AOS Semiconductor
Product Reliability Report

AOZ15333DI rev A

Plastic Encapsulated Device

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The AOS product reliability report summarizes the qualification results for AOZ15333DI in DFN3x3-12L package. Accelerated environmental tests are performed on a specific sample size, samples are electrically tested before and after each stress time point. Review of final electrical test results confirm that AOZ15333DI pass the AOS quality and reliability requirements. The released products will be categorized by its process family and routinely monitored for continuous improvement of product quality.

I. Reliability Stress Test Summary and Results

<table>
<thead>
<tr>
<th>Test Item</th>
<th>Test Condition</th>
<th>Time Point</th>
<th>Sample Size / Lots</th>
<th>Number of Failures</th>
<th>Reference Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>HTOL</td>
<td>$T_J = 150^\circ$C, $V_{IN} = V_{in, max}$</td>
<td>168 / 500 / 1000 hours</td>
<td>231 pcs (3 lots)</td>
<td>0</td>
<td>JESD22-A108</td>
</tr>
<tr>
<td>Preconditioning (Note A)</td>
<td>$T_A = 85^\circ$C, RH = 85% + 3 cycle reflow @ 260°C (MSL 1)</td>
<td>168 hours</td>
<td>924 pcs (3 lots)</td>
<td>0</td>
<td>JESD22-A113</td>
</tr>
<tr>
<td>HAST</td>
<td>$T_A = 130^\circ$C, RH = 85%, $P = 33.3$psia, $V_{IN} = V_{in, max}$</td>
<td>96 hours</td>
<td>231 pcs (3 lots)</td>
<td>0</td>
<td>JESD22-A110</td>
</tr>
<tr>
<td>Autoclave</td>
<td>$T_A = 121^\circ$C, RH = 100%, $P = 29.7$psia</td>
<td>96 hours</td>
<td>231 pcs (3 lots)</td>
<td>0</td>
<td>JESD22-A102</td>
</tr>
<tr>
<td>Temperature Cycle</td>
<td>$T_A = -65^\circ$C to 150°C, air to air</td>
<td>250 / 500 cycles</td>
<td>231 pcs (3 lots)</td>
<td>0</td>
<td>JESD22-A104</td>
</tr>
<tr>
<td>High Temperature Storage</td>
<td>$T_A = 150^\circ$C</td>
<td>168/500 / 1000 hours</td>
<td>231 pcs (3 lots)</td>
<td>0</td>
<td>JESD22-A103</td>
</tr>
</tbody>
</table>

Note: The reliability data presents total of available generic data up to the published date.
Note A: MSL (Moisture Sensitivity Level) 1 based on J-STD-020

II. Reliability Evaluation

The presentation of FIT rate for the individual product reliability is restricted by the actual burn-in sample size of the product technology. Failure Rate Determination is based on JEDEC Standard JESD 85.

**FIT rate (failures per billion device hours): 14.10**

**MTTF = 70.9 million hours =8098 years**

**Condition:** $V_o = 5.5$V, $T_o = 55^\circ$C, $V_S = 5.5$V and $T_S = 125^\circ$C

**Sample Size: 871**

The failure rate ($\lambda$) is calculated as follows:

$$\lambda = \frac{\chi^2[CL,(2f+2)]}{2 \times [1/(SS \times t \times AF)]]; \text{[equation 1]}$$

where

- $\chi^2$ = % of confidence level
- $f$ = number of failure
- $SS$ = sample size
- $t$ = stress time

Looking up the $\chi^2/2$ table for zero failure (burn-in) with 60% confidence, the value of $\chi^2[CL,(2f+2)]/2$ is 0.92.

The Acceleration Factor (AF) is calculated from the following formula (both temperature and voltage acceleration factors are used in the final acceleration factor calculation):

$$AF = AF_T \times AF_V = \exp[(E_a/k) \times (1/T_o - 1/T_S)] \times \exp[\beta (V_S - V_o)]$$

where

- $E_a$ = activation energy
- $k$ = Boltzmann constant
- $T_o$ = operating $T_J$
- $T_S$ = stress $T_J$
- $V_S$ = stress voltage
- $V_o$ = operating voltage
- $\beta$ = voltage acceleration coefficient
Assuming typical operating environment, $V_o = 5.5\text{V}$, $T_o = 55^\circ\text{C}$, $E_a = 0.7\text{eV}$, $V_s = 5.5\text{V}$, $T_s = 150^\circ\text{C}$, $\beta = 0.5$ (silicon defect)

$$AF = \exp\left[\left(\frac{0.7}{8.617E - 5}\right) \cdot \left(\frac{1}{273 + 55} - \frac{1}{273 + 125}\right)\right]$$

Substituting the values in equation 1, we have $\lambda =

$$0.92 \cdot \frac{1}{\text{sample Size} \cdot \text{Stress Duration} \cdot \text{AF}} \text{hr}^{-1}$$

$\lambda = 14.10 \times 10^{-9} \text{hr}^{-1}$ or 14.10 FIT; $\text{MTTF} = (1/ \lambda) = 70.9$ million hrs $= 8,098$ years

The calculation shows failure rate is 14.10 FIT, MTTF is 70.9 million hours under typical operating conditions.

### III. ESD and Latch Up Test Results

<table>
<thead>
<tr>
<th>Test</th>
<th>Test Conditions</th>
<th>Total Sample Size</th>
<th>Number of Failures</th>
<th>Reference Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrostatic Discharge</td>
<td>$T_A = 25^\circ\text{C}$, +/-2kV</td>
<td>10</td>
<td>0</td>
<td>JESD-A114</td>
</tr>
<tr>
<td>Human Body Model</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electrostatic Discharge</td>
<td>$T_A = 25^\circ\text{C}$, +/-1kV</td>
<td>10</td>
<td>0</td>
<td>JESD-C101</td>
</tr>
<tr>
<td>Charged Device Model</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Latch Up</td>
<td>$T_A = 25^\circ\text{C}$, +/-100mA, 1.5x OV</td>
<td>10</td>
<td>0</td>
<td>JESD78</td>
</tr>
<tr>
<td>Latch Up</td>
<td>$T_A = 125^\circ\text{C}$, +/-100mA, 1.5x OV</td>
<td>10</td>
<td>0</td>
<td>JESD78</td>
</tr>
</tbody>
</table>

**Note:** ATE results are used to determine PASS/FAIL. Parametric shift<10%.