The Premier Advanced Recording Technology Forum

THIC Inc.

LARGE CAPACITY AIRBORNE DATA RECORDERS FOR RECONNAISSANCE APPLICATIONS

Alain Queau

Enertec, Clamart, France **queau@enertec.avicore.com**

Tel : +33-1-41 28 88 43 Fax : +33-1-41 28 87 00

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Data Storage on-board : Why ?

- **Sophisticated airborne sensors** are getting versatile and generate more and more data
- **Data links** between air vehicles and ground stations have limited bandwidth
- **Satellite or Earth relays** may not be available at all time
- **Missing data** during the mission can cost very much
- **Replay and/or reprocessing** are mandatory

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Sensor data storage requirements

- **Following payloads have needs for on-board storage:**
  - tactical optical reconnaissance (EO, IR)
  - radar (Conventional & SAR)
  - video surveillance (Analog or Digital)
  - electronic warfare (ELINT, COMINT)
- **Sustained output data rates** are in excess of 500 Mbit/sec with bursts at even higher rates(more than 1 Gbit/s).
- **All these Data** are pre-processed on board before Recording
- **Duration of operational phases** (with recording on) can be up to several hours for Reconnaissance Aircraft's and Endurance UAV's

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Existing Data Storage Technologies

- **MAGNETIC TAPE RECORDERS** are widely used in airborne platforms for analog or digital data storage
- **HIGH END TAPE RECORDERS** match the performances of airborne sensors, but...
- **VOLUME AND WEIGHT** are not always compatible with small payloads
- **ACCESS TO DATA ON TAPE IS ONLY SEQUENTIAL**
- **SOLID STATE NON VOLATILE MEMORY** is a COSTLY EMERGING Storage Technology
- **RAM DVD** and others magneto optical devices are ARCHIVAL ORIENTED

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Disk Features and Advantages

- **HIGHEST CAPACITY/cu.ft/ lb/ $**
- **TODAY** : 25 GB on a 2.5” HDD ,36 GB (50 GB) on a 3.5” HDD
- **BIT DENSITY :** + 60% / YEAR
- **R/W OR R WHILE W** RANDOM ACCESS
- **EASY ”PLUG-AND- PLAY” INSTALLATION** AS A DIRECT ACCESS(DISK) PERIPHERAL
- **CONNECTION TO INDUSTRY STANDARD WORK STATIONS**
- **WELL KNOWN ROAD MAP IMPROVEMENT**
- **RELIABILITY AND ENVIRONMENTAL CHARACTERISTICS** ARE COMPATIBLE WITH OPERATION IN AIRBORNE PLATFORMS

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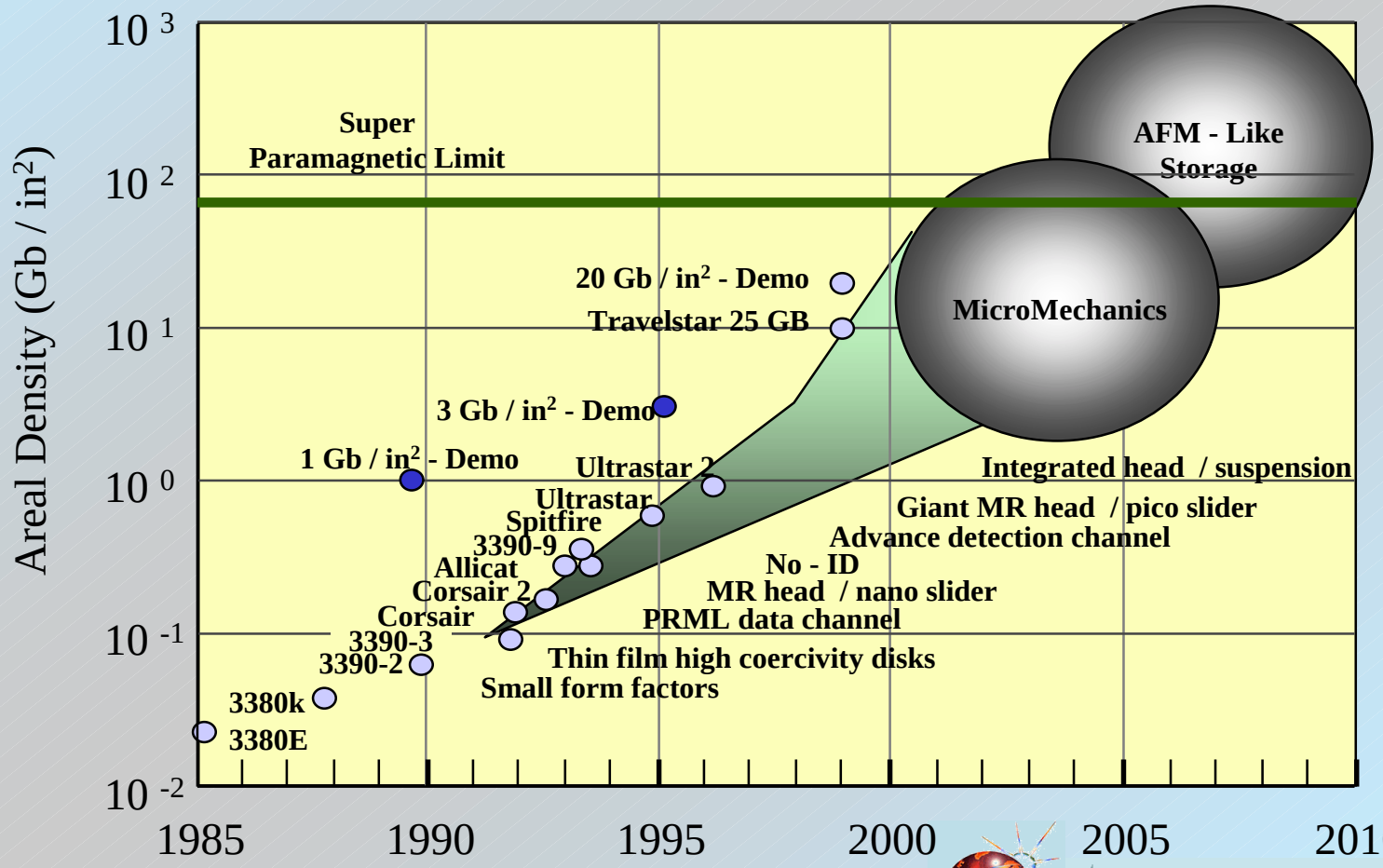
ADVANCED STORAGE ROAD MAP



