



High-Temperature Discrete and Managed NAND Solutions

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Agenda

- Embedded Temperature Ranges
- Why Temperatures Above 85°C?
- Comparison of NAND-Based Solutions
- NVM Trends
- High-Temperature Data Integrity Challenges
- Summary

Embedded Temperature Ranges

- Commercial: 0°C to 70°C
 - Cost-optimized
- Industrial (IT): -40°C to 85°C
 - Uncontrolled temperature environments
- Beyond industrial: -40°C up to 105°C
 - Demonstrated to exceed 85°C

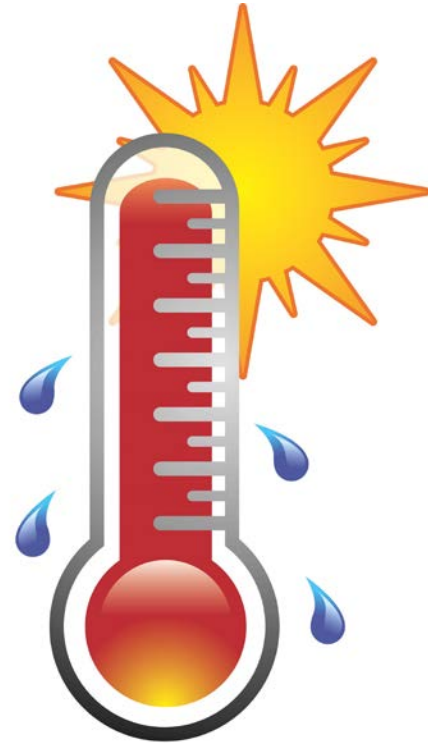


Focus is on “beyond industrial”



Why Temperatures Above 85°C?

- Fanless and quiet
- Small and cute
- Thermal suffocation
- Increased electronics in automotive with higher temperatures
 - Automakers are jointly defining temperature ranges that exceed 85°C



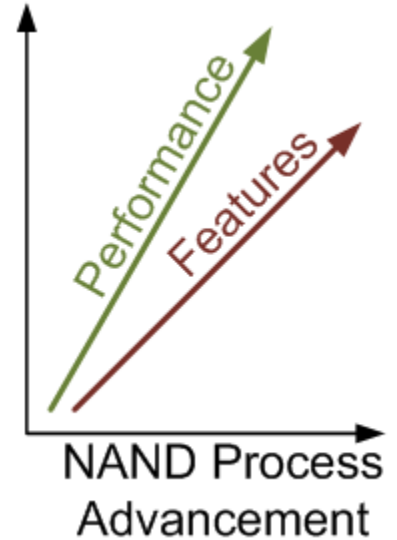
Comparison of NAND-Based Solutions

	Discrete NAND	e.MMC	SSD
Density range	16MB to 64GB	2GB to 128GB	2GB to 512GB
Temperature range	-40°C to 105°C	-40°C to 105°C	-40°C to 85°C
Media management effort	Low to High	Low	Low

- All solutions are essential across the entire range of high-temperature embedded applications
- Choice depends heavily on density and willingness to manage NAND media

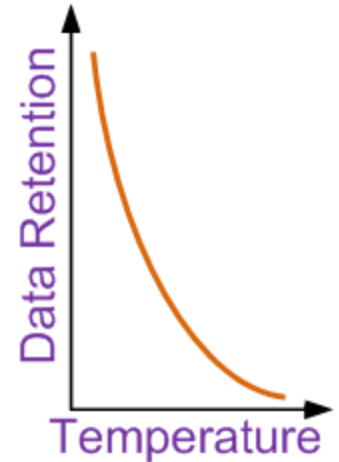
NVM Trends

- Improved NAND performance
- Improved discrete NAND usability
- Low-density NAND still needed
- More aggressive product qualifications



High-Temperature Data Integrity Challenges

- High temperatures make data retention worse
- Higher temp → wider X-temp → rel challenges
 - SLC to improve P/E cycling and data retention
 - Relaxation of cold temperature extreme
- Data refresh is an important consideration
 - Longer product life (in excess of 15 years)
 - Sustained high temperatures



Summary

- Maximum embedded temperatures are rising
- Embedded product life is increasing
 - Discrete and managed NAND are fulfilling these requirements
- High-temperature data integrity issues must be solved at all levels of integration