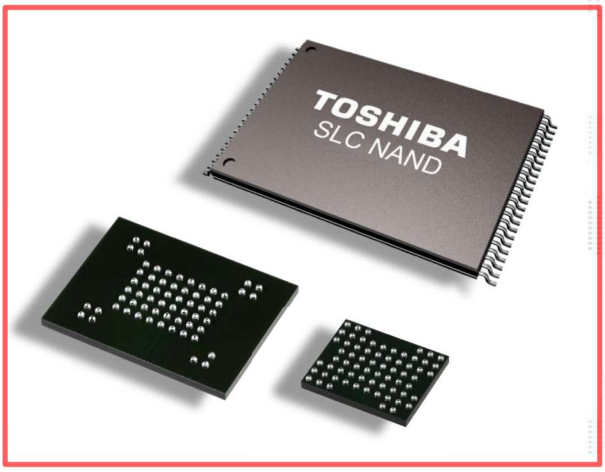
TOSHIBA
Leading Innovation

NAND FLASH MEMORY

SLC NAND & BENAND

Reliability and Performance



Toshiba's SLC NAND advanced flash memory products provide cutting-edge endurance and data retention for sensitive or frequently used system data. For long-lasting products or systems working with extremely high data throughput between the host and the memory, Toshiba's SLC is a suitable solution.

Toshiba's new BENAND™ removes the burden of error correction code (ECC) from the host processor by embedding ECC directly in the hardware while maintaining the same specifications, reliability and performance as raw SLC NAND.

INVENTOR OF FLASH MEMORY

APPLICATIONS

- Industrial
- Consumer Electronics
- Multimedia
- Smart Metering & Intelligent Lighting

FEATURES

- **SLC NAND 24nm**
  - 1Gb – 128Gb
  - Extended temperature range
  - TSOP and BGA package
- **BENAND 24nm**
  ➔Built-in ECC SLC NAND
- 1Gb – 8Gb
- On-chip H/W ECC
- Same reliability and performance as raw SLC
- Same hardware interface and package as raw SLC

ADVANTAGES

- Broad lineup to meet customer demand for different densities
- 24nm technology for cost optimization
- Long data retention, extreme write/erase performance
- Small package available to reduce board space
- No ECC operation is required on the host side (BENAND)
- Produced in Toshiba's cutting-edge technology flash factory

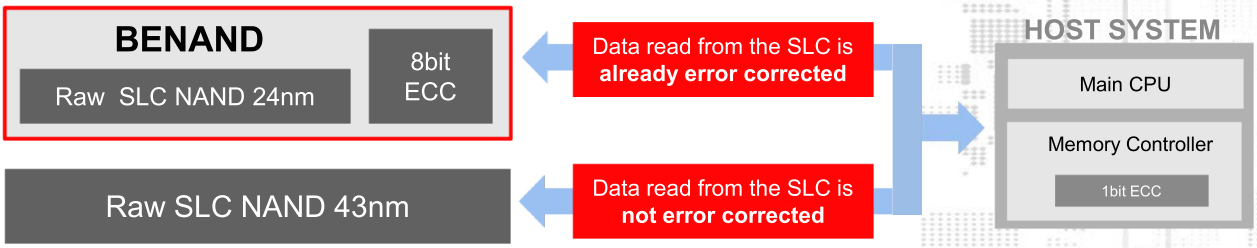
BENEFITS

- A suitable solution for long-lasting storage of significant or frequently changed data
- Reduced BOM cost due to latest 24nm production technology
- Supports smaller board size (e.g. for mobile devices)
- Using Toshiba BENAND, it is possible to utilize the latest 24nm SLC NAND flash technology even if the existing platform cannot support higher bit ECC. **No hardware change necessary.**

SPECIFICATIONS

Product / Features	SLC NAND	BENAND™ (SLC+ECC)
Density	1Gb – 128Gb	1Gb – 8Gb
Technology	24nm	
ECC (Error Correction Code)	Required on Host Side	Embedded on Memory Chip
Temperature	-40°C to 85°C 0°C to 70°C	
Package	TSOP and BGA	

