A Scalable Next-Generation NOR type Flash

- Market requires More Features in Flash -

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Market requires More Features in Flash

For Example:

- Advanced Vehicle Systems
  - Electrically Robust Storage
  - High Speed Data Transaction
  - High Density Program Storage

- Industrial IoT
  - XIP Memory with Data Storage
  - Shut-Down Store Memory
  - High Reliable Program Storage

- More Wearables
  - High Density XIP Memory
  - Hybrid Storage for Data & Program

New Flash with:
- Fast Read
- Fast Write
- High Reliability
- High Density
  all in one

NEXT GENERATION NOR
B4-Flash is the Innovation of Flash Physics

**NOR**
- Read Speed: Fast
- Scaling: NG
- Prog: Slow
- Erase: Slow

**NAND**
- Read Speed: Fast
- Scaling: Excellent
- Prog: Fast
- Erase: Fast

**B4-Flash Memory**
- Read Speed: Fast
- Scaling: Good
- Prog: Fast
- Erase: Fast
- Reliability: Excellent

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B4-Flash is utilizing New Flash Mechanism
B4-Flash based on the new Flash Mechanism

B4-HE injection + Pch MOS transistor memory cell

- Fastest Re-writable and Highly Scalable NOR Flash
- High Endurance to 100K E/W and Excellent Retention of 20 years after 100K E/W

B4-Flash achieves the scalable NOR with fast re-write capability and excellent reliability.
B4-Flash is the Next Generation NOR.

- It can offer new features
B4-Flash achieves

- 100ns NOR read speed
- NAND level re-write speed
- Simultaneously.

B4-Flash includes both features of NOR and NAND

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Faster Read

For Storage

X200 Faster Read

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Faster Program Speed

0.1MB/s 1MB/s 10MB/s
# Main Features of Each Flash

<table>
<thead>
<tr>
<th>Performance</th>
<th>B4-Flash 128Mb</th>
<th>B4-Flash 512Mb</th>
<th>B4-Flash 2Gb</th>
<th>General NOR (128Mb-2Gb)</th>
<th>General NAND(SLC) (1Gb-4Gb)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Read Latency</strong></td>
<td>80ns</td>
<td>115ns</td>
<td>90ns</td>
<td>80-110ns</td>
<td>25us</td>
</tr>
<tr>
<td><strong>Page Write Latency</strong></td>
<td>150us</td>
<td>150us</td>
<td>210us</td>
<td>200-300us</td>
<td>200-300us</td>
</tr>
<tr>
<td><strong>Read Page Size</strong></td>
<td>32B</td>
<td>32B</td>
<td>32B</td>
<td>32B</td>
<td>512B-2KB</td>
</tr>
<tr>
<td><strong>Small Data Read Speed (32B)</strong></td>
<td>84MB/s</td>
<td>57MB/s</td>
<td>102MB/s</td>
<td>50-100MB/s</td>
<td>&lt;2MB/s</td>
</tr>
<tr>
<td><strong>Write Throughput</strong></td>
<td>3.3MB/s</td>
<td>6.5MB/s</td>
<td>19MB/s</td>
<td>&lt;2MB/s</td>
<td>5-15MB/s</td>
</tr>
<tr>
<td><strong>Erase Throughput</strong></td>
<td>3.3MB/s</td>
<td>40MB/s</td>
<td>62MB/s</td>
<td>&lt;1MB/s</td>
<td>30-250MB/s</td>
</tr>
<tr>
<td><strong>E/W cycles</strong></td>
<td>100K</td>
<td>100K</td>
<td>100K</td>
<td>100K</td>
<td>100K</td>
</tr>
<tr>
<td><strong>Retention</strong></td>
<td>20 yrs @125C after 100K E/W</td>
<td>20 yrs @125C after 100K E/W</td>
<td>20 yrs @125C after 100K E/W</td>
<td>10-20 yrs @55C-85C after 10K-100K E/W</td>
<td>10 yrs @55C-85C with ECC</td>
</tr>
<tr>
<td><strong>Read Cycles</strong></td>
<td>10 billion after 100K E/W</td>
<td>10 billion after 100K E/W</td>
<td>100 billion after 100K E/W</td>
<td>(Product Life ?)</td>
<td>1 million</td>
</tr>
</tbody>
</table>
Scalability of B4-Flash

- Scaling Down to 20nm
- 8F2 must be maintained and 5-6 F2 can be challenged with much more precise technology
- MLC of B4-Flash has been already done in 90nm and 58nm
- Virtual Grand Array (VGA) will be the challenge for 4F2 SLC/2F2 MLC same as 2D NAND in future
What Benefit can B4-Flash bring into Market?

- High Temp. Data Retention to 125C like in Cars
- High Density XIP Memory
- Hybrid Storage of Prog. and Data
- Wide Temp. Range Operation to 125C
- Continuous Write/Erase/Read applications
- Data Back-Up in Tough Environment

B4-Flash can bring New Benefit into Market
Applications with the benefit of B4-Flash

- Automotive
- Fuel Cell Vehicle
- Industry Equipment
- Embedded Board, PLC, POS, ATM
- High Temperature (125°C) operation machine
- FA Equipment, NC machine, Logistic System, Measurement and Analysis Instrument, Medical Equipment
- Broadcasting System
- Home Gateway
- Others
- Train Control System
- Cellphone Base Station
- Amusement Equipment
- Cellphone
- Base Station
- Smart Grid
- ADAS, Navigation, Data logger, Drive Recorder, Display
- Automotive
- Industry Equipment
- Embedded Board, PLC, POS, ATM
- High Temperature (125°C) operation machine
- FA Equipment, NC machine, Logistic System, Measurement and Analysis Instrument, Medical Equipment
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Thank you for your attention!

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