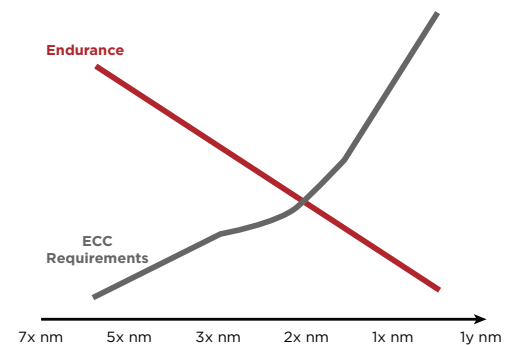# SanDisk®
a Western Digital brand

GUARDIAN TECHNOLOGY™
PLATFORM

Introduction

Due the industry's push to smaller lithography in the roadmap, the cost of NAND has continued to decrease. However, with each drop in the process node, endurance and reliability of the NAND flash decreases, going against the needs of enterprise environments where data reliability and integrity are critical.

Historically, the issue of endurance and reliability was addressed by adding Error Correcting Code (ECC) capability to the SSD controller. This approach is no longer sufficient as enterprise environments require higher endurance, predictable performance and reliability. To make SSDs viable in the data center, a new approach to overcoming NAND flash's inherent endurance and reliability limitations is required so that enterprise-grade SSDs can become both more cost-effective and meet enterprise application requirements.

Endurance

ECC Requirements

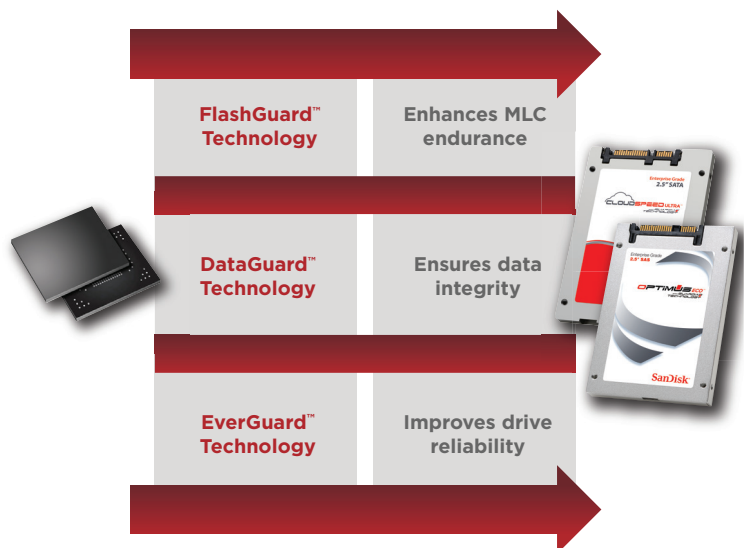| 7x nm | 5x nm | 3x nm | 2x nm | 1x nm | 1y nm |

Guardian Technology™ Platform

The award-winning Guardian Technology Platform from SanDisk® is a proprietary suite of enterprise features and endurance enhancement technologies designed to make the most cost effective NAND flash enterprise ready. Because of SanDisk's vertical integration and ownership of the flash, the Guardian Technology Platform and NAND have been designed to work seamlessly with each other, taking full advantage of the endurance, performance and reliability enhancements the platform provides.
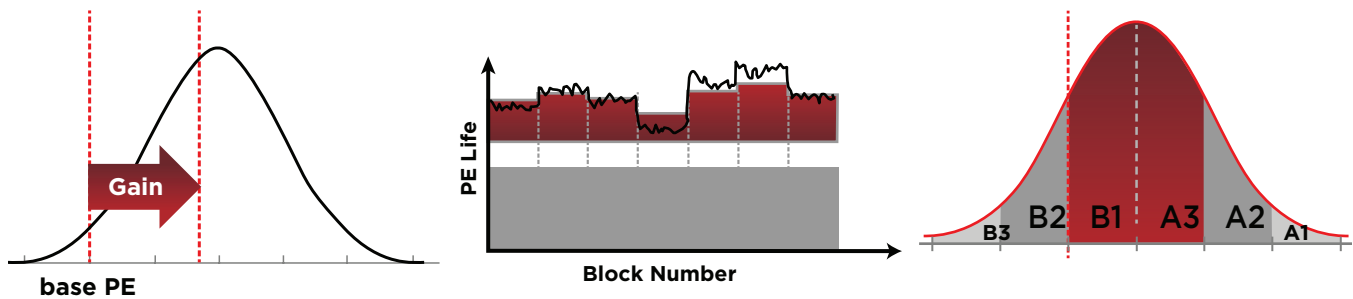
SanDisk's Guardian Technology Platform is comprised of the following technologies:

- FlashGuard™ Technology reliably extracts significantly more usable life from MLC flash than provided by the standard specifications of the flash;
- DataGuard™ Technology provides full data path protection ensuring that user data will be safe throughout the entire data path, and provides the ability to recover data from failed page and NAND blocks;
- EverGuard™ Technology prevents the loss and corruption of user data during unexpected power interruptions.

FlashGuard™ Technology — Enhances MLC endurance

DataGuard™ Technology — Ensures data integrity

EverGuard™ Technology — Improves drive reliability

FlashGuard™ Technology

Leveraging two innovative technologies, Aggregated Flash Management and Advanced Signal Processing, and a mix of flash grades, FlashGuard technology extends the endurance of commercial grade MLC NAND flash to meet enterprise application endurance and reliability requirements.

Aggregated Flash Management

- Utilizes average endurance of all die within the SSD
- SSD flash population endurance is greater than the sum of individual components

Advanced Signal Processing

- Provides adaptive programming of flash parameters throughout the life of the device
- Includes algorithms for adaptive programming developed based on extensive flash characterization
- Ensures each flash block is used to its maximum endurance capability
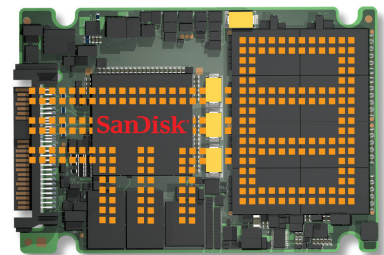
Intelligent Flash Mixing

- Takes advantage of fab data
- Provides intelligent mixing of "graded" die/wafer
- Ensures each drive has right mix of grades

DataGuard™ Technology

DataGuard technology features full data path protection, safeguarding user data from corruption along all data paths in the SSD, such that SanDisk SSDs are specified to a BER of 10^{17}, offering:
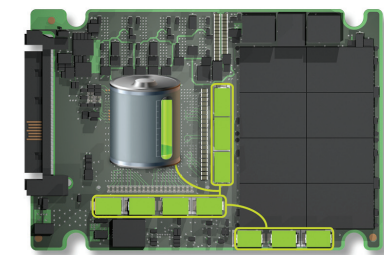
- T10-DIF (Data Integrity Field) for host control
- F.R.A.M.E. (Flexible Redundant Array of Independent Memory Elements)
  - Cross-die data redundancy
  - Data recovering on failed or blocked page

EverGuard™ Technology

EverGuard technology protects against loss of user data in the event of unexpected power interruptions using a 3rd generation backup power circuitry design and high-reliability discrete capacitors.

- Protects data loss upon power failure
- Ensures no degradation over time
- Rated for high temperatures

25 years of storage innovation

At SanDisk, we're expanding the possibilities of data storage. For more than 25 years, SanDisk's ideas have helped transform the industry, delivering next generation storage solutions for consumers and businesses around the globe.

For more information, please visit:
www.sandisk.com/enterprise

SanDisk®
a Western Digital brand