High efficiency, reduced costs and quicker time to market

Expand device development with capable memory solutions

To meet current trends for advanced mobile device designs, manufacturers require memory that is increasingly dense, robust and small:

- **Dense.** Sophisticated mobile devices require high-density content storage that supports high-definition video playback and other high-end multimedia features. As a result, memory densities are rapidly advancing.
- **Robust.** Today's fastest and most demanding embedded uses require strong memory management solutions. Embedded uses include multifunctional smartphones, portable media players and tablet computers.
- **Small.** The Joint Electron Device Engineering Council (JEDEC) encourages memory to be produced in extremely compact sizes to allow space for other components.

To focus on these demands, developers need an efficient way to control software development by simplifying mass storage designs and improving device production. Developers also require the ability to create efficient mobile device designs with minimal costs and brief time to market. Finally, they need superior storage capabilities to augment device production.

Samsung has a wide range of eMMC solutions based on performance requirements.

Samsung embedded multimedia card (eMMC) addresses these needs with advanced embedded NAND Flash. The eMMC helps simplify mass storage designs for the latest consumer electronics. Samsung eMMC is produced in very compact sizes (typically smaller than a postage stamp) to create room within devices for additional parts. Key applications that can benefit from Samsung eMMC include advanced mobile devices and handsets. These products use eMMC to expand computing power and content storage. They also use eMMC to provide booting functionality.

Simplify mass storage designs

Conventional NAND Flash memory can be challenging to adopt. Developers may have some difficulty controlling software development, particularly when implementing wear leveling, bad block management, device mapping and error handling. Developers may also encounter issues related to die shrinkage, including page size and error correcting code (ECC) management.

Conversely, Samsung eMMC is designed to be easy to adopt. It is suitable for the latest consumer electronics, including tablets, smartphones, GPS systems and e-readers. Chipset validation means that eMMC is a thoroughly tested solution. Samsung eMMC incorporates a mature interface standardized by JEDEC, and key functionality yields strong power management and performance optimization.

Samsung eMMC provides enhanced storage capabilities, a reduced controller footprint and streamlined data reads and writes. Standardized packaging and device specifications plus intelligent firmware ease design work and provide a common footprint for the use of embedded and removable NAND. Samsung offers a single footprint combining boot, embedded storage and external mass storage in one device.

In addition, Samsung offers a wide range of eMMC solutions based on low (4GB or 8GB) to high (16GB, 32GB, 64GB or 128GB) density requirements.

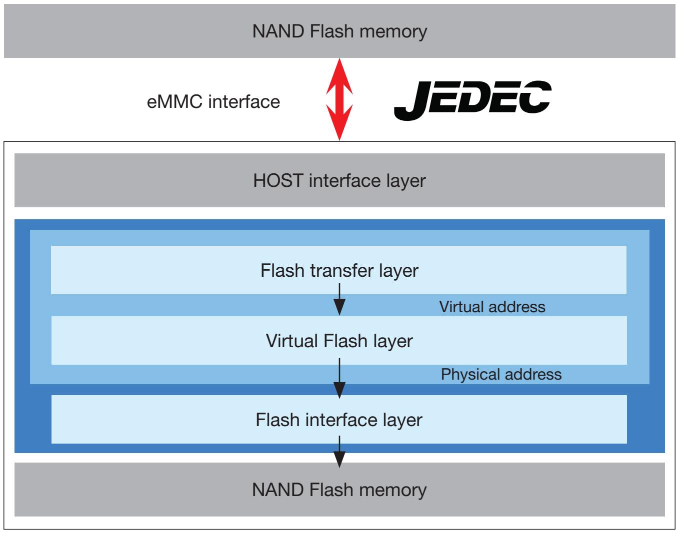


Figure 1. MMC user

Enhanced ability to proceed directly from concept to testing

Reduce development time and control costs

In the past, a product using NAND memory required changes in the chipset or the OS. At times, the NAND memory also required changes to be made in the Flash translation layer (FTL). The changes then needed to be tested at the NAND level, which could lead to significant delays in product-level testing. In contrast, developers using Samsung eMMC can move directly from product concept to product testing. Samsung eMMC isolates the host from changes in NAND memory technology and bypasses the FTL, which reduces design, development and testing time, and helps control costs.