BENAND – SLC WITH EMBEDDED ECC FOR BOM REDUCTION AND SYSTEM FLEXIBILITY



SLC NAND – PRODUCT LIST

Density	Part Number	Techn.	Page Size	Vcc	ECC	Temperature	Package
1Gb	TC58NVG0S3HTA00	24nm	(2048+128)x8 bit	3.3V	8bit/512B	0°C to 70°C	48TSOP 12x20
	TC58NYG0S3HBAI4	24nm	(2048+128)x8 bit	1.8V	8bit/512B	-40°C to 85°C	63BGA 9x11
	TC58NVG0S3HTAI0	24nm	(2048+128)x8 bit	3.3V	8bit/512B	-40°C to 85°C	48TSOP 12x20
	TC58NVG0S3HBAI4	24nm	(2048+128)x8 bit	3.3V	8bit/512B	-40°C to 85°C	63BGA 9x11
	TC58NYG0S3HBAI6	24nm	(2048+128)x8 bit	1.8V	8bit/512B	-40°C to 85°C	67BGA 6.5x8
	TC58NVG0S3HBAI6	24nm	(2048+128)x8 bit	3.3V	8bit/512B	-40°C to 85°C	67BGA 6.5x8
2Gb	TC58NVG1S3HTA00	24nm	(2048+128)x8 bit	3.3V	8bit/512B	0°C to 70°C	48TSOP 12x20
	TC58NYG1S3HBAI4	24nm	(2048+128)x8 bit	1.8V	8bit/512B	-40°C to 85°C	63BGA 9x11
	TC58NVG1S3HTAI0	24nm	(2048+128)x8 bit	3.3V	8bit/512B	-40°C to 85°C	48TSOP 12x20
	TC58NVG1S3HBAI4	24nm	(2048+128)x8 bit	3.3V	8bit/512B	-40°C to 85°C	63BGA 9x11
	TC58NYG1S3HBAI6	24nm	(2048+128)x8 bit	1.8V	8bit/512B	-40°C to 85°C	67BGA 6.5x8
	TC58NVG1S3HBAI6	24nm	(2048+128)x8 bit	3.3V	8bit/512B	-40°C to 85°C	67BGA 6.5x8
4Gb	TH58NVG2S3HTA00	24nm	(2048+128)x8 bit	3.3V	8bit/512B	0°C to 70°C	48TSOP 12x20
	TC58NVG2S0HTA00	24nm	(4096+256)x8 bit	3.3V	8bit/512B	0°C to 70°C	48TSOP 12x20
	TC58NVG2S0HTAI0	24nm	(4096+256)x8 bit	3.3V	8bit/512B	-40°C to 85°C	48TSOP 12x20
	TH58NVG2S3HTAI0	24nm	(2048+128)x8 bit	3.3V	8bit/512B	-40°C to 85°C	48TSOP 12x20
	TH58NVG2S3HBAI4	24nm	(2048+128)x8 bit	3.3V	8bit/512B	-40°C to 85°C	63BGA 9x11
	TH58NYG2S3HBAI4	24nm	(2048+128)x8 bit	1.8V	8bit/512B	-40°C to 85°C	63BGA 9x11
