TOSHIBA
Leading Innovation

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Memory Storage Devices

SEMICONDUCTOR & STORAGE PRODUCTS

http://www.semicon.toshiba.co.jp/eng

Memory Storage Devices

In 1984, Toshiba developed a new type of semiconductor memory called flash memory, leading the industry into the next generation ahead of its competitors. Some time later, in 1987, NAND flash memory was developed, and this has since been used in a variety of memory cards and electronic equipment. The NAND flash market has grown rapidly, with flash memory becoming an internationally standardized memory device.
This brochure introduces Toshiba's memory solutions, mainly those based on NAND flash memory.

Toshiba, the inventor of flash memory, has carved out a path to a new era in which we are all able to carry videos, music and data with us wherever we go.

Toshiba's Leading Technology Areas

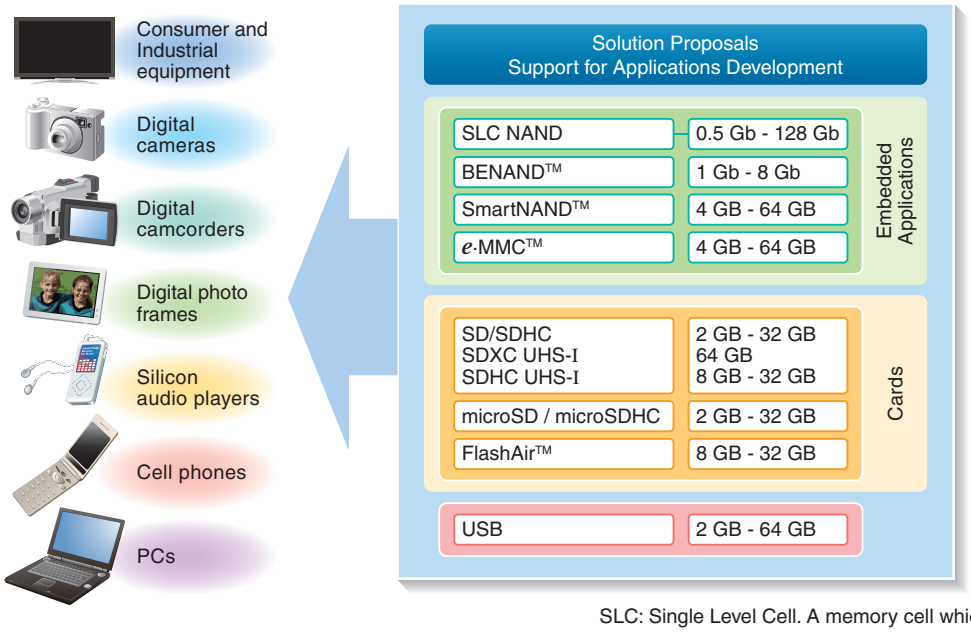
- Process technology
- Multi-level-cell (MLC) technology
- Controller technology
- Die stacking technology
- Packaging technology

Features of Toshiba's Memory Storage Devices

- Suitable for storing large files
- Fast write and erase rates
- Low per-bit cost
- Easily extendable using the NAND interface
- Offers products with a standard HS-MMC interface
- Offers products with UHS-I, a high-speed SD bus interface

Extensive Memory Lineups and Solutions

Toshiba is committed to supporting customers in their efforts to create new applications by offering an extensive portfolio of memory solutions. Among our memory products are raw NAND chips that allow great flexibility in system design according to customer needs, high-reliability single-level-cell (SLC) NAND products with embedded error correction code (ECC) and NAND flash memories that integrate both large-capacity MLC NAND and controller chips in one package, as well as cards and storage products.



Toshiba's Memory Lineup

- NAND flash memories
  - SLC NAND
- NAND flash memories with control functionality
  - e·MMC™
  - SmartNAND™
  - BENAND™
- Media cards
  - SD memory cards
  - microSD memory cards
  - USB flash memories
  - FlashAir™

SLC: Single Level Cell. A memory cell which can store a bit of information.
MLC: Multiple Level Cell. A memory cell which can store more than a bit of information.