Samsung eMMC simplifies system design and integration of 2-bit and 3-bit multi-level cell (MLC)-type NAND memory, and triple-level cell (TLC) memory, leading to faster overall time to market. This approach makes Samsung eMMC memory an excellent choice for deployment across a variety of segments, including low-cost legacy chipsets. Samsung eMMC operates at standard 4.41, 4.5, and 5.0 voltage levels, so there is no need to develop or use separate firmware. This interface turns memory accesses into straightforward read-write operations with advanced security and reliability features.

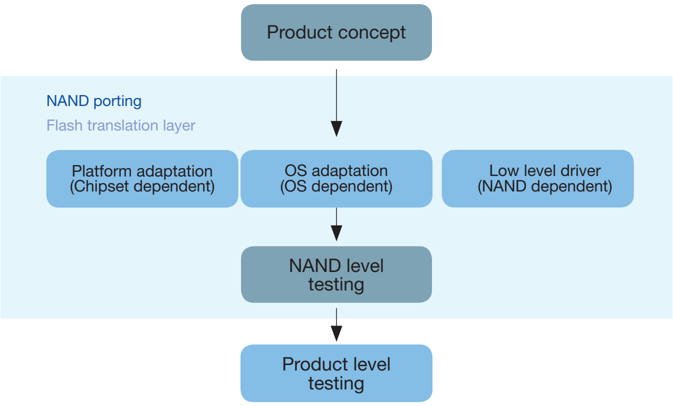


Figure 2. Samsung eMMC memory enables users to proceed from product concept directly to product testing.

Increase storage capabilities for diverse applications

Advanced mobile devices and handsets can use Samsung eMMC to expand computing power and content storage. Enhanced storage solutions for mobile devices that provide high-density solid state memory can be integrated into system designs. Traditional storage media, as a result of the high storage capacity of eMMC, can be replaced by lower-power solid-state drives (SSDs). Including SSDs enables increased storage densities, reduced costs and low power consumption. Content storage supports high-definition video playback and other complex multimedia features. Computing power provides booting functionality.

Samsung eMMC comprises high-density 2-bit and 3-bit MLC NAND, and an intelligent MMC controller in a Ball Grid Array (BGA) package.

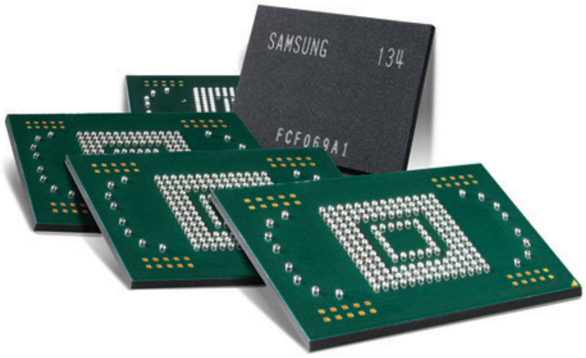


Figure 3. 10nm-class eMMC

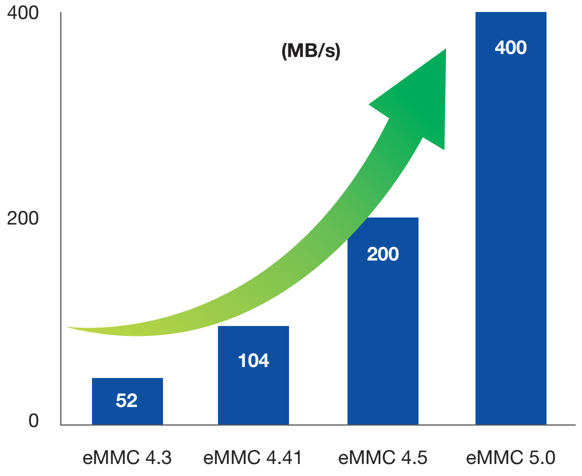
Intelligent mobile device development

Create an efficient way to develop well-designed mobile devices

To maintain the required data rates and throughput for high-density chips, the eMMC standard was developed to enhance storage capabilities, reduce controller footprint and streamline data reads and writes. Advanced Samsung technology helps reduce the cost of application development and increase work efficiency, enabling developers to stay competitive by building better and faster.