	TC58NVG2S0HBAI4	24nm	(4096+256)x8 bit	3.3V	8bit/512B	-40°C to 85°C	63BGA 9x11
	TC58NYG2S0HBAI4	24nm	(4096+256)x8 bit	1.8V	8bit/512B	-40°C to 85°C	63BGA 9x11
	TC58NVG2S0HBAI6	24nm	(4096+256)x8 bit	3.3V	8bit/512B	-40°C to 85°C	67BGA 6.5x8
	TC58NYG2S0HBAI6	24nm	(4096+256)x8 bit	1.8V	8bit/512B	-40°C to 85°C	67BGA 6.5x8
8Gb	TH58NVG3S0HTA00	24nm	(4096+256)x8 bit	3.3V	8bit/512B	0°C to 70°C	48TSOP 12x20
	TH58NVG3S0HBAI4	24nm	(4096+256)x8 bit	3.3V	8bit/512B	-40°C to 85°C	63BGA 9x11
	TH58NYG3S0HBAI4	24nm	(4096+256)x8 bit	1.8V	8bit/512B	-40°C to 85°C	63BGA 9x11
	TH58NVG3S0HTAI0	24nm	(4096+256)x8 bit	3.3V	8bit/512B	-40°C to 85°C	48TSOP 12x20
	TH58NVG3S0HBAI6	24nm	(4096+256)x8 bit	3.3V	8bit/512B	-40°C to 85°C	67BGA 6.5x8
	TH58NYG3S0HBAI6	24nm	(4096+256)x8 bit	1.8V	8bit/512B	-40°C to 85°C	67BGA 6.5x8
16Gb	TH58NVG4S0FTA20	32nm	(4096+256)x8 bit	3.3V	4bit/512B	0°C to 70°C	48TSOP 12x20
	TH58NVG4S0FTAK0	32nm	(4096+256)x8 bit	3.3V	4bit/512B	-40°C to 85°C	48TSOP 12x20
	TH58NVG4S0FBAID	32nm	(4096+256)x8 bit	3.3V	4bit/512B	-40°C to 85°C	63BGA 10x11
	TH58NVG4S0HTA20	24nm	(4096+256)x8 bit	3.3V	8bit/512B	0°C to 70°C	48TSOP 12x20
	TH58NVG4S0HTAK0	24nm	(4096+256)x8 bit	3.3V	8bit/512B	-40°C to 85°C	48TSOP 12x20
32Gb	TC58NVG5H2HTA00	24nm	(8192+1024)x8 bit	3.3V	24bit/1024B	0°C to 70°C	48TSOP 12x20
	TC58NVG5H2HTAI0	24nm	(8192+1024)x8 bit	3.3V	24bit/1024B	-40°C to 85°C	48TSOP 12x20
64Gb	TH58NVG6H2HTAK0	24nm	(8192+1024)x8 bit	3.3V	24bit/1024B	-40°C to 85°C	48TSOP 12x20
128Gb	TH58NVG7H2HTA20	24nm	(8192+1024)x8 bit	3.3V	24bit/1024B	0°C to 70°C	48TSOP 12x20

