Present and Future Directions for Ampex DCRsi™ and DD-2 Format Products

THIC
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Overview of Recording Techniques

- Helical
- Longitudinal (Linear)
- Transverse

AMPEX
Ampex 19mm tape technology offers high performance, high capacity and high reliability!
DST™ and DIS™ Update

• DST is strictly for computer data storage and retrieval applications
  • 25 (50)¹, 75 (150)¹, 165 (330)¹ GB cartridges
  • 15 MB/sec (dual SCSI-2 ports)

• DIS has dual usage capability
  • Computer mode thru first port (SCSI-2)
  • DST/ER-90 tape format compatible
  • Instrumentation mode thru a second port
    • 8-bit Parallel & Clock
    • BIT Serial
    • IRIG-B Timecode
    • RS-232 Control
  • Supports tape-tape copy for DCRsi
  • 160 Mb/sec version available

• Technology updates to be first shown on DIS product
  • Double density in beta site testing
  • 240 Mb/sec version due in 1997

¹ Double density configuration
<table>
<thead>
<tr>
<th>Features</th>
<th>Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Automatic Scan Tracking (AST™)</td>
<td>- Tape Interchange</td>
</tr>
<tr>
<td>• Metal particle (MP) tape</td>
<td>- Higher packing density/multiple vendor support</td>
</tr>
<tr>
<td>• Field replaceable head modules</td>
<td>- Reduction MTTR-simple alignment required</td>
</tr>
<tr>
<td>• Air lubricated tape guides</td>
<td>- High speed tape handling</td>
</tr>
<tr>
<td>• Powerful error correction system</td>
<td>- 3-level Reed-Solomon coding</td>
</tr>
<tr>
<td></td>
<td>- Read-After-Write with automatic rewrite</td>
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<tr>
<td></td>
<td>- Multi-track (3-1/3) burst correction capability/block</td>
</tr>
<tr>
<td></td>
<td>- Less than one permanent error in $10^{14}$ bytes read using qualified media</td>
</tr>
<tr>
<td>• Advanced read/write heads</td>
<td>- Azimuth heads</td>
</tr>
<tr>
<td></td>
<td>- Long-life configuration</td>
</tr>
</tbody>
</table>
DST™ Data Cartridges

- 19mm metal particle media
- Fully certified for data
- Conditioned to prolong head life
- Archive quality

<table>
<thead>
<tr>
<th>Size</th>
<th>Standard Density</th>
<th>Double Density</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small</td>
<td>25 GB</td>
<td>50 GB</td>
</tr>
<tr>
<td>Medium</td>
<td>75 GB</td>
<td>150 GB</td>
</tr>
<tr>
<td>Large</td>
<td>165 GB</td>
<td>330 GB</td>
</tr>
</tbody>
</table>
DIS 160i Tape Drive Subsystem

- Supports 3 cartridge sizes:
  - 25(50)$^{1}$, 75(150)$^{1}$, 165(330)$^{1}$ Gigabytes
- Instrumentation interface
  - 0 - 160 Mb/sec variable
  - DCRsi tape-tape copy
  - RS-232 control
  - IRIG-B time code
- Search speed
  - 800 MB/sec (1500 MB/sec)$^{1}$
    logical, physical, time code
- Tape format
  - DD-2 format compliant
  - DST/ER-90 compatible
- SCSI-2 interface (16 bit fast & wide)
  - <20 MB/sec sustained
  - 20 MB/sec burst
- Error rate
  - 1 in $10^{14}$ bytes read

$^{1}$ Double density configuration
DIS 220i Automated Cartridge Library

- Up to 1.15 (2.3)\(^1\) terabyte capacity in less than eight square feet (0.7m\(^2\)) of floor space

- Supports three cartridge sizes, with capacities of 25(50)\(^1\), 75(150)\(^1\), 165(330)\(^1\) GB

- Uses DIS drive with one instrumentation interface and one SCSI-2 interface

- Transfer rate of 0 - 120 MB/sec or 0 - 160 Mb/sec instrumentation data

\(^1\) Double density configuration
DIS 820i Automated Library

- 6.4 (12.8)\(^1\) TB on-line capacity
- 256, 25 (50)\(^1\) GB cartridges
- One to four DIS tape drives
- 21 sq. ft. (2m\(^2\)) floor space
- Average cartridge cycle time <7 seconds
- Average data access time <30 seconds
- Aggregate transfer rate of up to 640 Mb/sec

\(^1\) Double density configuration
• Hardware device support:
  • Tape drives
  • Automated tape libraries

• Unix environments:
  • Sun-Solaris (Cray Super Server)
  • SGI-IRIX
  • IBM-AIX
  • DEC-Alpha
  • HP-800 - HP/UX

• Third party integration:
  • Spectra Logic Alexandria™
  • Legent/CA - OSM™
  • Legato Networker 4.2

