A Robust Automotive Grade-0 Embedded Flash Technology

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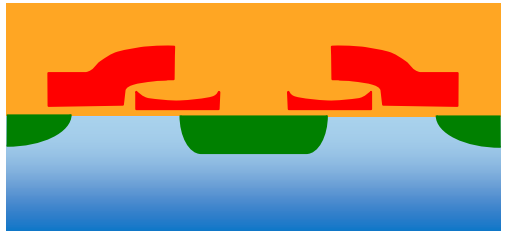
August 8, 2024

Requirements for Embedded Non-Volatile Memory (NVM) in Automotive Grade-0 Applications

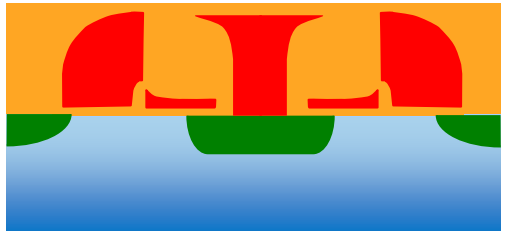
- **High temperature:** Performance and reliability at junction temperature 175°C
- **High speed:** Fast erase, program and read; Low latency; Important for time-sensitive task execution
- **Low power:** Low power consumption in both active and inactive modes; Important for battery conservation and heat dissipation
- **High endurance:** 100K-200K for data storage and EEPROM emulation; 1K-20K for code storage
- **High data retention:** Data integrity over 20 years or more, at elevated temperatures
- **Low bit error rate:** Wide read margin throughout device lifetime, at all PVT corners
- **Low cost:** Competitive cost of product development, wafer manufacturing and testing
- **Resistance to harsh environment:** Temperature / voltage fluctuations, electromagnetic interference and radiation
- **Density scalability:** Easy scaling to higher density; Enables flexible expansion of product family
- **Logic compatibility:** Minimal disruption to platform logic device performance; IP compatibility between pure logic and embedded flash processes
- **Functional safety:** Compliance to safety standards; Safety mechanisms to detect and mitigate impending failure
- **Rigorous test screen:** Detection of active defects as well as latent defects
- **Rigorous qualification:** JEDEC and AEC-Q100 compliance; Reliability over temperature mission profile; Reliability projection based on statistical data collection and modeling