BENAND™ – PRODUCT LIST

Density	Part Number	Techn.	Page Size	Vcc	ECC	Temperature	Package
1Gb	TC58BVG0S3HTA00	24nm	(2048+64)x8 bit	3.3V	internal ECC	0°C to 70°C	48TSOP 12x20
	TC58BYG0S3HBAI4	24nm	(2048+64)x8 bit	1.8V	internal ECC	-40°C to 85°C	63BGA 9x11
	TC58BVG0S3HTAI0	24nm	(2048+64)x8 bit	3.3V	internal ECC	-40°C to 85°C	48TSOP 12x20
	TC58BVG0S3HBAI4	24nm	(2048+64)x8 bit	3.3V	internal ECC	-40°C to 85°C	63BGA 9x11
	TC58BYG0S3HBAI6	24nm	(2048+64)x8 bit	1.8V	internal ECC	-40°C to 85°C	67BGA 6.5x8
	TC58BVG0S3HBAI6	24nm	(2048+64)x8 bit	3.3V	internal ECC	-40°C to 85°C	67BGA 6.5x8
2Gb	TC58BVG1S3HTA00	24nm	(2048+64)x8 bit	3.3V	internal ECC	0°C to 70°C	48TSOP 12x20
	TC58BYG1S3HBAI4	24nm	(2048+64)x8 bit	1.8V	internal ECC	-40°C to 85°C	63BGA 9x11
	TC58BVG1S3HTAI0	24nm	(2048+64)x8 bit	3.3V	internal ECC	-40°C to 85°C	48TSOP 12x20
	TC58BVG1S3HBAI4	24nm	(2048+64)x8 bit	3.3V	internal ECC	-40°C to 85°C	63BGA 9x11
	TC58BYG1S3HBAI6	24nm	(2048+64)x8 bit	1.8V	internal ECC	-40°C to 85°C	67BGA 6.5x8
	TC58BVG1S3HBAI6	24nm	(2048+64)x8 bit	3.3V	internal ECC	-40°C to 85°C	67BGA 6.5x8
4Gb	TH58BVG2S3HTA00	24nm	(2048+64)x8 bit	3.3V	internal ECC	0°C to 70°C	48TSOP 12x20
	TC58BVG2S0HTA00	24nm	(4096+128)x8 bit	3.3V	internal ECC	0°C to 70°C	48TSOP 12x20
	TC58BVG2S0HTAI0	24nm	(4096+128)x8 bit	3.3V	internal ECC	-40°C to 85°C	48TSOP 12x20
	TH58BVG2S3HTAI0	24nm	(2048+64)x8 bit	3.3V	internal ECC	-40°C to 85°C	48TSOP 12x20
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8Gb	TH58BVG3S0HTA00	24nm	(4096+128)x8 bit	3.3V	internal ECC	0°C to 70°C	48TSOP 12x20
	TH58BYG3S0HBAI4	24nm	(4096+128)x8 bit	1.8V	internal ECC	-40°C to 85°C	63BGA 9x11
	TH58BVG3S0HTAI0	24nm	(4096+128)x8 bit	3.3V	internal ECC	-40°C to 85°C	48TSOP 12x20
	TH58BVG3S0HBAI4	24nm	(4096+128)x8 bit	3.3V	internal ECC	-40°C to 85°C	63BGA 9x11
	TH58BVG3S0HBAI6	24nm	(4096+128)x8 bit	3.3V	internal ECC	-40°C to 85°C	67BGA 6.5x8
	TH58BYG3S0HBAI6	24nm	(4096+128)x8 bit	1.8V	internal ECC	-40°C to 85°C	67BGA 6.5x8

Product density is identified based on the maximum density of memory chip(s) within the Product, not the amount of memory capacity available for data storage by the end user Consumer-usable capacity will be less due to overhead data areas, formatting, bad blocks, and other constraints, and may also vary based on the host device and application.

Maximum read and write speed may vary depending on the host device, read and write conditions, and file size.

KIOXIA

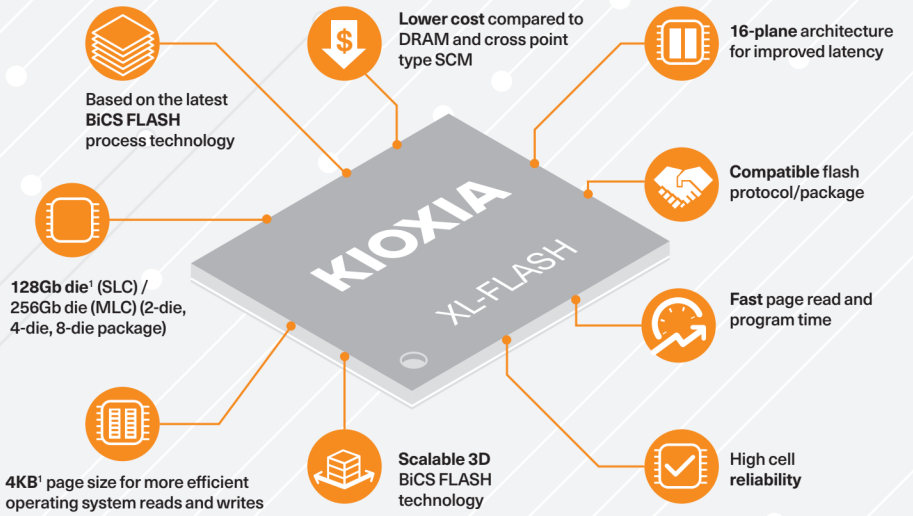
XL-FLASH: Designed for Speed

KIOXIA delivers flash-based products for next-generation storage applications. Having invented NAND flash memory over 35 years ago, KIOXIA is now one of the world's largest flash memory suppliers – and continues to move the technology forward.