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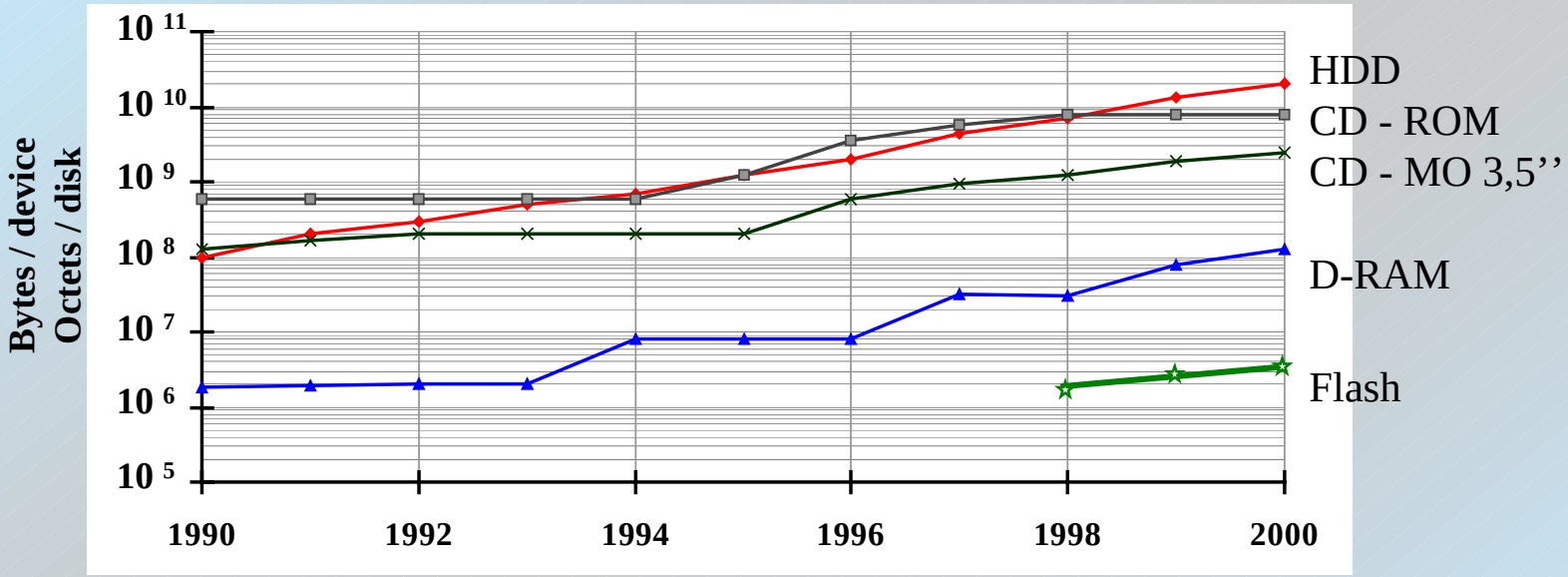
MEMORY COSTS & CAPABILITIES