SLC (Single Level Cell) NAND

SLC NAND flash has the advantages of higher write cycle endurance, faster read/write speeds and greater reliability. Toshiba offers a wide range of SLC NAND flash from low capacity to high capacity. All products embody Toshiba's advanced technology and meet the market demand for higher reliability.

▶ SLC NAND Lineup

■ Low Capacity (Small Block Size)

Capacity	Page Size (bytes)	Block Size (bytes)	Power Supply (V)	Operating Temperature (˚C)	Package
512 Mbit	512	16 K	2.7 to 3.6 1.70 to 1.95	0 to 70 –40 to 85(Note)	48 pin TSOP 63 Ball BGA
1 Gbit					

■ Small to Mid Capacity (Large Block Size)

Capacity	Page Size (bytes)	Block Size (bytes)	Power Supply (V)	Operating Temperature (˚C)	Package
512 Mbit	2 K	128 K	2.7 to 3.6 1.70 to 1.95	0 to 70 –40 to 85(Note)	48 pin TSOP 63 Ball BGA
1 Gbit					
2 Gbit					
4 Gbit					

■ High Capacity

Capacity	Page Size (bytes)	Block Size (bytes)	Power Supply (V)	Operating Temperature (˚C)	Package
4 Gbit	4 K	256 K	2.7 to 3.6 1.70 to 1.95	0 to 70 –40 to 85(Note)	48 pin TSOP 63 Ball BGA
8 Gbit					
16 Gbit (8 Gb x 2)					
32 Gbit (8 Gb x 4)					

■ High-Capacity NAND for Enterprise Applications (with Legacy Interface)

Capacity	Page Size (bytes)	Block Size (bytes)	Power Supply (V)	Operating Temperature (˚C)	Package
32 Gbit	8 K	1 M	2.7 to 3.6	0 to 70 –40 to 85(Note)	48 pin TSOP
64 Gbit (32 Gb x 2)					
128 Gbit (32 Gb x 4)					

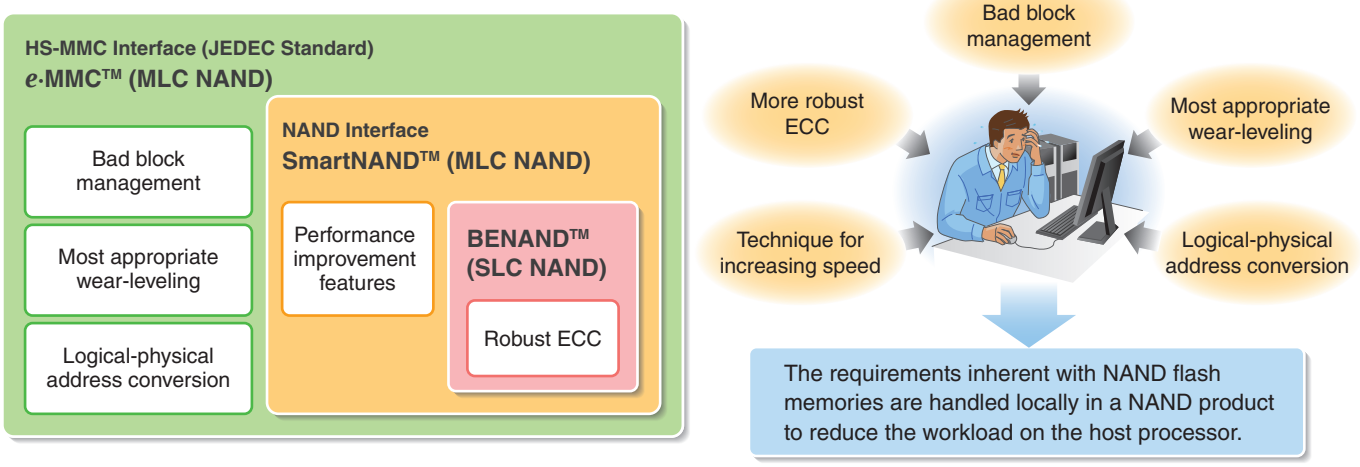
■ High-Capacity NAND for Enterprise Applications (with Toggle Interface)

