“AMOLED, Ready To Take Off”

- SID Mobile Display 2006 -
- Contents -

1. Company Overview
2. AMOLED Introduction
3. Features of AMOLED
4. Product Roadmap
5. Q & A
As a market leader in the display industry, Samsung SDI continuously reinvents itself to bring the best display technology to the world such as AMOLED.

**Product Portfolio**

- **Mobile Display**
  - MSTN
  - CSTN
  - TFT-LCD
  - PMOLED
  - AMOLED

- **Electronic Materials**
  - Phosphor
  - Electronics
  - Electron Gun
  - Coating Substance

- **Mobile Energy**
  - Rechargeable Battery
  - Fuel Cell

**Sales Projection**

- **2005:** USD 8 Billion
  - PDP: 32%
  - CRT: 37%
  - Mobile Display: 29%
  - Phosphor: 22%
  - Electron Gun: 8%

- **2010:** USD 10 Billion
  - PDP: 32%
  - CRT: 14%
  - Mobile Display: 15%
  - AMOLED: 19%
  - Coating Substance: 19%
  - Electron Gun: 15%
  - Battery: 14%
  - Electronic Materials: 19%
Samsung SDI is expected to retain the top position of worldwide mobile display market in 2006 with 21% market share, and will continue to be No. 1 company in 2007 and beyond.

- **2006**
  - Market: 950M
  - SDI Sales: 200M (M/S 21%)

- **2007**
  - Market: 1070M
  - SDI Sales: 240M (M/S 23%)

* SDI’s sales of PMOLED include main and sub display
Samsung SDI’s Cheonan Campus has a state-of-the-art, 4th generation one-stop production generating a complete display panel from backplane glass.

- Production Start
  - Secondary Battery : July 2000
  - PDP : July 2001
  - AMOLED : Jan. 2007
## Capacity Plan

<table>
<thead>
<tr>
<th>Yielded Capacity (2”/Month)</th>
<th>'06</th>
<th>'07</th>
<th>'08</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1H</td>
<td>2H</td>
<td>1H</td>
</tr>
<tr>
<td>'06</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>'07</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>'08</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **Avg. 1.5M/Month**
- **Avg. 4.5M/Month**
- **4Q~**
- Contents -

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AMOLED is self light emitting display which emits separate R,G,B lights directly from layers of organic compounds. True black and life-like color can be represented through AMOLED.

In case of TFT-LCD, backlight unit has to be on all the time regardless of image, making true black unattainable.
SDI’s AMOLED technology is based on

- Color Patterning: R, G, B individually evaporated
- Emission type: Top emission
- Backplane: LTPS

※ Conceptual Image
- Contents -

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2. AMOLED Introduction
3. Features of AMOLED
4. Product Roadmap
5. Q & A
The Prominent Next-generation Display

Superior Image
- Vivid Color
- High Contrast
- Better Sunlight Readability
- Outstanding Luminescence

Fast Response
- Free Viewing Angle
- Slim Form factor
- No audible Noise
AMOLED looks superior to any other types of display technology due to its vivid color, outstanding luminescence, and better sunlight readability.
AMOLED maintains 100 percent color gamut (NTSC) at all time regardless of the change in gray scale.

- TFT-LCD: 75% (at 100% gray level) → 11% (at 10% gray level)
- AMOLED: 100% → 100% (No change)

※ Super ECB Version 2 (Contrast 300:1, Color Gamut 75%)
AMOLED has exceptionally high contrast than TFT-LCD because it can express true black, expressing crystal clear image.

※ Contrast Ratio is more than 10,000:1

※ Contrast Ratio is 300 : 1
AM OLED is perceived to be about 100~150 cd/㎡ brighter than TFT-LCD due to wider color gamut and higher contrast.

**Superior Image … Brighter Luminescence**

- AMOLED
  - Measured brightness: 150 cd/㎡
- TFT-LCD
  - Measured brightness: 150 cd/㎡

- Perceived brightness
  - AMOLED: 150 cd/㎡
  - TFT-LCD: 250 cd/㎡
“Helmholtz-Kohlrausch Effect” and “Bartleson-Breneman Effect” explain the influence of color gamut and contrast on perceived brightness.

Wider Color Gamut

100% @ any gray level (HK Effect)

Superior Contrast

10,000:1 (BB Effect)
HK Effect states that a display with wider color gamut appears to be brighter than a display with smaller color gamut display.

Contours of constant brightness-to-luminance ratio

<table>
<thead>
<tr>
<th>Gray Scale</th>
<th>NTSC</th>
<th>NTSC</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>AMOLED</td>
<td>TFT</td>
</tr>
<tr>
<td>100</td>
<td>106%</td>
<td>75%</td>
</tr>
<tr>
<td>50</td>
<td>103.9%</td>
<td>54%</td>
</tr>
<tr>
<td>10</td>
<td>97.7%</td>
<td>11%</td>
</tr>
</tbody>
</table>
Perceived brightness of AMOLED

\[ (Y) = (X) \times (PB) \]

PB (Perceived Brightness) factor

\[ PB = \frac{\text{Summation of HK values of AMOLED pixels (a)}}{\text{Summation of HK values of TFT-LCD pixels (a)}} \]

Example)

Perceived brightness of AMOLED

\[ 223 \text{cd/m}^2 \]

Brightness of TFT-LCD

\[ 150 \text{cd/m}^2 \]

Perceived Brightness factor

\[ 1.4998 \]
In addition, AMOLED is perceived to be brighter than TFT-LCD due to its higher contrast*

“Bartleson-Breneman Effect”: An optical illusion of perceived contrast appears when image is viewed against a light or dark background.