Year	1980	1987	1990	1994	1997	2000
D-RAM Bit cell (μm^2)	50	20	10	2.5	1	0.5

Memory	Solid states	HDD	Magnetic Tapes
US $ /GB	5,000	35	0,2

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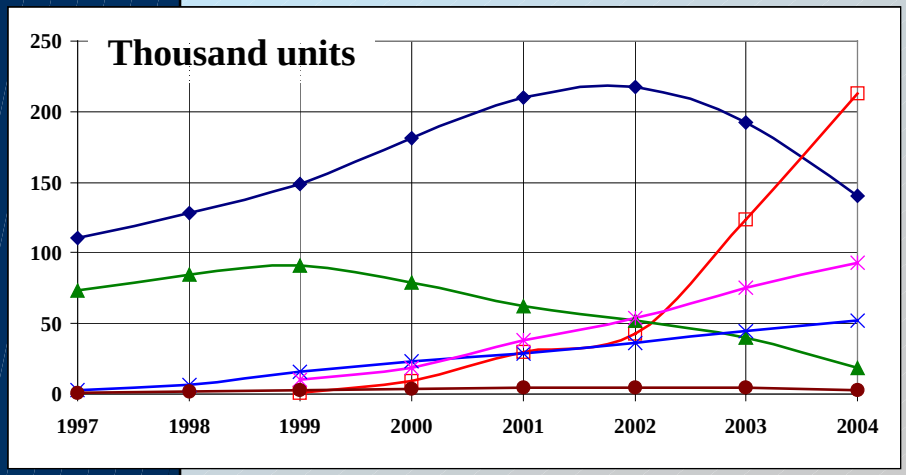
MARKET TREND Vs FORM AND MEDIA



2.5"

3.5"

DVD

CD-RW

CD-ROM

Removable disks

Computer Economics report 99

	Results	Forecast			
Ø (inch)	**1998**	**1999**	**2000**	**2001**	**2002**
5,25"	**4 074**	2 175	1 095	400	
3,5"	**123 047**	145 189	168 385	193 330	220 330
2,5"	**17 730**	20 817	24 090	27 740	31 850
≤ 1,8"	**116**	173	250	475	750
Unit shipments in thousands	**144 967**	**168 354**	**193 820**	**221 945**	**252 930**
Growth	**11%**	**16%**	**15%**	**15%**	**14%**

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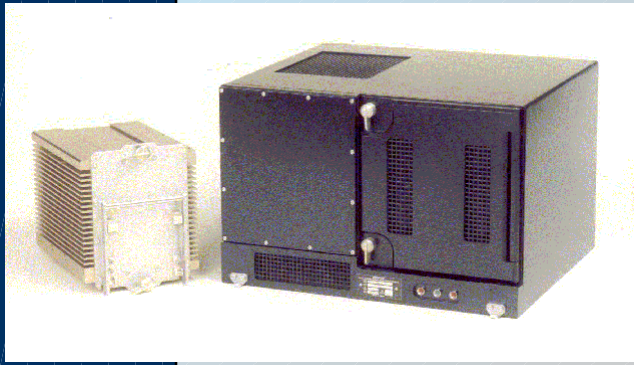
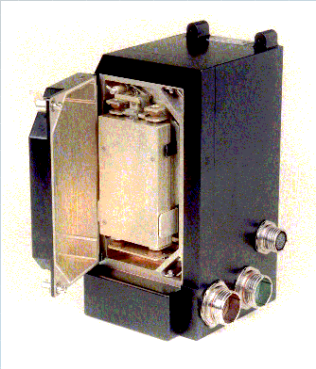
Products & Systems

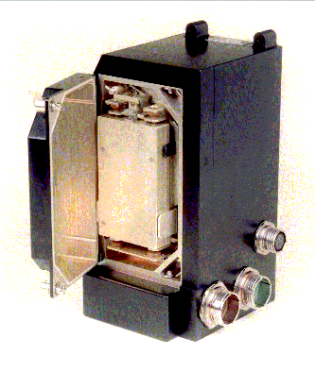
HDS SERIES
CARTRIDGE RECORDERS



DS4000 :
compact airborne,
wide interface flexibility,
220 Mbit/s, 72 GBytes/cartridge



DS2000 :
ultra-compact airborne,
8-bit parallel interface,
60 Mbit/s, 25 GBytes/cartridge



VS2000 :
compact airborne,
multi-channel video,
30 image/s, 5 hours of record time

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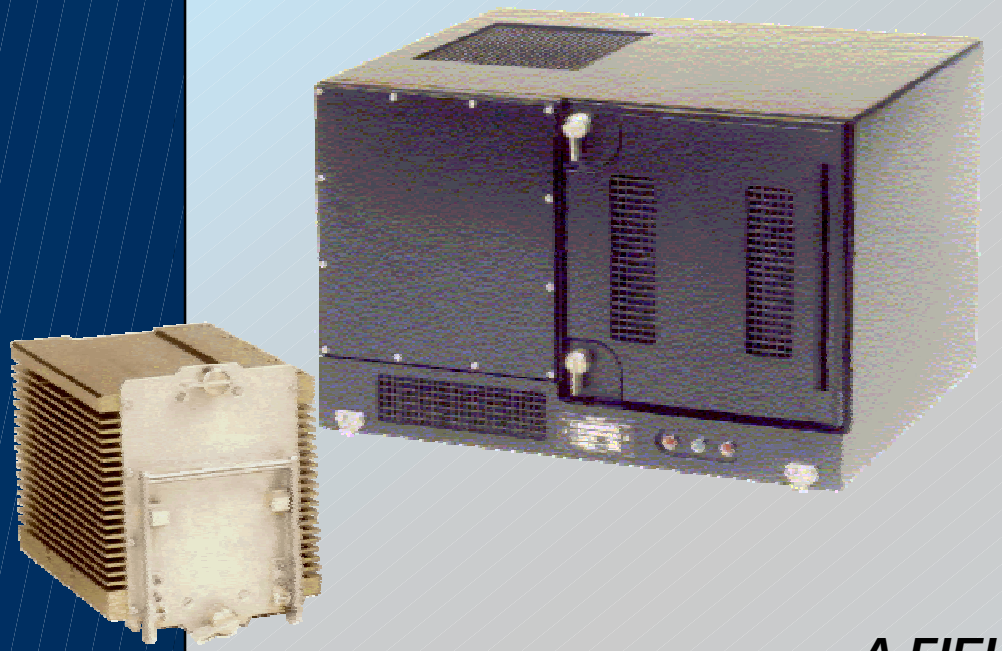