Capacity	Page Size (bytes)	Block Size (bytes)	Power Supply		Operating Temperature (˚C)	Package
			Vcc (V)	VccQ (V)		
64 Gbit (32 Gb x 2)	8 K	1 M	2.7 to 3.6	2.7 to 3.6 1.70 to 1.95	0 to 70	132 Ball BGA
128 Gbit (32 Gb x 4)						
256 Gbit (32 Gb x 8)						

Note: For products for use in the -40°C to 85°C temperature range, contact your local Toshiba sales representative.

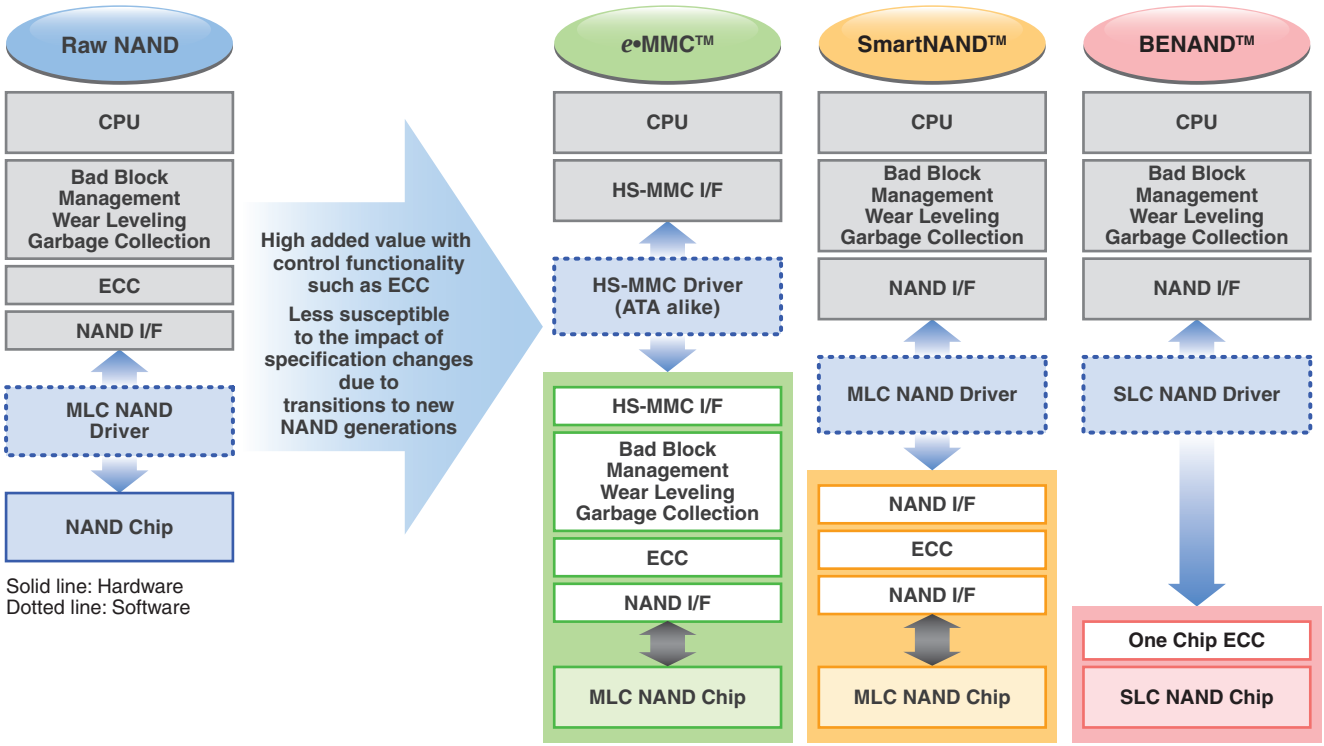
NAND Flash Memories with Control Functionality

If you are considering a NAND flash as your memory solution, Toshiba recommends its NAND flash product with control functionality.
If you opt for raw NAND chips, you need to implement ECC, bad-block management, logical-to-physical address conversion, wear leveling (a technique for distributing re-writes evenly across a memory array) and other control functions on the host side.
With evolving NAND manufacturing processes, ECC, in particular, is becoming more sophisticated and putting heavier burdens on the host processor.
To meet customer needs in addressing this issue, Toshiba offers NAND flash memories with embedded ECC and those that integrate a controller in the same package.