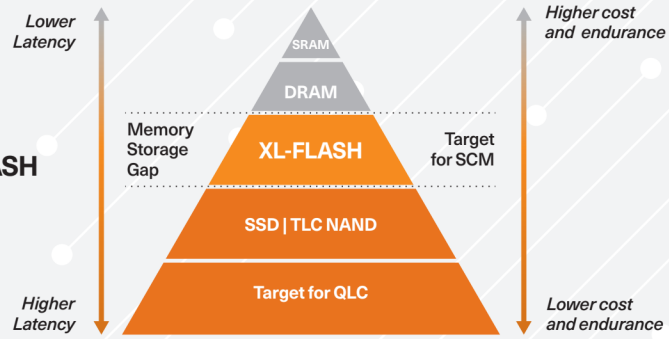
What is XL-FLASH?

XL-FLASH is extremely low-latency, high-performance flash memory that is based on KIOXIA's BiCS FLASH™ 3D flash memory technology. It was designed to address the performance gap between existing volatile memories and flash memory. XL-FLASH is classified as Storage Class Memory (or persistent memory), meaning RAM with the ability to retain its contents like flash memory – bridging the performance gap of DRAM and flash memory. Easy to manage and scale, XL-FLASH features a 128 gigabit (Gb) die for SLC / 256 gigabit (Gb) die for MLC (in a 2-die, 4-die, 8-die package), a 4kB page size for more efficient operating system reads and writes, fast page read and program times, and a low read latency.

KEY FEATURES



Where does XL-FLASH fit in the Memory Hierarchy?



BiCS FLASH: Accelerating Beyond 2D

Aug. 2022 — 256Gb die MLC XL-FLASH introduced

Aug. 2019 — XL-FLASH 128Gb[1] die introduced

Aug. 2018 — XL-FLASH concept introduced at Flash Memory Summit

Jul. 2018 — Achieved industry's highest single-chip capacity of 1.33Tb[1,2] (QLC BiCS FLASH)

Jun. 2017 — First to introduce 4-bit-per-cell technology[3] (QLC BiCS FLASH)

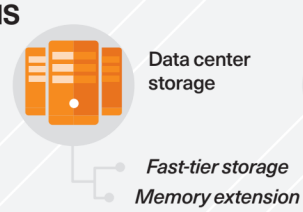
Aug. 2015 — First to introduce 256Gb[1] 48-layer memory chip[4] (TLC BiCS FLASH)

BiCS FLASH™

Jun. 2007 — First to announce 3D flash memory technology[5]

APPLICATIONS

Targeting the Storage Class Memory (SCM) layer between DRAM and NAND



$2 Billion *2024*

The Storage Class Memory market is expected to reach in excess of $2 billion in 2024[6].

Source: IDC, 2021

"With XL-FLASH, we are giving hyperscalers and enterprise server/storage providers a more cost-effective, lower latency storage solution that bridges the gap between DRAM and flash memory performance."

***– Scott Nelson,** Senior Vice President and General Manager, Memory Business Unit, KIOXIA*

[1] Product density is identified based on the density of memory chip(s) within the Product, not the amount of memory capacity available for data storage by the end user. Consumer-usable capacity will be less due to overhead data areas, formatting, bad blocks, and other constraints, and may also vary based on the host device and application. Density definitions: 1Gb = 2^30 bits = 1,073,741,824 bits, 1KB = 2^10 bytes = 1,024 bytes, 1Tb = 2^40 bits = 1,099,511,627,776 bits.
[2] KIOXIA Survey: July 2018
[3] KIOXIA Survey: June 2017
[4] KIOXIA Survey: August 2015,
[5] KIOXIA VLSI Presentation: June 2007
[6] IDC May 2021 - Worldwide Solid State Storage Forecast, 2021-2025, Doc # US46412021

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