DS4000

COMPACT AIRBORNE DIGITAL CARTRIDGE DATA RECORDER

A FIELD-PROVEN RUGGEDIZED PRODUCT FOR AIRBORNE RECCE AND UNMANNED AIRBORNE VEHICLES.

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DS4000
Design Concept

MODULAR CONCEPT : 2 LRU's

- **DS 4100 Record/Reproduce Unit (RRU) :**
  houses the data & control interfaces
  houses the cartridge removable media
- **DC 3000 Digital Data Cartridge (DDC) =** removable media

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DS4000
Design Features

- **RRU is based on Compact PCI backplane architecture**
  - Open standard
  - Robust packaging
  - COTS electronic cards (3U form factor)
  - High bandwidth bus
  - Shock mounted removable Data Cartridge
- **DDC Sealed Data Cartridge for Housing 2 x 3.5” Disk Drives**
  - Standard computer peripheral interface (SCSI Ultra Wide)
  - RAID or software data stripping for maximum bandwidth
  - Suitable for daisy-chaining for extra-capacity
  - 10000 insertion extraction connector (Patent Pending)
  - operates up to 70000 feet

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DS4000
Record & Playback Characteristics

- **Record & playback data rate :**
  - Sustained : 0 to 220 Mb/s
    burst : up to 480 Mb/s
  - Growth potential to 600 Mb/s sustained (1 Gb/s for burst) for field applications starting 2003.
- **Storage capacity :**
  - 36 GB per DDC (72 GB late 1999)
  - Evolving rapidly : 150 GB available for field applications starting 2003
- **Record time :** 1 hour @ 160 Mb/s (72 GB DDC)
- **Directory** for Fast Search

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DS4000
Physical Interface

- **RRU**
  - Dimensions 192 H x 255 W x 240 D (mm)
  - Weight : < 10 kg (DDC not Included)
- **DDC :SEALED CARTRIDGE**
  - Dimensions : 138 H x 115 W x 190 D (mm)
  - Weight : 3.8 kg
- **OPERATING ENVIRONMENT**
  - Temperature : - 40°C to + 60 °C (Warm up below -10°C)
  - Humidity :5% to 95 % RH without condensing
  - Altitude :0 to 70,000 feet
  - Vibrations : up to 7.8 g RMS
  - Acceleration: 9 g Shocks 13 g ,11ms

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DS4000
Operational Features

- **Built-in buffer memory allowing :**
  - Instant recording
  - Variable rate and burst data record / playback
- **10^{-13} bit error rate**
- **Simultaneous Read-while-Write** of different record sections
- **Full remote control capability**
- **Search capability :**
  - Data block address
  - Time code data
  - Annotation data
  - Event marker
- **Lossless data compression capability**

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DS4000
Ground Replay Work Station

- **Connection** to industry-standard work stations .
- **Easy "plug-and-play" installation** as a direct access (disk) peripheral .
- **Direct and instant access** to any recorded data regardless of its location .
- **Control protocol** fully compliant with SCSI standard .
- **Data recovery software,** for Windows NT and SUN operating systems .

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DS4000
Project Milestones

- **Technology validation** in 1996-1997
- **Airborne prototypes** available 09/98
- **Environmental qualification testing** starting 10/98, completed in 03/99
- **Full scale flight test campaign** on a French Air Force Mirage 2000 aircraft starting 12/98, completed 03/99
- **First shipment of airborne unit :** 11/99

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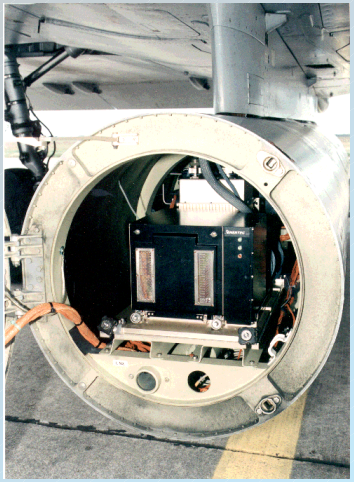
DS4000
Full Scale Flight Test Campaign