Toshiba's NAND Product Lineup and Product Overview

Toshiba offers *e*-MMC™ that integrates a NAND controller and large-capacity MLC NAND memories in the same package; SmartNAND™ that integrates a controller for ECC and performance improvement and large-capacity MLC NAND memories in the same package; and BENAND™ that combines only ECC with high-reliability SLC NAND memories.
All these NAND solutions provide ECC and other control functions optimized by Toshiba, the NAND vendor, for each NAND technology generation.
They will help to reduce the workload on the host processor, simplify product development, shorten time-to-market and increase ease of use of memory products.



NAND Flash Products with Control Functionality

e·MMC™ Lineup

e-MMC™ is a family of NAND flash memories with control functionality such as ECC, wear leveling and bad-block management. e-MMC™ also provides a high-speed memory card interface compliant with JEDEC/MMCA Version 4.41/4.5, eliminating the need for users to be concerned about directly controlling NAND flash memories. Thus, e-MMC™ can easily be used as an embedded MultiMedia Card (MMC) memory.

Capacity	Part Number	Class	Speed (MHz)	Power Supply		Operating Temperature (˚C)	Package	
				Vcc (V)	VccQ (V)		Type	Size (mm)
4 GByte	THGBMAG5A1JBAIT	Premium	Up to 200	2.7 to 3.6	1.70 to 1.95 2.7 to 3.6	–25 to 85	P-WFBGA153	11 x 10
	THGBMAG5A1JBAIR	Premium					P-VFBGA153	11.5 x 13
8 GByte	THGBMAG6A2JBAIR	Premium					P-VFBGA153	11.5 x 13
16 GByte	THGBMAG7B2JBAIM	Supreme					P-VFBGA169	12 x 16
	THGBMAG7A2JBAIR	Premium					P-VFBGA153	11.5 x 13
32 GByte	THGBMAG8B4JBAIM	Supreme					P-VFBGA169	12 x 16
	THGBMAG8A4JBA4R	Premium					P-VFBGA153	11.5 x 13
	THGBM7G8T4JBAIR	Prime					P-VFBGA153	11.5 x 13
64 GByte	THGBMAG9B8JBAIE	Supreme					P-TFBGA169	12 x 16
	THGBMAG9A8JBA4G	Premium					P-TFBGA153	11.5 x 13
	THGBM7G9T8JBAIG	Prime					P-TFBGA153	11.5 x 13

e·MMC™ is a trademark of JEDEC/MMCA.

SmartNAND™ Lineup

SmartNAND™ is a family of NAND products with embedded ECC that provides a standard raw NAND interface. The speed performance optimization is easier with some modes of read and program operations. Toshiba's SmartNAND™ portfolio includes large-capacity products. You can easily use SmartNAND™ together with existing host controllers (hardware) by optimizing of NAND driver software on the host side.

Capacity	Part Number(Note)	DQ Interface	Page Size (bytes)	/CE Signal & Ready/Busy Signal	Power Supply		Operating Temperature (˚C)	Package
					Vcc (V)	VccQ (V)		
4 GByte	THGBR2G5D1JTA00	SDR	16 K	1 & 1	2.7 to 3.6	2.7 to 3.6 1.70 to 1.95	0 to 70(Note)	48 pin TSOP
8 GByte	THGBR2G6D1JTA00	SDR						
	THGBR2G6D1JBA01	SDR						132 Ball BGA
	THGBT2G6D1JBA01	Toggle DDR1.0						
16 GByte	THGBR2G7D2JBA01	SDR		2 & 2				
	THGBT2G7D2JBA01	Toggle DDR1.0						
32 GByte	THGBR2G8D4JBA01	SDR						
	THGBT2G8D4JBA01	Toggle DDR1.0						
64 GByte	THGBR2G9D8JBA01	SDR						
	THGBT2G9D8JBA01	Toggle DDR1.0						

SmartNAND™ is a trademark of TOSHIBA CORPORATION.
Note: For products for use in the -40°C to 85°C temperature range, contact your local Toshiba sales representative.

