1.8” Super Small Slim HDD

Digital Media Network Company
Storage Device Division

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Why 1.8” HDD?

• **Larger Capacity**
  – About half of the 2.5” drive’s capacity
  – Can record about 1 hour MPEG2 SDTV (with 2.0GB)

• **Lower Power Consumption**
  – Will be better storage for mobile devices

• **Standard Interface**
  – PC-Card is a standard interface in notebook PCs
  – Used as a bridging media between notebook PCs
  – Can be used as an embedded storage device
Form Factor: Media Size

- **2.5”**: DATA ZONE: 100
- **3.0”**: DATA ZONE: 177
- **3.5”**: DATA ZONE: 246
- **1.8”**: DATA ZONE: 57
- **1.0”**: DATA ZONE: 13

Dimensions:
- 2.5”:
  - É20mm
  - É65mm
- 3.0”:
  - É25mm
  - É84mm
- 3.5”:
  - É25mm
  - É95mm
- 1.8”:
  - É12mm
  - É48mm
- 1.0”:
  - É7.0mm
  - É27.4mm
Form Factor : Comparison of Footprint

2.5" HDD
(100+9.3) x 70 = 7651

1.8" HDD
(PC Card size)
(85.6+7.4) x 54 = 5022

1.8" HDD
(Built-in model)
(78.5+3.5) x 54 = 4428

Area factor

Host Connector

HDD

70 100%

54 66%
(100%)

54 58%
(88%)
Capacity Trend by Form Factor

Capacity Trend by Size

- 2.5"
- 1.8"
- 1.0"

Storage Device Division
Product Concept

- Provides small, light, silent and low power HDD with sufficiently large capacity.
  - For PC-Card as a bridging media

- Provides further small footprint HDD with abundantly large capacity for advanced usage.
  - For built-in drive as ATA interface embedded storage of mobile products

- Use the same technology (head, media, channel) proven on the former generation 2.5” HDD
  - Development was focused on mechanical design and production equipment.
  - Parts mounting technology as well as chip size IC package are important.
Key Technologies

• **High Recording Density**
  - 5GB/Disk : 22.4Gbps (41.6KTPi, 538KBPI)
  - Advanced servo control

• **Small Form Factor**
  - LSI : Ball Grid Array, Low profile package
  - Mechanical parts: Thinner SPM, VCM, etc.

• **Low Power Consumption**
  - 3.3 Volt operation
  - High efficiency VCM and lower inertia carriage

• **Mechanics**
  - Inertia latch mechanism with ramp-load
  - High stiffness base plate and SPM

• **Low Acoustics**
  - About 10dB less than those of 2.5"
Recording Density

![Graph showing recording density improvements over years with various technologies]

- Improved Head & Media
- FDB Motor
- GMR
- Ramp Load
- PRML
- MR Head
- ID-less
- Thin Film Head
- Glass Media
- MIG Head
- Sputtered Media
- CDR

- 180% Yearly Improvement
- 100% Yearly Improvement
- 60% Yearly Improvement
- 30% Yearly Improvement
Small and slim form factor

• **Printed Circuits Board**
  - Use of integrated LSI’s
  - Low profile package of 0.5mm thickness BGA
  - PCB of 0.45mm thickness

• **Base plate**
  - Sheet metal of 0.6mm thickness
  - Steel base plate by press process
  - Used as a yoke of magnet

• **Spindle Motor**
  - Spindle motor of 4.05mm thickness
  - Inner rotor type with ball bearings
  - Same size of balls used in 2.5”HDD
    for higher shock resistance
Block Diagram : 5GB Card type

HDA
Disk

GMR-Head AMP
Differential AMP With Shock Circuit
SONY: CXA3566

SPM

Motor Driver
Spindle motor controller & Driver
VCM controller & Driver
Power Supply

VCM

MPU
ARM7TDMI 66MHz
SRAM 2Mbit
Serial FROM 2Mbit

PCB
R/W Channel

HDC(ASIC)
HDC
PCMCIA & ATA interface (Ultra-DMA 66Mbps)
Buffer controller
Recording controller
ECC

SDRAM

Head Positioning Servo Controller

Storage Device Division
LSI’s (1/2)

- **HDC(ASIC)**
  - 0.25um CMOS, 5.5x5.5mm, 2Mbit SDRAM+220Kgates
  - PC Card Bus & ATA interface, 5V Tolerant Inputs/Outputs
  - 7Burst - 3Way interleave ECC, Ultra-DMA 66Mbps
  - Servo Controller, Cache & Buffer controller

- **MPU**
  - 0.15um CMOS, 5.0x5.0mm
  - ARM7 Core, 2Mbits SRAM, 16Kbits ROM & Peripherals

- **R/W Channel**: Marvell - 88C4310
  - 0.25um CMOS, 3.5x3.5mm
  - 32-34/64-66 ENDEC with Post-Processor
    - Modified EE PRML
    - Servo Detector & Demodulator for Digital Servo Control
  - Data Rate: Up to 550Mbps (Drive’s Data Rate: 90-130Mbps)
• **Motor Driver** : TI - TLS2256(Toki)
  - 0.8um Linear Bi-CMOS
  - Spindle Motor Controller with 600mA Driver
    FLL & PLL Speed Controller
    Voice Coil Motor Controller with 400mA Driver
    12bit DAC/ADC
  Ramp Load Control & Emergency Retract Circuits
Power Controller
  3.3, 2.5 & 1.8V Outputs for 5 or 3.3V Input
  Power Monitor for Input & Output Voltages
Shock Sensor & Detector Circuits
Smaller & Low Profile Package