Date :	**February 1999**
Place :	**Brétigny, France**
Platform :	**Mirage 2000, Center Pod**
Test unit :	**airborne prototype, flight test configuration**
Record Mode :	**Test data, continuous recording**
Conditions :	**3 flights covering flight domain, including high "g" flight maneuvers and high vibration flight phases**



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DS4000
Full Scale Flight Test Campaign

Date : May 1999

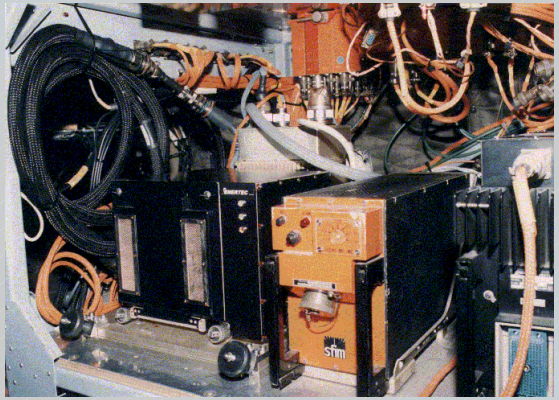
Place : Brétigny, France

Platform : Puma Helicopter

Test unit : airborne prototype, flight test configuration

Record Mode : Test data, continuous recording

Conditions : 1 flight covering flight domain,
high vibration stationary flight



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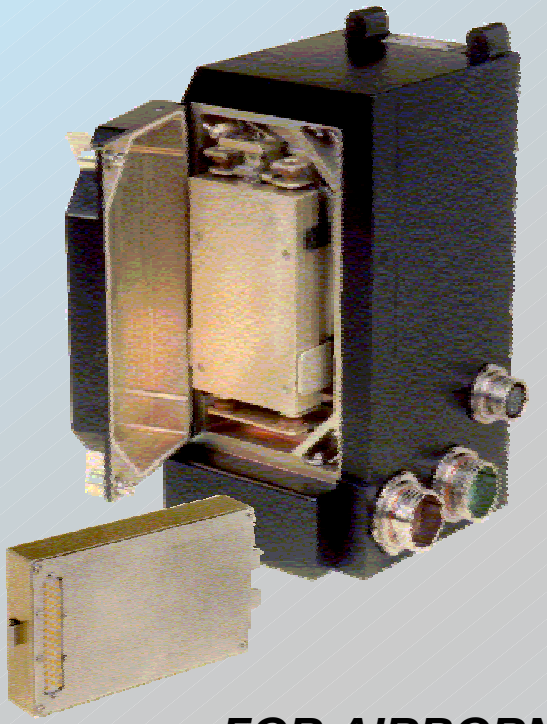

DS2000

ULTRA-COMPACT AIRBORNE DIGITAL CARTRIDGE DATA RECORDER

A FIELD-PROVEN RUGGEDIZED PRODUCT FOR AIRBORNE RECCE AND FLIGHT TEST APPLICATIONS.

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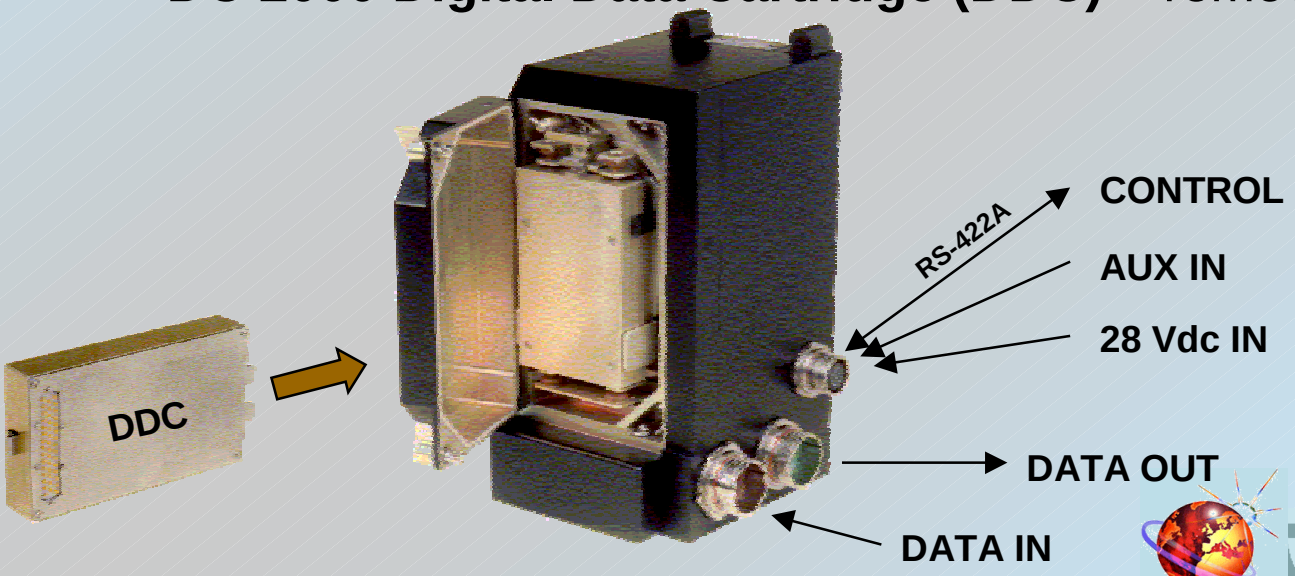
DS2000
Design Concept

