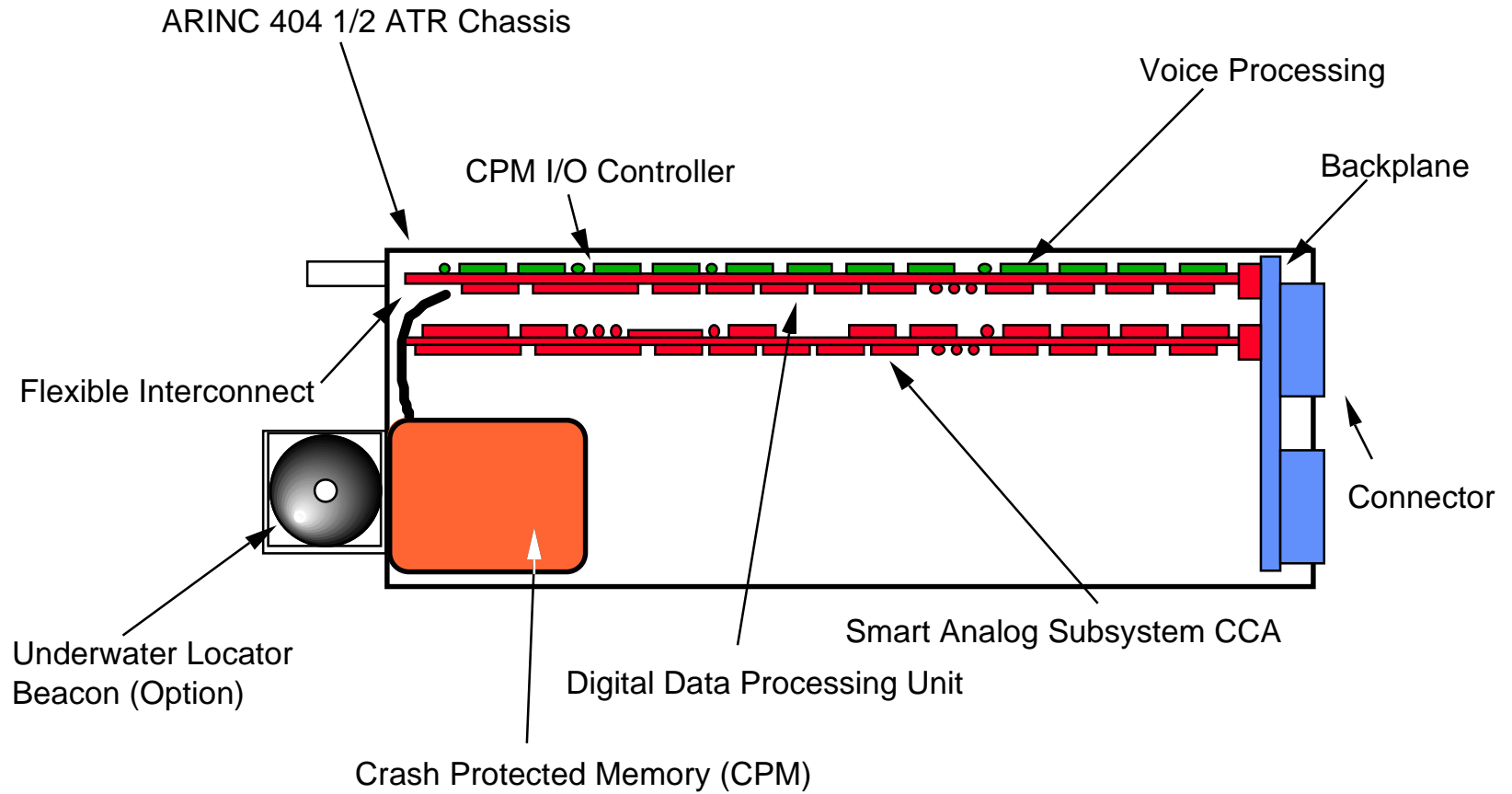


Model 3255 IDARS™

- **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





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

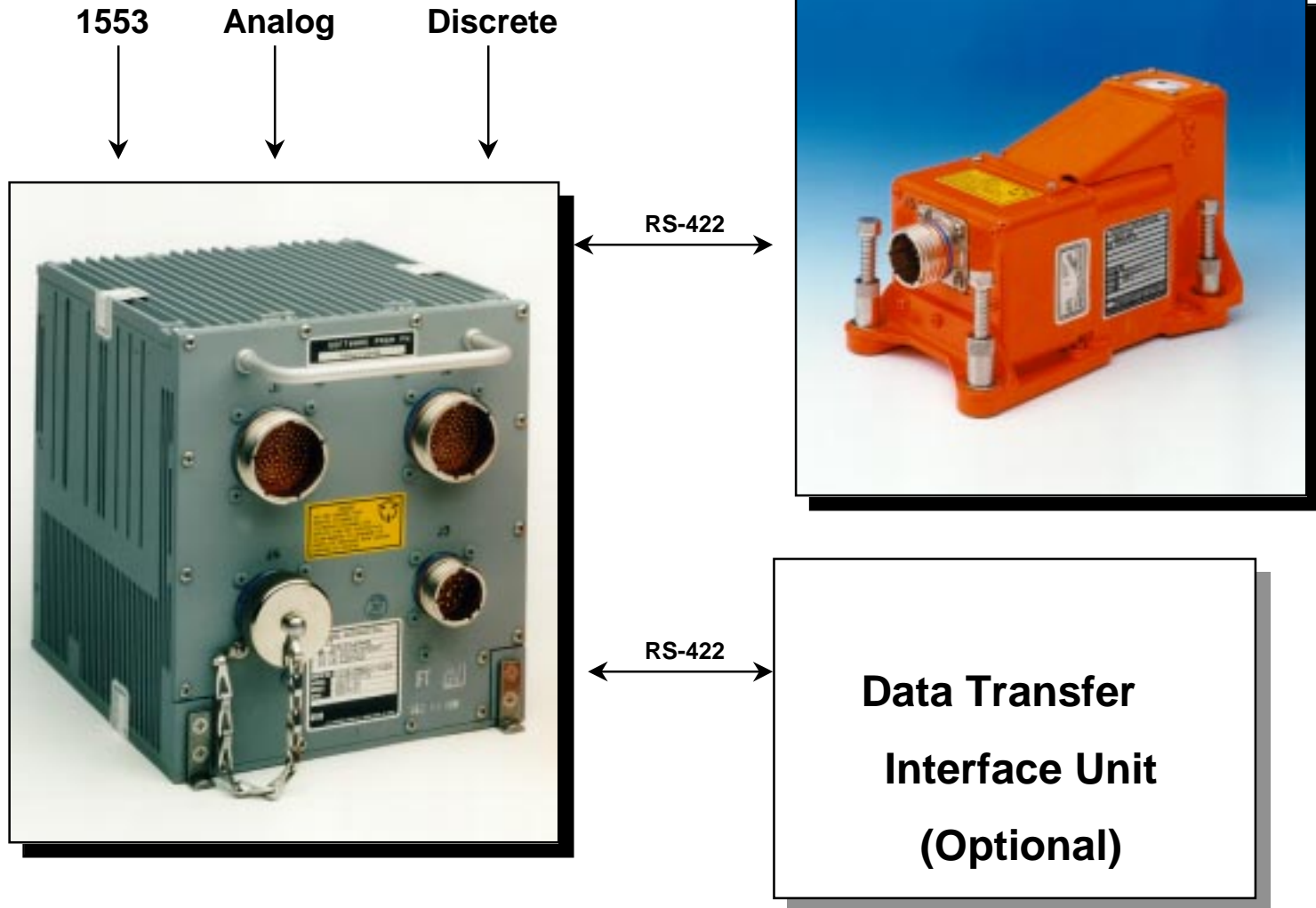
- Dimensions:

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





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



1553 Bus
Analog
Discrete

RS-422 →



Pilot Audio
Co-Pilot Audio
Add'l Crew Audio
Cockpit Audio

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



IDARS Configuration 1997



Signal Acquisition Unit



Crash Survivable
Voice and Data Recorder



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 Csette 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**