Solving functional safety challenges in Automotive with NOR Flash Memory

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Automotive Megatrends

- Totally Connected Car
- Levels 1 – 5
- Intuitive & Responsive
- Electrified Transportation

Connectivity
Autonomous
HMI
Electrification
Autonomous Driving – Evolution

Key Benefits
- Higher Safety Levels
- Reduced Emissions
- Increased productivity
- Improved Mobility
Challenges Facing Next-Gen Automotive Systems

Need safe, secure, and reliable external NOR Flash memories for code and data storage

- Heterogenous Architectures
- Real-Time Sensor Processing
- Safety and Reliability
- Security
- Software Complexity
- High-Speed Connectivity

!(Embedded Flash)
ADAS System Solution
Instrument Cluster System Solution
How Safety is Implemented in Automotive Today

Vehicle Manufacturer
- List of Systems and their ASIL level

System Suppliers

Component Supplier

ISO26262 Processes
- ASIL D System
- Development Interface Agreement (DIA)

Detection and Management
- Random and Systematic Faults
- Single-Point Faults – 99% for ASIL-D System
- Latent Faults – 90% for ASIL-D System
- Probabilistic Metric Hardware Faults – 10-9h-1
- Fault-Tolerant Time Interval – 10ms

Safety Documentation
- Safety manual
- Failure Mode Effects and Diagnostic Analysis (FMEs)
- Dependent Failure Analysis (DFA)
- Safety Element Out of Context (SEooC)
- Hardware Safety Requirements (HWSRs)
# Functional Safety in NOR Flash

Diagnostics Provide the System with Critical NOR Flash Device Status

<table>
<thead>
<tr>
<th>Category</th>
<th>Function</th>
<th>Provides</th>
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</thead>
<tbody>
<tr>
<td>Data Integrity</td>
<td>ECC (SECDED)</td>
<td>Error detection and correction over memory array</td>
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<tr>
<td></td>
<td>Data Integrity Check</td>
<td>Error detection over memory array</td>
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<td></td>
<td>Interface CRC</td>
<td>Error detection over memory interface</td>
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<td></td>
<td>Sector Protection</td>
<td>Prevents inadvertent writes to the device</td>
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<tr>
<td>Embedded Operation</td>
<td>SafeBoot</td>
<td>Reporting of proper flash device initialization</td>
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<tr>
<td>Error Reporting</td>
<td>Program Operation</td>
<td>Reporting of program failure</td>
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<tr>
<td></td>
<td>Erase Operation</td>
<td>Reporting of erase failure</td>
</tr>
<tr>
<td></td>
<td>Erase Status</td>
<td>Reporting of erase failure for sector selected by Evaluate Erase Status instruction</td>
</tr>
<tr>
<td></td>
<td>Memory CRC</td>
<td>Reporting abort of CRC calculation</td>
</tr>
<tr>
<td>Operational Recovery</td>
<td>Configuration Data Corruption</td>
<td>Rebooting in SPI mode allowing host to program configuration registers</td>
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<td></td>
<td>(Brown-out during Register Write)</td>
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<td></td>
<td>Safe Reset</td>
<td>Graceful hardware system recovery using existing SPI signals</td>
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<tr>
<td></td>
<td>Sector Erase Power Loss Detection</td>
<td>Erase power loss indicator status flag for each sector</td>
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Next-Generation System Requirements for Memory

Functional safety from product definition through production in accordance with ISO 26262 and IEC 61508

Highest reliability and integrity of critical data, and early detection of possible failures

Scalable, high-density, high-performance interfaces that provide code and data storage and instant-on functionality

Zero-defect quality management processes and established longevity of supply
Semper NOR Flash Family Architecture

FEATURES

Functional Safety
- Architected and designed to automotive safety standards
- ASIL-B-compliant and ASIL-D ready

Best Reliability and Endurance
- EnduraFlex™ architecture enables >1M endurance cycles and 25 years data retention
- Grade-1 (125C) automotive qualified

Highest Density
- MirrorBit® technology delivers up to 4Gb with 400MB/s JEDEC xSPI