Samsung eMMC contributes to successful mobile device development. The intelligent interface is designed for ease of use, and enhanced storage solutions improve device designs. Samsung eMMC also helps developers go straight from concept to testing, reducing time to market.

eMMC Interface Bandwidth



Features and benefits

Features	Benefits
Density of 4 GB to 128 GB	Contributes to a variety of mobile & consumer designs
Small size	Helps meet today's mobile design requirements Frees up space for other components
Enhanced storage capabilities	Enhances robust mobile devices Enables traditional storage media to be replaced by lower-power SSDs
Advanced embedded NAND Flash	Helps simplify mass storage designs Aids in expanding computing power and content storage Is designed for easier adoption
Standard, mature interface by JEDEC	Provides strong power management and performance optimization Open, Standard Specifications for device features, function, and package pinout
Intelligent firmware	Facilitates easier design work Provides a common footprint for the use of embedded and removable NAND
Single footprint	Combines boot, embedded storage and external mass storage in one device
Isolation of the host from changes in NAND memory technology	Enables developers to move directly from product concept to product testing
FTL bypass	Reduces design, development and testing time
Mobile-Centric	Optimized for very low power consumption

eMMC Features	eMMC 4.5	eMMC 5.0
Interface Speed/Max Bandwidth	200MB/s	400MB/s
Clock Frequency	200MHz	200MHz
Data Rate, Mode	HS200, SDR	HS400, DDR
Bus Width	x4/x8	x4/x8
H/W Reset	Yes	Yes
Multi-Partition	Yes	Yes
Enhanced Mode (SLC + MLC)	Yes	Yes
Alternative Boot	Yes	Yes
Security Features (Trim, RPMB, Secure Erase, Secure Trim)	Yes	Yes
Secure Trim Refinement	Yes	Yes
High Priority Interrupt	Yes	Yes
Back Ground Operation	Yes	Yes
Packed Command	Yes	Yes
Cache Handling	Yes	Yes
Discard	Yes	Yes
Dynamic Capacity	Yes	Yes
Sanitize	Yes	Yes
Smart Report	Vendor Specific	Yes-standardized
F/W Update	N/A	Yes-standardized

Samsung eMMC Part Number Matrix

Standard eMMC:

Density	Part Number	Flash	MMC	Class*	Seq R/W (MB/s)	Ran R/W IOPS	Pkg Size (mm)	Status
4 GB	KLM4G1YEMD-C031	32Gb*1	5.0	200	100/6	2500/200	11.5x13x0.8	CS
8 GB	KLM8G1WEMB-B031	64Gb*1		200	100/6	2500/200	11.5x13x0.8	CS
16 GB	KLMAG2WEMB-B031	64Gb*2		700	170/11	4000/500	11.5x13x0.8	CS
32 GB	KLMBG4WEMC-B031	64Gb*4		1500	200/50	4000/1500	11.5x13x1.0	CS
64 GB	KLMCG8WEMC-B031	64Gb*8		1500	200/50	4000/1500	11.5x13x1.0	CS

High-Performance eMMC-Pro:

Density	Part Number	Flash	MMC	Class*	Seq R/W (MB/s)	Ran R/W IOPS	Pkg Size (mm)	Status
4 GB	KLM4G1FEAC-B031	32Gb*1	5.0	700	150/10	4000/700	11x10x0.8	MP
8 GB	KLM8G1GEAC-B031	64Gb*1		700	180/20	4000/700	11.5x13x1.0	MP
16 GB	KLMAG2GEAC-B031	64Gb*2		2000	240/40	6000/2500	11.5x13x1.0	MP
32 GB	KLMBG4GEAC-B031	64Gb*4		2000	240/60	6000/2500	11.5x13x1.0	MP
64 GB	KLMCG8GEAC-B031	64Gb*8		2000	240/60	6000/2500	11.5x13x1.2	MP
128 GB	KLMDGAGEAC-B001	64Gb*16	4.5	2000	150/50	3500/2000	11.5x13x1.4	MP

* eMMC Class refers to RW IOPS

** eMMC Performance Conditions: Bus width x8, cache on, 512KB data transfer, device is full w/o file system overhead

*** eMMC 5.0 is JEDEC Compliant and is backwards compatible with older eMMC versions such as 4.41 & 4.5.

Legal and additional information

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 eMMC, visit www.samsung.com/semiconductor.

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