• Future
  • NT device driver
  • LSC - HSM
Ampex DD-2 Technology Roadway

- **Small Cartridge Capacity (GB):**
  - Double density (1)
  - Quad density (2)
  - Ten times density (3)

- **Data Rate:**
  - 15 MB/sec
  - 15/20 MB/sec
  - 30/40 MB/sec
  - 25/40 MB/sec

- **Density:**
  - 5 MB/in²
  - 10 MB/in²
  - 20 MB/in²
  - 40 MB/in²

- **Status:**
  - (1) Product Development
  - (2) Technology Development
  - (3) Projected
DCRsi Product Overview

- Data transfer rate:
  - DCRsi 75 0 to 8.37 MB/sec
  - DCRsi 107 0 to 13.4 MB/sec
  - DCRsi 240 0 to 30 MB/sec

- Buffered data I/O eliminates data transfer restriction
  - Data transfer can be continuous or in bursts
  - No adjustments are required to compensate for data rate changes
  - DCRsi is a “slave” to user interface equipment
  - 100% tape utilization at all data rates
• Highly interleaved Reed-Solomon error correction code
  • Bit error rate better than $1 \times 10^{-9}$ under ALL interchange conditions

• Built-in data tagging
  • Each data block is time tagged upon arrival at input to DCRsi

• Transverse scanning transport topology
  • Simple and compact tape path
  • Superior performance in hostile environments
  • “Azimuth” recording
  • >3,000 hour head life - typical
Tape Path Comparisons

Tape Transport Relative Sizes

Transverse (DCRsi)

Helical (ID-1)
Environmental Performance

Helical

- Long distance between guides and head
- Format sensitive to humidity and temperature

Helical tracks are sensitive to vertical tracking errors

Transverse

- Short distance between guides and head
- Pilot tone servo control provides “active” tracking

Vertical digital tracks are NOT sensitive to vertical tracking errors

Edge Guide

to

Canoe Guide

Edge Guide

Capstan
DCRsi “Clip-On” Interface Plans

- Provide a fast/high capacity solid state front end for DCRsi - aimed initially at tactical RECCE imagery applications
  - Expandable from 2 to 10 GB of solid state FIFO memory
  - Burst data rate up to 100 MB/sec
  - Integral cache memory of up to 500 MB for “instant access” to selected frames
  - Automatic backup to DCRsi tape

- Availability in 1997
Standards Efforts

• DD-2 - ANSI - X3B.5 Project
  • Efforts underway to update revision 3 to include double density considerations and instrumentation unique considerations

• DCRsi - NATO standards and CIGSS
  • STANAG 4283: Annex C is being updated to include DCRsi as a fully compliant high density digital recorder (HDDR) for use on marine patrol aircraft (MPA) for acoustic data recording
  • STANAG 7024: a new annex to STANAG 7024 is being considered which would incorporate the DCRsi transversal format for imagery recording on NATO reconnaissance systems
  • CIGSS: DCRsi is CIGSS compliant
## Digital Data Recorders Comparison

<table>
<thead>
<tr>
<th>Item</th>
<th>ID-1</th>
<th>DD-2</th>
<th>DCRsi</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capacity per cassette (GB)</td>
<td>small: 13 1</td>
<td>small: 25 (50) 1</td>
<td>one only: 48</td>
</tr>
<tr>
<td></td>
<td>medium 42</td>
<td>medium 75 (150)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>large 96</td>
<td>large 165 (330)</td>
<td></td>
</tr>
<tr>
<td>Data rate</td>
<td>8 MB/sec; 16 MB/sec</td>
<td>15 MB/sec</td>
<td>13.375 MB/sec</td>
</tr>
<tr>
<td></td>
<td>32 MB/sec; 50 MB/sec</td>
<td>20 MB/sec</td>
<td>30 MB/sec</td>
</tr>
<tr>
<td>Tape type</td>
<td>Gamma ferric oxide</td>
<td>Metal Particle</td>
<td>Gamma ferric oxide</td>
</tr>
<tr>
<td>Head tracking</td>
<td>fixed or auto tracking</td>
<td>AST™ (active)</td>
<td>Auto Tracking</td>
</tr>
<tr>
<td>Supports multiple platforms?</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Supports file marks?</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>SER</td>
<td>$10^{30}$ (w/ exceptions)</td>
<td>$10^{30}$ (no exceptions)</td>
<td>$10^{9}$ (no exceptions)</td>
</tr>
<tr>
<td>Archival media stability</td>
<td>15+years</td>
<td>15+years</td>
<td>15+years</td>
</tr>
<tr>
<td>Standards status</td>
<td>ANSI standard</td>
<td>X38.5 Project underway</td>
<td>STANAG 4283 and</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>STANAG 7024 in progress</td>
</tr>
</tbody>
</table>

1 Double density configuration