SuperFlash® Technology

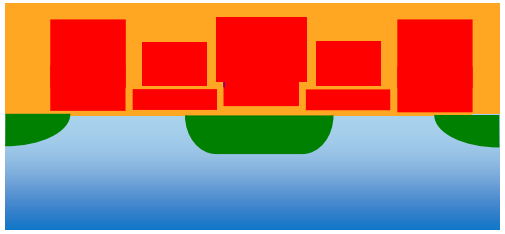
ESF1



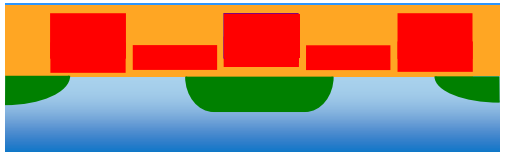
ESF2



ESF3

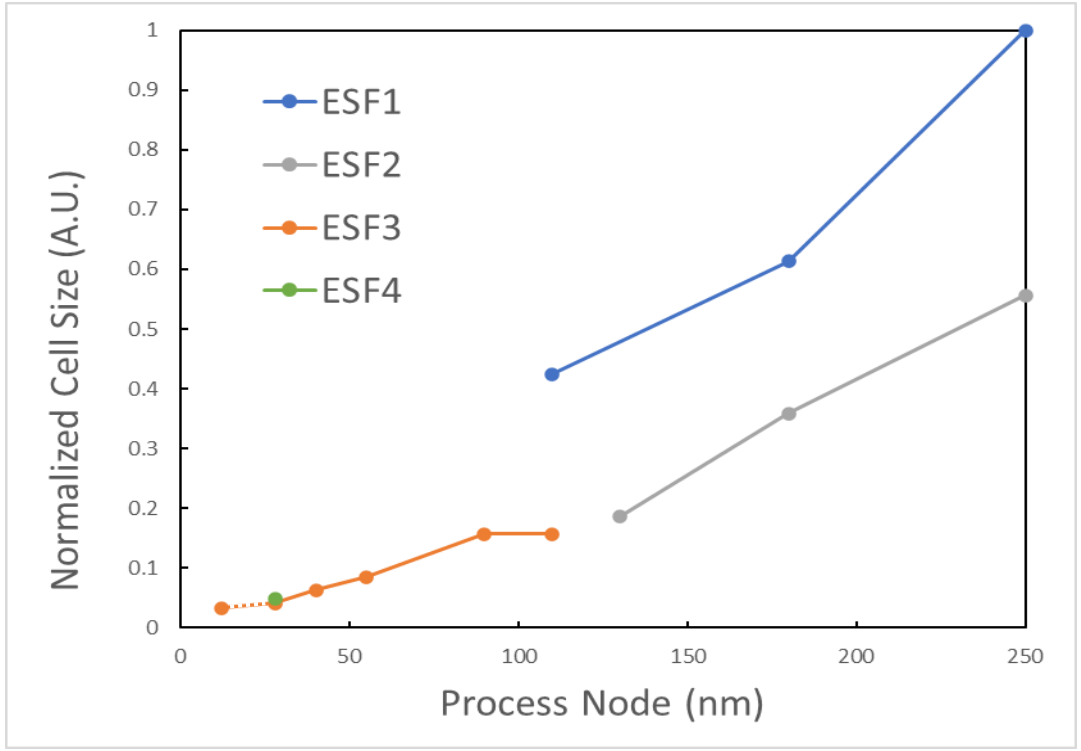


ESF4



- SuperFlash Technology is the leader in embedded flash technologies
- Over the past 35 years, SuperFlash Technology has evolved through 4 generations
- All generations share the same performance and reliability advantages:
  - Logic-compatible integration of memory cell and HV devices
  - Split-gate architecture enables low-power, high-speed read, wide read window, and simple erase/program/read operation
  - Corner-enhanced poly-to-poly tunneling enables low-power, high-speed erase
  - Source-side hot electron injection enables a low-power, high-speed program
  - Simple erase, program and read operations
  - Cell is free of Stress Induced Leakage Current (SILC) and has robust reliability
- It is widely used in security, IoT, general purpose and automotive MCUs

SuperFlash® Technology Scaling



- SuperFlash Technology has been scaled steadily into advanced nodes
- It is widely available in major foundries

SuperFlash® Technology Capabilities in Automotive Grade-0 Market

	ESF1	ESF3
Temperature Range	-40°C to 175°C	-40°C to 175°C
Raw Bit Error Rate	≤1e-9	≤1e-9
Read Speed	25-33 ns	8-20 ns
Erase Speed	1-10 ms / sector, block, or chip	1-20 ms / sector, block, or chip
Program Speed	20 us / word	5-10 us / word
Active Power for Read / Erase / Program	0.3-0.5 mA per MHz / 2-5mA / 4-5mA	0.3-0.5 mA per MHz / 2-5mA / 4-5mA
Data Retention	20 years at 125C	20 years at 125C
Endurance	10K – 100K	100K – 200K
Mask Adder for cell and HV devices	3-5	7-13 in 40 nm and above; 10-18 in 28 nm and below

Functional Safety Development Process

- FuSa certification
- Dedicated safety management team
- ISO26262-compliant development process
  - Safety lifecycle management
  - Risk assessment and hazard analysis based on understanding of technology, design, and reliability
  - Design for reliability
  - Design for testability
  - Safety mechanisms for fault detection and response
  - Change management

Certificate

Functional Safety Management

FS Management (TÜV Rheinland)
Manufacturer of Semiconductors Devices, related to
ISO 26262 Road vehicles - Functional safety &
IEC 61508 E/E/PE System Realisation (Phase 10)
A-FSM 179

Certificate No.	**968/A-FSM 179.00/23**
Certified Company & Location	**Microchip Technology Inc** 2355 W. Chandler Boulevard Chandler, AZ 85224 **USA**
Scope of Certification	Manufacturer of Semiconductors Devices, related to **ISO 26262-2:2018 Management of functional safety** **ISO 26262-4:2018 (in extracts) Product development at the system level** **ISO 26262-5:2018 Product development at the hardware level** **ISO 26262-6:2018 Product development at the software level** **ISO 26262-7:2018 Supporting processes** **ISO 26262-8:2018 (in extracts) ASIL-oriented and safety-oriented analyses** **ISO 26262-9:2018 Production, operation, service and decommissioning** and **IEC 61508-1:2010 General requirements** **IEC 61508-2:2010 (in extracts) Requirements for E/E/PE System Realization (Phase 10)** **IEC 61508-3:2010 (in extracts) Software requirements**

MICROCHIP

A Microchip Technology Company

Automotive Grade-0 SuperFlash® Technology Readiness

- ESF1 180nm in production
- ESF1 130nm in production
- ESF3 55nm in development
- ESF3 40nm qualified
- ESF3 28nm in qualification

Thank you!

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