

AOS Semiconductor Product Reliability Report

AOZ18103DI-01 rev A

Plastic Encapsulated Device

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The AOS product reliability report summarizes the qualification results for AOZ18103DI-01 in DFN3X3-10L 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 AOZ18103DI-01 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. AOZ18103DI-01 Reliability Stress Test Summary and Results

Test Item	Test Condition	Time Point	Sample Size / Lots	Number of Failures	Reference Standard
HTOL	$T_J = 125^\circ\text{C}$, $V_{IN} = 20\text{V}$	168 / 500 / 1000 hours	231 pcs (3 lots)	0	JESD22-A108
Preconditioning (Note A)	$T_A = 85^\circ\text{C}$, RH = 85% + 3 cycle reflow @ 260°C (MSL 1)	168 hours	924 pcs (3 lots)	0	JESD22-A113
HAST	$T_A = 130^\circ\text{C}$, RH = 85%, $P = 33.3\text{psia}$, $V_{IN} = 20\text{V}$	96 hours	231 pcs (3 lots)	0	JESD22-A110
Temperature Cycle	$T_A = -65^\circ\text{C}$ to 150°C , air to air	500 / 1000 cycles	231 pcs (3 lots)	0	JESD22-A104
HTSL	$T_A = 150^\circ\text{C}$	1000 hours	231 pcs (3 lots)	0	JESD22-A103
Autoclave	$T_A = 121^\circ\text{C}$, RH = 100%, $P = 29.7\text{psia}$	96 hours	231 pcs	0	JESD22-A102
HTGB (MOSFET)	$T_J = 150^\circ\text{C}$, $V_{GS} = 5\text{V}$	168 / 500 hours	231 (3 lots)	0	JESD22-A108
HTRB (MOSFET)	$T_J = 150^\circ\text{C}$, $V_{DS} = 18\text{V}$	168 / 500 hours	231 (3 lots)	0	JESD22-A108

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): 2.939

MTTF = 340.3 million hrs=38844.25 years

Condition: $V_o = 5.5\text{V}$, $T_o = 55^\circ\text{C}$, $V_{s(IC)} = 20\text{V}$, $V_{s(MOSFET)} = 18\text{V}$, $T_{s(IC)} = 125^\circ\text{C}$ and $T_{s(MOSFET)} = 150^\circ\text{C}$

Accumulated Sample Size x Hours: MOSFET = 280000, IC = 1077320

The failure rate (λ) is calculated as follows:

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

where

CL = % 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 $\chi^2[\text{CL},(2f+2)] / 2$ 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) :

$$\text{AF} = \text{AF}_T \times \text{AF}_V = \exp[(E_a/k) \times (1/T_0 - 1/T_s)] \times \exp[\beta (V_s - V_o)] \text{ where}$$

$$E_a = \text{activation energy}$$

k = Boltzmann constant
 T_o = operating T_J
 T_s = stress T_J
 V_s = stress voltage
 V_o = operating voltage
 β = voltage acceleration coefficient

Assuming typical operating environment, $V_o = 5.5V$, $T_o = 55^\circ C$, $E_a = 0.7\text{eV}$, $V_{s(IC)} = 20V$, $V_{s(MOSFET)} = 18V$, $T_{s(IC)} = 125^\circ C$ and $T_{s(MOSFET)} = 150^\circ C$, $\beta = 0.5$ (silicon defect)

$$AF(DriverIC) = \exp \left[\left(\frac{0.7}{8.617E - 5} \right) \cdot \left(\frac{1}{273 + 55} - \frac{1}{273 + 125} \right) \right] \cdot \exp[0.5 \cdot (20V - 5.5V)]$$

$$AF(MOSFET) = \exp \left[\left(\frac{0.7}{8.617E - 5} \right) \cdot \left(\frac{1}{273 + 55} - \frac{1}{273 + 150} \right) \right] \cdot \exp[0.5 \cdot (18V - 5.5V)]$$

Substituting the values in equation 1, we have

$$\lambda = 0.92 \cdot \frac{1}{\text{Sample Size} \cdot \text{Stress Duration} \cdot AF(MOSFET)} + \frac{1}{\text{sample Size} \cdot \text{Stress Duration} \cdot AF(DriverIC)} \text{hr}^{-1}$$

$$\lambda = 2.939 \cdot 10^{-9} \text{ hr}^{-1} \text{ or } 2.939 \text{ FIT; MTTF} = (1/\lambda) = 340.3 \text{ million hrs} = 38844.24 \text{ years}$$

The calculation shows failure rate is 2.939 FIT, MTTF is 340.3 million hours under typical operating conditions.

III. AOZ18103DI-01 ESD and Latch Up Test Results

Test	Test Conditions	Total Sample Size	Number of Failures	Reference Standard
Electrostatic Discharge Human Body Model	$T_A = 25^\circ C, +/-4kV$	10	0	JESD-A114
Electrostatic Discharge Charged Device Model	$T_A = 25^\circ C, +/-1kV$	10	0	JESD-C101
Latch Up	$T_A = 25^\circ C, +/-100mA, 1.27x OV$	10	0	JESD78
Latch Up	$T_A = 125^\circ C, +/-100mA, 1.27x OV$	10	0	JESD78

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