BENAND™ Lineup

BENAND™ is an SLC NAND flash solution with embedded ECC, which removes the burden of ECC from the host processor. Use of the common NAND interface allows BENAND™ to maintain compatibility with general SLC NAND flash in terms of the command set, device operation, packaging, pin configuration, etc. Therefore, the latest BENAND™ can easily be used as a replacement for a general SLC NAND flash without being concerned about a system's error correction capability.

Capacity	Part Number(Note)	I/O	Page Size (bytes)	Block Size (bytes)	Power Supply Vcc (V)	Operating Temperature (˚C)	Package
1 Gbit	TC58BVG0S3HTA00	x 8	2 K	128 K	2.7 to 3.6	0 to 70(Note)	48 pin TSOP
	TC58BVG0S3HBAI6					–40 to 85	67 Ball BGA
	TC58BVG0S3HBAI4					–40 to 85	63 Ball BGA
2 Gbit	TC58BVG1S3HTA00	x 8	2 K	128 K	2.7 to 3.6	0 to 70(Note)	48 pin TSOP
	TC58BVG1S3HBAI6					–40 to 85	67 Ball BGA
	TC58BVG1S3HBAI4					–40 to 85	63 Ball BGA
4 Gbit	TC58BVG2S0FTA00	x 8	4 K	256 K	2.7 to 3.6	0 to 70(Note)	48 pin TSOP
	TC58BVG2S0FBAI4					–40 to 85	63 Ball BGA
	TC58BVG2S0HTA00					0 to 70(Note)	48 pin TSOP

Note: For products for use in the -40°C to 85°C temperature range, contact your local Toshiba sales representative.

Media Cards

Toshiba's SD and microSD memory cards are widely used as compact, standard solutions for storing data and transporting data from one device to another.

EXCERIA™ Series

The Premiugate™ Series is a new-generation high-speed SD memory card. When used in a device compliant with the UHS-I bus interface and the SDR104 speed mode, Premiugate™ delivers the maximum data rate*1.

SD, SDHC and SDXC Memory Cards

Type1 (Read 95 MB/s, Write 90 MB/s)

SDHC UHS-I, SD Speed Class 10

Type2 (Read 95 MB/s, Write 60 MB/s)

SDXC(*2) UHS-I
SD Speed Class 10

SDHC UHS-I
SD Speed Class 10

TypeHD (Read 95 MB/s, Write 30 MB/s)

SDHC UHS-I, SD Speed Class 10

microSDHC Memory Cards

Type HD (Read 95 MB/s, Write 30 MB/s)