- et-BGA
  (Extremely Thin Ball Grid Array)
- Wafer Level BGA
  (Chip Size Package)
- 0.5mm height
Spindle Motor

2.5 inch HDD

1.8 inch HDD

Same size of Ball

Rotor Magnet

Stator Coil
Advanced Tracking Technology

• **Adaptive Feed-forward Control**
  - Compensating large media shift and disk deflection

• **High Performance Servo Controller**
  - Improving servo stability by reduced output delay

• **Multi-rate Control**
  - Extending servo bandwidth by reduced phase delay
  - Canceling arm-suspension vibratory mode
Acoustic Noise (Sound Power)

<table>
<thead>
<tr>
<th>Storage Device Division</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECMA SEEK (dBA)</td>
</tr>
<tr>
<td>Idle (dBA)</td>
</tr>
<tr>
<td>20 22 24 26 28 30 32 34 36 38 40</td>
</tr>
<tr>
<td>3.5” HDD</td>
</tr>
<tr>
<td>3.5” AV-HDD</td>
</tr>
<tr>
<td>2.5” HDD</td>
</tr>
<tr>
<td>2.5” Toshiba’s Current Model</td>
</tr>
<tr>
<td>2.5” Toshiba’s FDB Motor Model</td>
</tr>
<tr>
<td>1.8” Built-in Model</td>
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</tbody>
</table>

Storage Device Division
## Table-1 1.8” HDD, Major specifications

<table>
<thead>
<tr>
<th>Model</th>
<th>PC Card Type</th>
<th>Built- in Type</th>
<th>2.5”</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2GB</td>
<td>5GB</td>
<td>10GB</td>
</tr>
<tr>
<td>Capacity ( Gbytes)</td>
<td>2.0</td>
<td>5.0</td>
<td>5.0</td>
</tr>
<tr>
<td>Number of disks</td>
<td>1</td>
<td>←</td>
<td>←</td>
</tr>
<tr>
<td>Number of heads</td>
<td>2</td>
<td>←</td>
<td>←</td>
</tr>
<tr>
<td>TPI (k)</td>
<td>24.2</td>
<td>41.6</td>
<td>←</td>
</tr>
<tr>
<td>BPI (k)</td>
<td>372</td>
<td>507</td>
<td>538</td>
</tr>
<tr>
<td>Recording density (Gbps)</td>
<td>9.0</td>
<td>21.1</td>
<td>22.4</td>
</tr>
<tr>
<td>Rotation speed (RPM)</td>
<td>4,200</td>
<td>3,990</td>
<td>4,200</td>
</tr>
<tr>
<td>Transfer rate</td>
<td>Internal (Mbits/sec)</td>
<td>75 - 130</td>
<td>94 - 123</td>
</tr>
<tr>
<td></td>
<td>Host (Mbytes/sec)</td>
<td>ATA</td>
<td>←</td>
</tr>
<tr>
<td></td>
<td>Ultra DMA mode</td>
<td>66.7</td>
<td>←</td>
</tr>
<tr>
<td></td>
<td>PIO mode</td>
<td>16.6</td>
<td>←</td>
</tr>
<tr>
<td></td>
<td>PC Card</td>
<td>←</td>
<td>←</td>
</tr>
<tr>
<td></td>
<td>Memory mode</td>
<td>20</td>
<td>←</td>
</tr>
<tr>
<td></td>
<td>I/O mode</td>
<td>5.2</td>
<td>←</td>
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<tr>
<td>Buffer size (kbytes)</td>
<td>256</td>
<td>1,024</td>
<td>←</td>
</tr>
<tr>
<td>Average seek time (msec)</td>
<td>15</td>
<td>←</td>
<td>←</td>
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<tbody>
<tr>
<td></td>
<td>2GB 1 Disk</td>
<td>5GB 1 Disk</td>
<td>5GB 1 Disk</td>
</tr>
<tr>
<td>Supply voltage (volts)</td>
<td>3.3 or 5</td>
<td>←</td>
<td>3.3</td>
</tr>
<tr>
<td>Power consumption (W Typ.)</td>
<td>Read/Write</td>
<td>1.2 / 1.3</td>
<td>←</td>
</tr>
<tr>
<td>Low power Idle</td>
<td>0.5</td>
<td>←</td>
<td>←</td>
</tr>
<tr>
<td>Stand-by</td>
<td>0.23</td>
<td>←</td>
<td>←</td>
</tr>
<tr>
<td>Shock (G's)</td>
<td>Operation</td>
<td>150</td>
<td>←</td>
</tr>
<tr>
<td>Non-operation</td>
<td>1,000</td>
<td>←</td>
<td>←</td>
</tr>
<tr>
<td>Acoustics idle mode (dB Typ.)</td>
<td>22</td>
<td>←</td>
<td>←</td>
</tr>
<tr>
<td>Dimension (mm)</td>
<td>Width</td>
<td>54</td>
<td>←</td>
</tr>
<tr>
<td></td>
<td>Depth</td>
<td>85.6</td>
<td>←</td>
</tr>
<tr>
<td></td>
<td>Height</td>
<td>5</td>
<td>←</td>
</tr>
<tr>
<td></td>
<td>Weight (gram)</td>
<td>55</td>
<td>←</td>
</tr>
</tbody>
</table>
Thank you

Y. Hashimoto