MODULAR CONCEPT : 2 LRU's

- **DS 2100 Record/Reproduce Unit (RRU) :**
  houses the data & control interfaces
  houses the cartridge removable media
- **DC 2000 Digital Data Cartridge (DDC) =** removable media



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DS2000
Record & Playback Characteristics

RECORD & PLAYBACK DATA RATE :

- **SUSTAINED :** 0 to 60 Mbit/s
  BURST : up to 120 Mbit/s during 2 seconds
- **GROWTH POTENTIAL** to 120 Mbit/s sustained
  doubles every 24 months

STORAGE CAPACITY :

- 14 GBytes per DDC
- EVOLVING RAPIDLY :
  25 GBytes available mid-2000
  doubles every 18 months

RECORD TIME : > 30 minutes @ 60 Mbit/s
(14 GB DDC) > 3 hours @ 10 Mbit/s

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DS2000
Physical Interface

- **RRU**
  - **Dimensions** 270 H x 160 W x 136 D (mm)
  - **Weight :** < 5 kg (DDC not Included**)**
- **DDC :SEALED CARTRIDGE**
  - **Weight :** 0.5 kg
- **OPERATING ENVIRONMENT**
  - **Temperature :** - 40°C to + 60 °C (Warm up below -10°C)
  - **Humidity :**5% to 95 % RH without condensing
  - **Altitude :**0 to 70,000 feet
  - **Vibrations :** up to 7.8 g RMS
  - **Acceleration:** 9 g
  - **Shocks :** 13 g , 11ms

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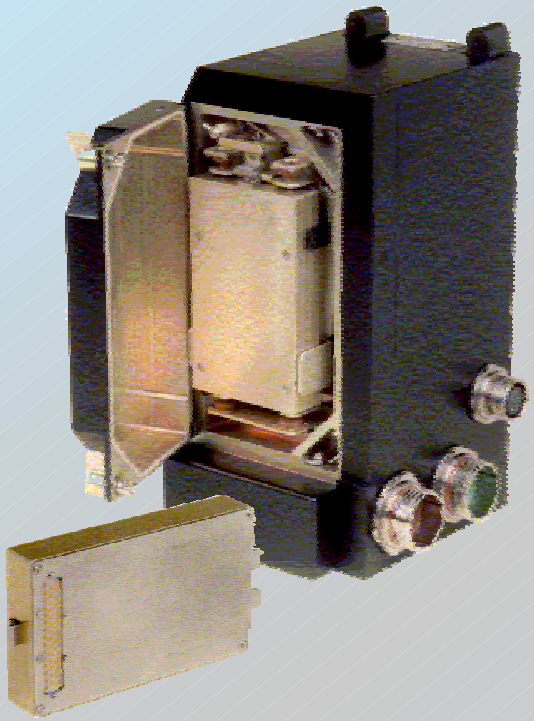

VS2000

4-CHANNEL VIDEO RECORD/REPLAY SYSTEM

A RUGGEDIZED PRODUCT

FOR AIRBORNE DIGITAL VIDEO ACQUISITION AND RECORDING.

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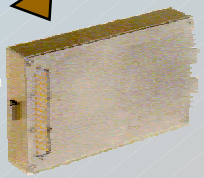
VS2000

