Samsung Mobile DRAM

High-speed, power-saving memory in a slim profile supports the next generation of mobile devices

QDP Package
Obtain higher performance with less power consumption.

Mobility drives need for specialized DRAM solutions

With the industry continuing to shift from desktop PCs to mobile electronics, consumers want their smartphones and tablets to be always on, always connected, while running high performance applications and providing all-day battery life in slim, lightweight form factors.

This need for more powerful and thinner mobile devices is requiring device manufacturers to seek versatile, high-performance memory solutions that minimize space and power.

Faster, higher-density memory is needed to handle processing of sophisticated software and larger, high-resolution display screens.

Samsung Mobile DRAM delivers high-performance and extended battery life

Samsung Mobile Dynamic Random Access Memory (DRAM) helps optimize performance with higher operational speeds and increased battery life.

Samsung Mobile DRAM chips are designed to consume less power than standard DRAM chips. Lower power consumption translates into longer battery life. Meanwhile Mobile DRAM chips offer comparable performance to standard DRAM chips in packages that maximize memory density while minimizing board space.

Samsung introduced the world’s first 20nm-class Low Power Double Data Rate 3 (LPDDR3) memory. LPDDR3 memory boasts higher bandwidths and improved energy efficiency compared to the previous generation (LPDDR2). It is designed to deliver DDR3 performance with significantly lower operational and standby power.

Higher bandwidth and data transfer rate

Samsung LPDDR3 operates at twice the speed of the previous generation LPDDR2 Mobile DRAM. The data rate of LPDDR3 is 1600 Mbps and the maximum bandwidth is 12.8 GB per second.

Optimize viewing on larger, high-resolution display screens

As the display screens on mobile devices move to higher resolution and larger sizes, increased demands are being placed on DRAM performance. Samsung LPDDR3 features high operational speeds that keep pace with today’s fast mobile CPUs and large, high-resolution displays.

Perform multitasking functions with increased density

Equipped with high density Samsung LPDDR3, mobile devices enable users to run complex applications, and multitask with greater ease and speed.

Figure 1. Handheld mobile devices represent a growing market
Mobile DRAM ranked higher in energy savings over other memory tested

Samsung labs compared the power consumption of DDR3L (1.35 V) and LPDDR3. It was determined that LPDDR3 showed significant power savings over DDR3L in operating and standby power.

Advanced circuit architectures conserve energy while maintaining performance

Innovative circuit design features in Samsung LPDDR2 and LPDDR3 memory help mobile devices conserve energy without sacrificing performance through several design features.

**Monolithic chip**

This chip enables users to gain additional power savings while maintaining the same total density as a dual-die package. The monolithic chip improves overall power efficiency at the component level up to 70 percent.

**Temperature-Compensated Self-Refresh (TCSR)**

Reduced power consumption in standby mode is enabled by this advanced, on-chip technology. Samsung LPDDR2 and LPDDR3 memory can add up to three days of standby battery life for a smartphone, a 23 percent improvement over LPDDR1. This equates to an increase in standby battery life from 12.5 days to 15.4 days.

**Partial Array Self-Refresh (PASR)**

This feature adjusts the size of the memory array to be refreshed.

**Deep Power Down (DPD)**

This feature powers down the array.

**Drive Strength (DS)**

The programmable DS reduces the driver strength based on system needs, thereby conserving energy.

---

*Figure 2. Energy efficiency: EDP DRAM versus Mobile DRAM*
Optimize space and efficiency for today’s lighter, thinner devices.

**Thin, compact design provides flexibility for super-slim mobile devices**

The increasing demand for smaller, more lightweight mobile devices presents a challenge for device manufacturers. Manufacturers need to find thinner mobile memory chips to conform to the space constraints of slimmer-profile devices.

Samsung Mobile DRAM is designed for flexibility with a choice of thin, small form-factor packages that occupy little to no board space. The Samsung small form-factors include:

- Discrete Fine-Pitch Ball Grid Arrays (FBGAs)
- Package-on-Package (POP)

These packages can be used in the most compact devices where board space is extremely limited. Package-on-Package devices use no additional board space since they are soldered directly on top of the application processor. Discrete packages, designed to be soldered directly to the printed circuit board are 11mm x 11.5mm. Using Samsung’s die stacking expertise, up to 3GB of Mobile DRAM can fit into a single package.

The super-compact profiles enable highly efficient use of board space. In addition, they have a significantly lower mass. This reduced mass helps keep the weight of the mobile device as light as possible, providing increased portability for the end user.

Figure 4. The super-slim profile of the Samsung 30nm-class 2GB LPDDR2 DRAM occupies very little board space, ideal for today’s ultra-thin mobile devices.

**Figure 5. A cross-sectional view of a typical mobile DRAM encapsulated in an FBGA package.**

**Vertical structure**
- Die thickness: 80–300um
- Tape thickness: 100–270um
- Total thickness: 0.8–1.0mm

**Cross-section view**
- Mold compound
- Wire bond
- Solder mask
- Solder ball
- Circuit trace
- BT resin
- Via hole
### Features and benefits

<table>
<thead>
<tr>
<th>Features</th>
<th>Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>High performance</td>
<td>Experience-optimized viewing on large, high-resolution mobile display screens.</td>
</tr>
<tr>
<td>Increased density</td>
<td>Perform complex application functions, and multitask with greater ease and speed.</td>
</tr>
<tr>
<td>Low power consumption</td>
<td>Provide extended battery life with enhanced energy-saving features in operating and standby modes.</td>
</tr>
<tr>
<td>Small form factor</td>
<td>Deliver lighter, thinner mobile devices to the marketplace with a slimmer design that uses less board space.</td>
</tr>
</tbody>
</table>

### Specifications

<table>
<thead>
<tr>
<th>Category</th>
<th>LPDDR2</th>
<th>LPDDR3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density</td>
<td>512MB - 2GB</td>
<td>512MB - 3GB</td>
</tr>
<tr>
<td>CLK frequency</td>
<td>533 MHz</td>
<td>800 MHz - 933MHz</td>
</tr>
<tr>
<td>VDD1 / VDD2 / VDDCA / VDDQ</td>
<td>1.8 V / 1.2 V / 1.2 V</td>
<td>1.8 V / 1.2 V / 1.2 V</td>
</tr>
<tr>
<td>Data scheme</td>
<td>DDR</td>
<td>DDR</td>
</tr>
<tr>
<td>ADDR/CTRL scheme</td>
<td>DDR</td>
<td>DDR</td>
</tr>
<tr>
<td>Organization</td>
<td>x32</td>
<td>x32</td>
</tr>
</tbody>
</table>
About Samsung Electronics Co., Ltd.

Samsung Electronics Co., Ltd. is a global leader in semiconductor, telecommunication, digital media and digital convergence technologies with 2011 consolidated sales of US$143.1 billion. Employing approximately 222,000 people in 205 offices across 71 countries, the company operates two separate organizations to coordinate its nine independent business units: Digital Media & Communications, comprising Visual Display, Mobile Communications, Telecommunication Systems, Digital Appliances, IT Solutions, and Digital Imaging; and Device Solutions, consisting of Memory, System LSI and LCD. Recognized for its industry-leading performance across a range of economic, environmental and social criteria, Samsung Electronics was named the world’s most sustainable technology company in the 2011 Dow Jones Sustainability Index. For more information, please visit www.samsung.com.

For more information

For more information about Samsung Mobile DRAM, visit www.samsung.com/semiconductor.