PMR on the Fast Track

Carl Che
Samsung Information Systems America

Dec. 7, IDEMA PMR Symposium
1. Samsung HDD Focus
2. PMR Integrations
3. On the fast track
<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>1986</td>
<td>Started HDD Business</td>
</tr>
<tr>
<td>1989</td>
<td>Established R&amp;D Center in San Jose</td>
</tr>
<tr>
<td>1996</td>
<td>Started Production in Gumi Factory</td>
</tr>
<tr>
<td>1999</td>
<td>Reached 10 Million Units / Year</td>
</tr>
<tr>
<td>2001</td>
<td>Started Major OEM Business</td>
</tr>
<tr>
<td>2004</td>
<td>Launched 2.5” HDD to Worldwide Market</td>
</tr>
<tr>
<td>2005</td>
<td>Launched 300GB HDD, SATA 3.0 Gbps</td>
</tr>
<tr>
<td>2006</td>
<td>Reached 5 Million Monthly Shipments</td>
</tr>
</tbody>
</table>
1. Samsung HDD Focus
2. PMR Integrations
3. On the fast track
Advantages of PMR

- **Higher Linear Density is achieved**
  - Larger signal amplitudes from media
  - Less media noise penalty at HF
  - HF write quality is better

- **Smaller Grains are possible**
  - Larger volume due to vertical height
  - Less Demag field at high frequency patterns
  - SUL effects

- **Flux is enhanced with SUL**
  - Larger write field for H/M optimization trade off
  - Easier to write HF than LF
  - Room for TPI increase (narrower TP)
Maximize Areal Density
Minimize Stray field Erasure and ATE/ATI
Meet reliability requirement
Recording Sub-system Impact

- Preamp Optimization
- Easier to write HF
- Risetime is more important than overshot

Graphs showing T50, SNR, and MWW.
Channel Optimization

Target

Nonlinear Distortions

Baseline Waving

Recording Sub-system Impact

Normalised Frequency (MHz)

Nonlinear distortions

Baseline Waving

Target
HDD System Integration

- Servo
  - Avoid DC
  - Utilize DC
- Burn-in
  - Bevel Angle
  - Defects
“Old” Concerns:

- **Pole Erasure**
  - Pass million writes
  - These issues are well controlled with H/M design awareness

- **Stray Field**
  - Pass million writes
  - These issues are well controlled with H/M design awareness
Ready for the Main Stage

SpinPoint M Series

3.5in 250G/p

Coming Soon
Reducing H/M magnetic spacing is critical
Take advantage of the scaling

Reducing Aspect Ratio

TPI will increase faster than BPI
**H/M Improvement**

- High Resolution
- Higher Amplitude
- Reducing transition curvature
- Reducing Bevel Angle

**H/M Integration is critical**
**H/M Improvement**

### Media Improvement
- Grain size control
- Easy axis
- IL reduction
- SUL Optimization
- COC Reduction (No Corrosion)

### New Concepts
- Writability/Stability
- Eraseband Reduction

![Image of recording layer](image-url)

---

**Equation:**

\[ \zeta = \frac{K_u V_{ext}}{M_H V_{ext} + V_{Sat}} \]

This figure of merit term can be used to compare the switching fields of different kinds of media with the same thermal barrier, volume and magnetization.

*Courtesy of Komag*
PMR HDD integration challenges have been overcome.

Enabling technologies for areal density increase are available.

Samsung is running on the PMR racing track → full speed!
Thanks!