SMART Technical Brief

eMMC: A New Era in Embedded Storage
NAND Flash memory has become the data storage technology of choice for Automotive and Industrial embedded applications, for its functionality, reliability and cost effectiveness. System designers seeking to incorporate NAND Flash in their products are challenged by the implementation of complex error correction codes (ECC) and data management algorithms necessary to utilize NAND Flash memory natively.

SMART’s eMMC Product Family is an embedded memory solution that combines NAND Flash Memory, an embedded MMC (MultiMediaCard) controller, and advanced firmware in a small BGA package that provides a robust, yet cost effective, high-density embedded NAND Flash storage solution. The eMMC products are compliant to the JEDEC® e•MMC™ v4.5 interface and protocol standard.

eMMC can simplify system design by making the complexity of the underlying NAND Flash technology invisible to the host system - enabling easier design-in, reduced time-to-market, and simpler migration as the NAND Flash technology scales.

**NAND Flash Technology Challenges**

While NAND Flash is a proven solid-state data storage technology, scaling towards ever finer geometries to reduce costs, results in greater limitation on the lifetime and endurance of the memory elements, resulting in a higher probability of errors in the stored data (bit error rate). In addition, multi-level cell (MLC) NAND Flash, which stores more than one bit of data in each memory element, with a lower endurance and higher bit error rate, is becoming main stream in embedded applications for cost reasons.

Sophisticated ECC and NAND data management structures, such as wear-leveling, are necessary to extract the best performance from the NAND Flash memory while managing the bit errors and limiting endurance, to deliver a reliable NAND Flash storage system.

**eMMC Benefits**

When working with native NAND Flash components, data are written and read directly to physical locations in the NAND Flash memory. Host system needs to actively manage data at physical memory locations and correct bit errors as the data are read back from NAND Flash. Designers must implement the necessary ECC engine and data management algorithm in the host system, increasing the burden on host hardware and software design and validation. Revision to the design may be necessary each time the NAND Flash component is replaced by a newer part or a part from a different vendor.

In comparison, eMMC functions as a block storage device, interacting with the host system through an abstracted interface protocol, analogous to an SSD. The host system simply writes and reads data to and from logical block addresses (LBA’s), without needing to anticipate data errors and how the data would be stored and managed in the NAND Flash memory. The eMMC controller hardware and firmware handles the error correction and data management functions internally without involvement from the host system.

Since the eMMC interface and protocol standardized by JEDEC® is agnostic to the underlying NAND Flash memory technology and configuration, compatibility and interoperability among different suppliers’ eMMC products can be assured.
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eMMC Key Features

Key features important for Automotive and Industrial applications:

**Boot Support:**
- eMMC can be utilized as an all-in-one non-volatile memory device in a host system. Low-level boot strap can be loaded directly from eMMC, eliminating the need of another non-volatile memory chip such as SPI-NOR

**Configurable Memory Space:**
- Support multiple hardware partitions; or the nominally MLC NAND based memory space can be reconfigured to pseudo-SLC enhanced storage media.

**Robust Power Loss Protection:**
- Power loss protection is a key differentiation for eMMC against other storage standards
- Reliable Write and Data Reliability parameter settings ensure existing data are not corrupted when a sudden power loss event occurs
- High-Priority Interrupt enables the host system to interrupt an on-going command execution in anticipation of an imminent power shutdown
- Power-Off Notification improves the communication between eMMC and the host system for gracefully power shutdown

SMART Modular eMMC

SMART’s eMMC Product Family is designed to meet the rigid requirements of the Automotive, Industrial, Medical, and Networking segments where technical support, extended life, and stable roadmaps are critical in choosing the right supplier.

SMART’s eMMC solution is available in the standard JEDEC® 0.5mm pitch 169-ball package as well as the 1.0mm pitch 100-ball package. Comparing to the former, the 100b package can provide customers a solution with larger ball pitch and ball diameter that enables lower cost PCB designs, simplifies PCB routing with wider metal traces that can provide better thermal dissipation.

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Why SMART for eMMC

- A trusted supplier - over 25 years of supporting demanding OEMs
- Support with a True Embedded Focus - we only focus on embedded applications so even the little guys are big in our eyes
- Differentiated Products - team of engineers to support your every need
- Support across the entire life cycle - dedicated support from womb to tomb

Features

- eMMC4.5 compliant (also compatible with hosts based on 4.41)
- 8GB to 64GB
- Dedicated SKU specifically for Automotive applications
- VCC = 3.3V and VCCQ = 3.3V or 1.8V
- Up to 160MB/s sequential read and 48MB/s sequential write
- Operating Temperature:
  - Automotive: -40°C to 85°C
  - Industrial: -40°C to 85°C
  - Extended Temp: -25°C to 85°C

Customer Benefits

- Governed by JEDEC
- Future generations designed to be backwards compatible
- NAND technology concerns hidden behind advanced controller
- High performance and low power in a small form factor

Target Application

- Automotive Infotainment (In-Dash)
- Factory Automation Equipment
- Networking applications (e.g., Routers)
- Medical Devices
- Point-of-sale terminal
- Printers
- RFID scanners
- Single Board Computers
- VoIP
- Servers