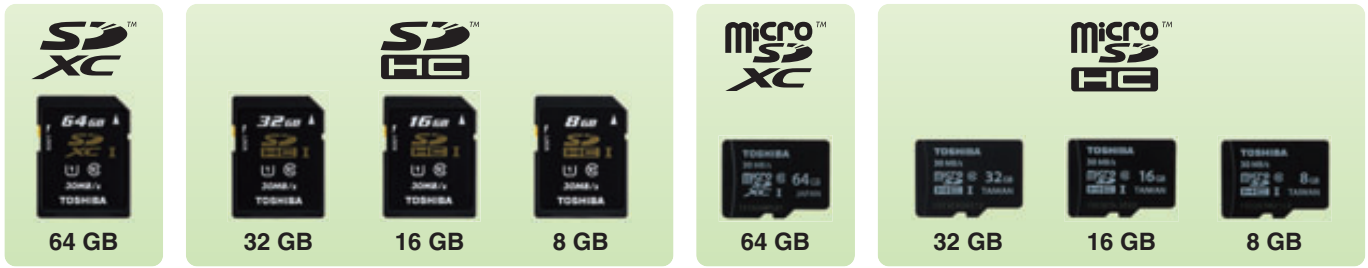
microSDHC UHS-I, SD Speed Class 10

Compatibility Considerations
*1: Maximum data transfer speeds can be achieved on devices supporting the high-speed SD bus interface UHS-I (104 MB/s).
*2: SDXC memory cards exceeding 32 GB in capacity employ a new exFAT file system, and cannot be used on devices that support SD/SDHC memory cards. They can be used on devices compliant with SDXC specifications.

Standard Series

Toshiba offers Standard media cards shown below with UHS-I, a high-speed bus interface, or a bus interface capable of operating at frequencies up to 50 MHz. These media cards can be used with a variety of different applications.

SDHC/SDXC(*2) Memory Cards, microSDHC and microSDXC(*2) Memory Cards



UHS-I, SD Speed Class 10

SDHC Memory Cards, microSDHC Memory Cards

SD Speed Class 4

▶ FlashAir™

FlashAir™ is an SD memory card with embedded wireless LAN functionality. It allows users to receive and transmit image, video and other files wirelessly.

Product Outline

- Compliant with the SD memory card standard.
- SHDC Speed Class 10
- Capacity: 8 GB, 16GB, 32 GB
- Compliant with IEEE802.11b/g/n.
- Supports HTTP/HTTPS protocols to enable interactions withWeb applications from a standard browser.
- Allows access from PCs and smartphones using server functions.
- Offers application software for smartphones and tablets.

FlashAir™

8 GB 16 GB 32 GB

■ Wireless LAN Specifications

Compliant standard	IEEE802.11b/g/n (2.4 GHz SISO, 20 MHz)
Modulation	DSSS/CCK (1, 2, 5.5, 11 Mbps), OFDM (6 to 72.2 Mbps)
Wireless LAN security	WEP, TKIP, AES (WPA/WPA2)
Wireless QoS	EDCA (WMM)
Others	Infrastructure-STA, Infrastructure-AP, WPS-enrollee

■ Networking Specifications

Supported protocol	TCP/IP (IPv4)
Server functionality	HTTP Server, DHCP Server
Client functionality	HTTP, DHCP, DNS, NETBIOS

USB Flash Memory TransMemory

USB flash drives are compact memory devices designed to meet the user needs for portability. They provide a convenient means of transferring data at offices and for sharing photos among friends. A USB flash drive is recognized automatically when you plug it into a USB port on a PC, etc.

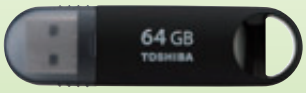
■ USB 3.0-Compliant TransMemory-Ex™

Designed with USB 3.0 ports, TransMemory-Exoffers maximum sequential data transfer rates of 220 MB/s for reading and 94 MB/s for writing, allowing users to transfer large amounts of data quickly.

Capacity	32 GB	64 GB

■ USB 3.0-Compliant TransMemory-Mx™

Offers a sequential read speed of 70 MB/s due to the use of a USB 3.0 port, allowing users to transfer large amounts of data quickly.



	8 GB	16 GB	32 GB	64 GB
Black	✔	✔	✔	✔
White		✔	✔	

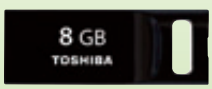
■ TransMemory™

Available in four color variations.
You can use memory sticks of different colors for different purposes.

	4 GB	8 GB	16 GB	32 GB	64 GB
White	✔	✔	✔	✔	✔
Orange		✔	✔		
Light Blue		✔	✔		
Blue		✔	✔		

■ TransMemory-mini™

TransMemory-mini is a variant of Trans-Memory with a smaller form factor. Thus, it is easy to carry in a pencil case.



	8 GB	16 GB	32 GB
Black	✔	✔	✔
White	✔	✔	

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Semiconductor & Storage Products Company

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Memory Storage Devices