Reliability Qualification Report

for

4GB eMMC with Pb/Halogen Free (Industrial)

Issued Date: April 07, 2022
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1. Title

This report describes the reliability and qualification data of Alliance product listed below. The qualification and reliability tests have been completed successfully based on Alliance standard.

2. Product and Package Information

Product Code: ASFC4G31M-51BIN
Operating Temperature: -40°C to +85°C (Industrial)
Package Type: FBGA 153B (11.5x13.0mm, 1.0T)
Flammability: UL-V0
Solder ball: SAC305 (96.5% Sn / 3.0% Ag / 0.5% Cu)

<table>
<thead>
<tr>
<th>Top View</th>
<th>Bottom View</th>
<th>Structure</th>
</tr>
</thead>
<tbody>
<tr>
<td>![Top View Image]</td>
<td>![Bottom View Image]</td>
<td>![Structure Image]</td>
</tr>
</tbody>
</table>

3. Result Summary

- Lifetime Simulation Tests: Passed ELFR & HTOL
- Environment Stress Tests: Passed All Tests
- ESD & Latch-up: Passed HBM 2000V, CDM 500V & Latch-up ±150mA
### 4. Accelerated Lifetime Simulation Tests

<table>
<thead>
<tr>
<th>Group</th>
<th>Test Item / Conditions</th>
<th>Test Method</th>
<th>Duration or Level</th>
<th>Result</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Early Life Failure Rate</td>
<td>JESD22-A108</td>
<td>96 hours</td>
<td>0 / 1000 (Passed)</td>
<td>1, 2</td>
</tr>
<tr>
<td></td>
<td>125°C, Dynamic stress</td>
<td></td>
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<td></td>
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</tr>
<tr>
<td></td>
<td>High Temperature Operating Life</td>
<td>JESD22-A108</td>
<td>1000 hours</td>
<td>0 / 387 (Passed)</td>
<td>1, 2</td>
</tr>
<tr>
<td></td>
<td>125°C, Dynamic stress</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Endurance</td>
<td>JESD22-A117</td>
<td>3k cycles</td>
<td>0 / 231 (Passed)</td>
<td>1,2</td>
</tr>
<tr>
<td></td>
<td>25°C, Dynamic stress, Program/Read&quot;0&quot;/Erase/Read &quot;1&quot; cycling</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Data Retention</td>
<td>JESD22-A117</td>
<td>Pre E/W+ 160hrs</td>
<td>0 / 231 (Passed)</td>
<td>1,3,4</td>
</tr>
<tr>
<td></td>
<td>85°C, All bit cells programmed</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Pre E/W+ 60hrs</td>
<td>0 / 231 (Passed)</td>
<td>1,3,4</td>
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<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

**Note:**
1) Electrical test is performed before and after each item. Above data is verified by providing data randomization and 48bit/1KByte ECC with Read Retry.
2) "Dynamic stress" means continuous memory operation like read or write function.
3) 160hrs of bake time is equivalent to 3 year. 60hrs of bake time is equivalent to 1 year.
4) The user's conditions of use were calculated at 40°C
## 5. Accelerated Environment Stress Tests

<table>
<thead>
<tr>
<th>Group</th>
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<th>Test Method</th>
<th>Duration or Level</th>
<th>Result</th>
<th>Notes</th>
</tr>
</thead>
</table>
| Accelerated Environment Stress Tests | Preconditioning  
Temperature Cycling : -55°C to 125°C  
Bake : 125°C  
Soak : 30°C, 60% RH  
Reflow : 260°C | JESD22 A113 | Level 3  
5 cycles  
24 hours  
192 hours  
3 cycles | 0 / 90  
(Passed) | 1 |
|                                | Unbiased HAST  
110°C, 85% RH | JESD22-A118 | 264 hours | 0 / 45  
(Passed) | 1, 2 |
|                                | Temperature Cycling  
-65°C to 150°C | JESD22-A104 | 500 cycles | 0 / 45  
(Passed) | 1, 2 |
|                                | High Temperature Storage Life  
150°C | JESD22-A103 | 1008 hours | 0 / 45  
(Passed) | 1 |

**Note:**
1) Electrical test is performed before and after each item.
2) Preconditioning is performed before the test.
## 6. Electrical Verification Tests (Electrostatic Discharge & Latch-up)

<table>
<thead>
<tr>
<th>Group</th>
<th>Test Item / Conditions</th>
<th>Test Method</th>
<th>Duration or Level</th>
<th>Result</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ESD Human Body Model</td>
<td>JS-001-2017</td>
<td>2000V</td>
<td>0 / 15 (Pass)</td>
<td>1, 2</td>
</tr>
<tr>
<td>Electrical Verification Tests</td>
<td>ESD Charged Device Model</td>
<td>JESD22-C101</td>
<td>500V</td>
<td>0 / 3 (Pass)</td>
<td>1, 2</td>
</tr>
<tr>
<td></td>
<td>Latch-Up (I-test)</td>
<td>JESD78</td>
<td>±150mA</td>
<td>0 / 6 (Pass)</td>
<td>1, 2</td>
</tr>
</tbody>
</table>

**Note:**
1) Electrical test is performed before and after each item.
2) HBM, CDM and Latch-up tests are performed at room temperature.