※ AMOLED achieves contrast of 10,000:1 because it can express true black color from its pixel
Superior Image ... Bartleson-Breneman Effect (2)

- Measurement Method: We compared 6 different levels of AMOLED’s luminescence (e.g. 140cd/m², 170 cd/m², etc.) with 300cd/m² TFT-LCD.
- AMOLED seems to be about 50 ~ 130cd/m² brighter due to BB Effect.

<table>
<thead>
<tr>
<th>Brightness [cd/m²]</th>
<th>Number of People * (Total: 52)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TFT</td>
<td>AMOLED</td>
</tr>
<tr>
<td>140</td>
<td>0</td>
</tr>
<tr>
<td>170</td>
<td>6</td>
</tr>
<tr>
<td>200</td>
<td>26</td>
</tr>
<tr>
<td>225</td>
<td>11</td>
</tr>
<tr>
<td>250</td>
<td>9</td>
</tr>
<tr>
<td>275</td>
<td>0</td>
</tr>
</tbody>
</table>

※ No. of people who recognized the luminescence TFT and AMOLED the same.
Readability of AMOLED under the sunlight of 50,000 lux is same as that of TFT-LCD under 30,000 lux, due to wider color gamut and higher contrast ratio. AMOLED with SIA can be clearly viewed even under 50,000 lux or higher, which is comparable to transflective TFT-LCD.

※ Real pictures
※ SIA: Sunlight-readability Improvement Algorithm
AMOLED’s response time is like a lightning, thus no shadow effect

With no shadow effect, end-users can enjoy movie clips for long time without eye fatigue or strain

<table>
<thead>
<tr>
<th>TFT-LCD</th>
<th>AMOLED</th>
</tr>
</thead>
<tbody>
<tr>
<td>30ms</td>
<td>0.01ms</td>
</tr>
</tbody>
</table>

X 3,000 times

【Response time by temperature】

- 40°C
- 25°C
- -10°C

TFT-LCD

Range of motion picture

AMOLED

Range of motion picture

0.01ms ← No change →

※ Real pictures

AMOLED's response time is like a lightning, thus no shadow effect.
With no shadow effect, end-users can enjoy movie clips for long time without eye fatigue or strain.
AMOLED’s already superior contrast ratio does not diminish with the viewing angle, expressing clear image from any direction.

**TFT-LCD**

- 400:1
- About 10~ max 50:1

**AMOLED**

- 10,000:1
- 8,000~9,000:1

※ Real pictures
AMOLED is stronger and more robust than TFT-LCD even though its total thickness of the panel is thinner.
**AMOLED’s thin form factor will give you lots of room in designing products that will win consumer’s heart.**

<table>
<thead>
<tr>
<th></th>
<th>'06</th>
<th>'07</th>
<th>'08</th>
<th>'09</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>'06</td>
<td>'07</td>
<td>'08</td>
<td>'09</td>
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<tr>
<td>Glass</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Encap</td>
<td>0.5</td>
<td>0.4</td>
<td>0.3</td>
<td>0.25</td>
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<tr>
<td>LTPS</td>
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<tr>
<td>Pol</td>
<td>0.20</td>
<td>0.20</td>
<td>0.17</td>
<td>0.15</td>
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<tr>
<td>Bezel</td>
<td>0.20</td>
<td>0.20</td>
<td>0.15</td>
<td>0.10</td>
</tr>
<tr>
<td>Others</td>
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<tr>
<td>Sealant</td>
<td>0.01</td>
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<td>0.01</td>
<td>0.01</td>
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<td>Tape</td>
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<td>0.05</td>
<td>0.04</td>
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</tr>
<tr>
<td>Total</td>
<td>1.46t</td>
<td>1.26t</td>
<td>0.97t</td>
<td>0.80t</td>
</tr>
</tbody>
</table>

※ The figure above represents the actual specification of Samsung SDI’s mass-produced AMOLED products.
AMOLED has zero audible noise from display panel

- **TFT-LCD’s audible noise**
  - Noise level: 22.2 dB(A)
    - (3.6 dB higher than default noise)
  - Considerable noise occurring at panel & capacitor

- **AMOLED’s audible noise**
  - No noise at panel
  - Very small noise from capacitor only

![Graph of sound pressure level vs. frequency for TFT-LCD](image)

![Graph of sound pressure level vs. frequency for AMOLED](image)
1.5 minute video clip about superior features of SDI AMOLED
- Contents -

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AMOLED will penetrate into larger displays and various applications

**AMOLED**

- WVGA (480x272)
- VGA
- WQVGA (480x272)
- QVGA (240x320)
- LQVGA (240x432)

**2006.2H**
- 2.8" 480x640
- 3.0" Landscape
- 4.0" 480x272
- 2.8" 240x400
- 2.5" Landscape 2.5" Delta
- 2.0"/ 2.2"/ 2.4"/ 2.6" 16M color
- 2.6" 262K color
- 2.0", 2.2", 2.4" 262K color

**2007.1H**
- 2.0", 2.2", 2.4" 262K color

**2007.2H**
- Under Development

**2008.1H**
- 7.0" WVGA
- 4.0" WVGA
- 6.0" WXGA

**2008.2H**
- UMPC
- Car Navi.
- PMP
- DSC
- Mobile phone

- AMOLED penetration into larger displays and various applications.
Thank you for your attention!