4-CHANNEL VIDEO RECORD/REPLAY SYSTEM
A COMPLETE SYSTEM SOLUTION

AIRBORNE VIDEO RECORDING
4 VIDEO CHANNELS + AIRCRAFT DATA
5 HOURS OF RECORD TIME

DS2100 Airborne Video Recorder

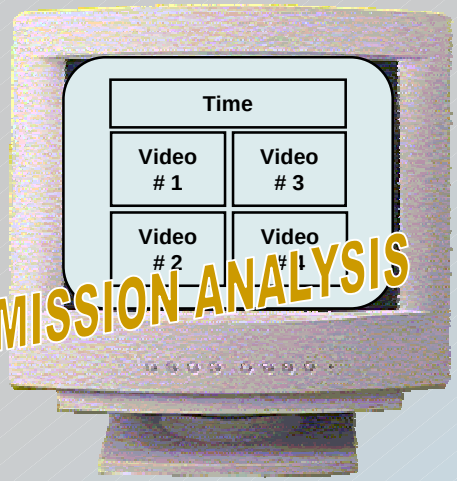
SINGLE LIGHT WEIGHT CARTRIDGE



PC WORK STATION

Ethernet

Mission Data Analysis System



MISSION ANALYSIS

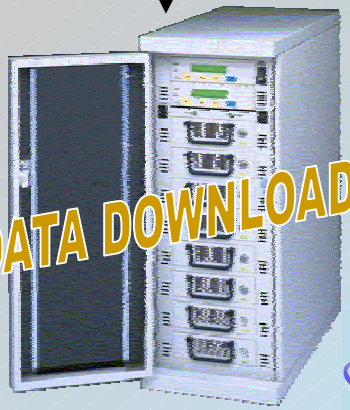
SCSI Ultra 2

CARTRIDGE REPLAY UNIT # 1 — DDC

CARTRIDGE REPLAY UNIT # 2 — DDC

CARTRIDGE REPLAY UNIT # 3 — DDC

CARTRIDGE REPLAY UNIT # 4 — DDC



DATA DOWNLOAD

SCSI Ultra

DV5830 Mass Storage Cassette Drive

VIDEO DATA ARCHIVAL

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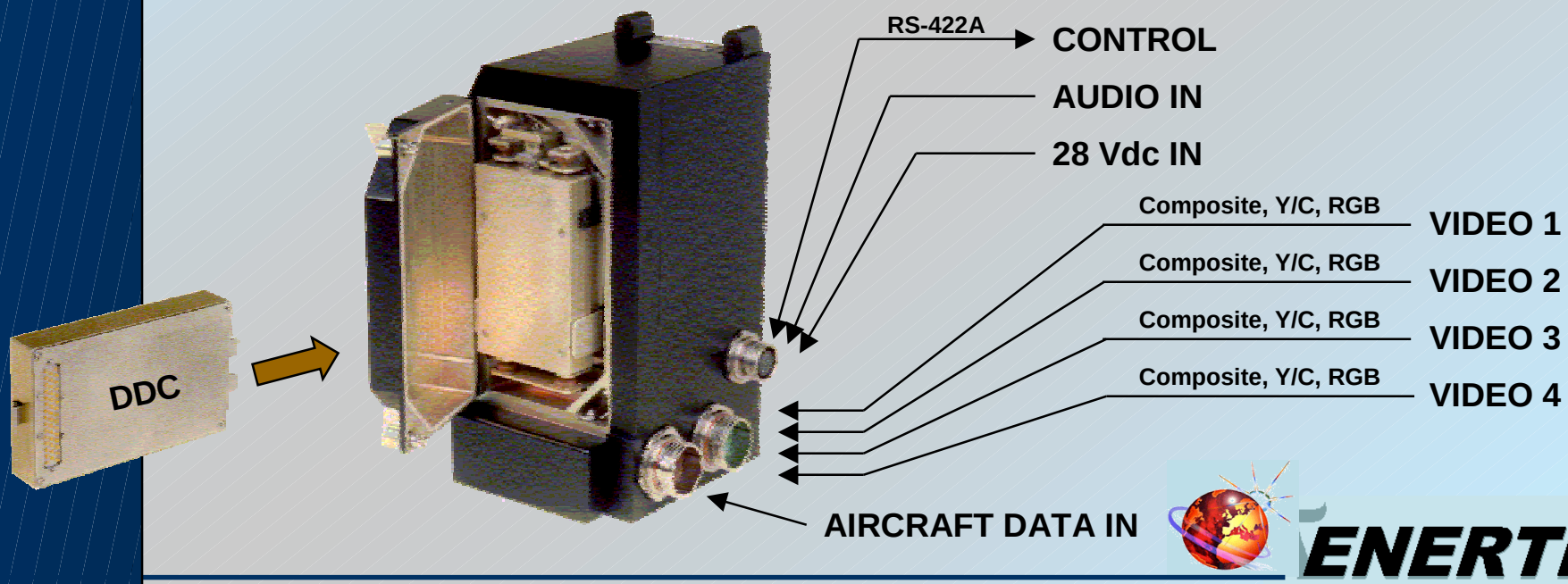
VS2000
Design Concept

MODULAR CONCEPT : 2 LRU's

- **VS2100 Video Acquisition & Recording Unit (VARU)**
  houses the video & control interfaces
  houses the cartridge removable media
- **DC2000 Digital Data Cartridge (DDC) =** removable media



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VS2000
Key Features

- Replacement of multiple-cassette analog video recorders
- Single LRU
- Multiple-channel video acquisition, digitization, compression and recording
- Acquisition and recording of avionics bus data
- Single digital data cartridge
- Transfer rate to storage media : 5 - 8 Mbit/s
- Storage capacity : 14 Gbytes
- Record time : up to 5 hours

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VS2000
Video/Audio Compression

- **ISO MPEG 2** video compression algorithm
- **Simultaneous processing of up to 4 independent video sources**
- **Adaptive compression algorithm:** best trade-off between image rate and image quality at constant average data rate
- **Audio compression** 2 sources
- **Supports** multiplexing of uncompressed auxiliary digital data
- **MPEG** Program stream

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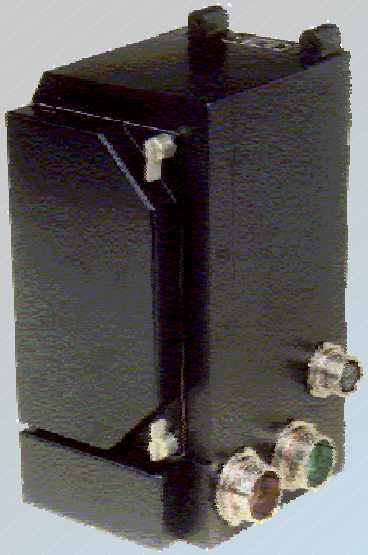
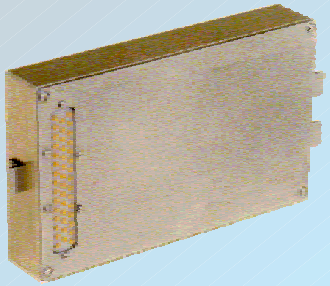
VS2000
Physical Interface

- **PHYSICAL CHARACTERISTICS :**
  - **SINGLE STANDALONE UNIT**
  - **DIMENSIONS :** 270 H x 160 W x 136 D (mm) excluding connector cage
  - **WEIGHT :**
    - **VS2100 :** 5 kg, not including DDC
    - **Digital Data Cartridge :** 0.5 kg
- **HARD MOUNTING :**
  - BUILT-IN VIBRATION / SHOCK ISOLATORS
- **COOLING / TEMPERATURE CONTROL :**
  - SELF-COOLING (NO FAN)
  - SEALED DDC
  - AUTOMATIC PRE-HEATING (50 W max.)





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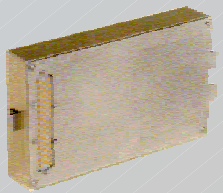
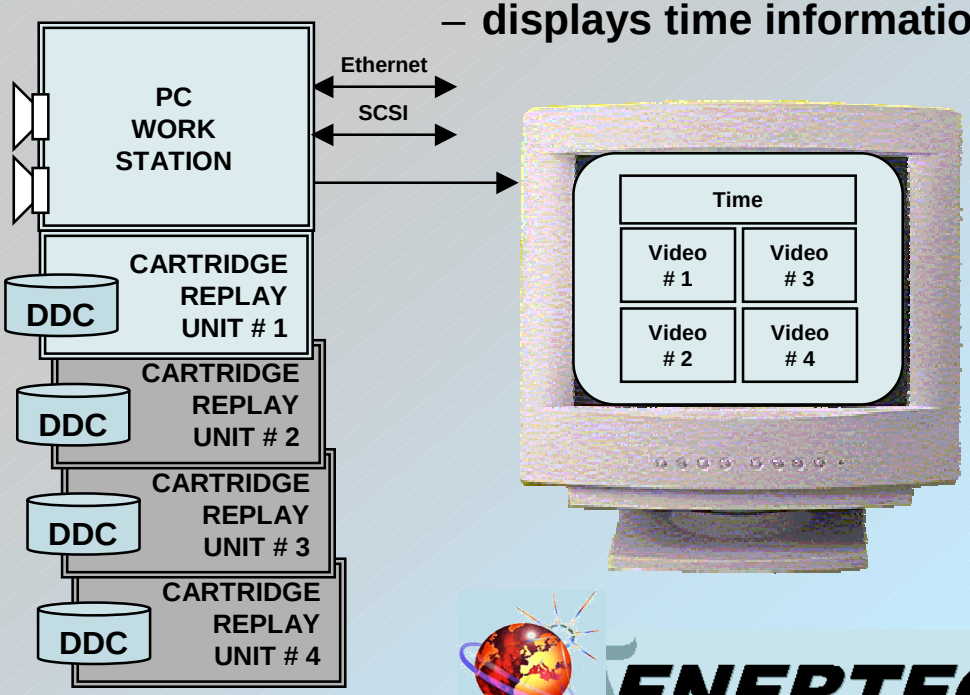
VS2300

GROUND VIDEO REPLAY SYSTEM
DESIGN CONCEPT

COMPOSED OF :

- **PC WORK STATION :**
  - **houses 1 to 4 Cartridge Replay Units (CRU)**
  - **performs video & audio reconstruction,**
  - **supports data & control interfaces**





- **21" MONITOR :**
  - **displays all 4 reconstructed video sources,**
  - **displays time information**

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VS2000
Ground Replay Unit

- **Direct playback from DDC**
  - Simultaneous display of 4 video channels and time code
  - Time relation between displayed video channels better than 500 ms
  - User-selected replay speed
- **Local or remote control**
- **SCSI interface**
  - Used for download/storage to/from storage device

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SUMMARY

- **VS2000** is dedicated to multi-video acquisition and storage:
  - Two LRUs, weight :5kg Suitable for small payloads
- **DS 2000** can acquire and record digital data up to 60 Mb/s
  - Two LRUs, weight :5kg Suitable for small payloads
- **DS4000** can acquire and record any type of digital data with a bandwidth compatible with multi-sensor payloads
  - Two LRUs, weight < 15 kg
  - Suitable for larger vehicles
- **Replay system** features standard bus interfaces for easy coupling to ground facilities

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