ALPHA & OMEGA
SEMICONDUCTOR

AOS Semiconductor
Product Reliability Report

AOZ1390DI-01 rev A

Plastic Encapsulated Device

ALPHA & OMEGA Semiconductor, Inc

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The AOS product reliability report summarizes the qualification results for AOZ1390DI-01 in DFN3.5X3-14L 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 AOZ1390DI-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. AOZ1390DI-01 Full Reliability Stress Test Results

Test Item	Test Condition	Time Point	Sample Size / Lots	Number of Failures	Reference Standard
HTOL	$T_J = 125°C$, $V_{IN} = 22V$	168 hours	231 pcs (3 lots)	0	JESD22-A108
		500 hours		0	
		1000 hours		0	
Preconditioning (Note A)	$T_A = 30°C$, RH = 60% + 3 cycle reflow @ 260°C (MSL 3)	192 hours	924 pcs (3 lots)	0	JESD22-A113
HAST	$T_A = 130°C$, RH = 85%, P = 33.3psia, $V_{IN} = 22V$	96 hours	231 pcs (3 lots)	0	JESD22-A110
Temperature Cycle	T_A = -65°C to 150°C, air to air	500 cycles	231 pcs (3 lots)	0	JESD22-A104
		1000 cycles		0	
HTSL	$T_A = 150°C$	1000 hours	231 pcs (3 lots)	0	JESD22-A103
Autoclave	$T_A = 121°C$, RH = 100%, P =29.7psia	96 hours	231 pcs (3 lots)	0	JESD22-A102
HTGB (MOSFET)	$T_J = 150°C$, $V_{GS} = 12V$	168 hours	231 (3 lots)	0	JESD22-A108
		500 hours			
HTRB (MOSFET)	$T_J = 150°C$, $V_{DS} = 30V$	168 hours	231 (3 lots)	0	JESD22-A108
		500 hours			

Note: The reliability data presents total of available generic data up to the published date.
Note A: MSL (Moisture Sensitivity Level) 3 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): 0.216
MTTF = 4621.6 million hrs
Condition: V_o = 14V, T_o = 55°C, $V_{s(IC)}$ = 22V, $V_{s(MOSFET)}$ = 30V, $T_{s(IC)}$ = 125°C and $T_{s(MOSFET)}$ = 150°C
Sample Size: MOSFET = 6,153, IC = 640

The failure rate (λ) is calculated as follows:
λ = χ^2[CL,(2f+2)] /2 x [1/(SS x t x AF)]; [equation 1]   where   CL = % of confidence level
f   = number of failure
SS = sample size
t   = stress time

Looking up the χ^2 /2 table for zero failure (burn-in) with 60% confidence, the value of χ^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 x AF_V = exp[(E_a/k) x (1/T_0-1/T_s)] x exp[β (Vs-Vo)] 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
β   = voltage acceleration coefficient

Assuming typical operating environment, V_o = 14V, T_o = 55°C, E_a = 0.7eV, $V_{s(IC)}$ = 22V, $V_{s(MOSFET)}$ = 30V, $T_{s(IC)}$ = 125°C and $T_{s(MOSFET)}$ = 150°C, β = 0.5 (silicon defect)

$$AF(DriverIC) = exp\left[\left(\frac{0.7}{8.617E-5}\right) \bullet \left(\frac{1}{273+55} - \frac{1}{273+125}\right)\right] \bullet exp[\, 0.5 \bullet (22V - 14V)]$$

$$AF(MOSFET) = exp\left[\left(\frac{0.7}{8.617E-5}\right) \bullet \left(\frac{1}{273+55} - \frac{1}{273+150}\right)\right] \bullet exp[\, 0.5 \bullet (30V - 14V)]$$

Substituting the values in equation 1, we have $\lambda = 2 \bullet \lambda(MOSFET) + \lambda(DriverIC) = $

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

λ = 0.216 10^{-9} hr $^{-1}$ or 0.216 FIT; MTTF = (1/ λ) = 4621.6 million hrs = 527577 years

The calculation shows failure rate is 0.216 FIT, MTTF is 4621.6 million hours under typical operating conditions.

III. AOZ1390DI-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°C, +/-2kV	10	0	JESD-A114
Electrostatic Discharge Charged Device Model	T_A = 25°C, +/-1kV	10	0	JESD-C101
Latch Up	T_A = 25°C, +/-100mA, 1.27x OV	10	0	JESD78
Latch Up	T_A = 125°C, +/-100mA, 1.27x OV	10	0	JESD78

Note: ATE results are used to determine PASS/FAIL. Parametric shift<10%.
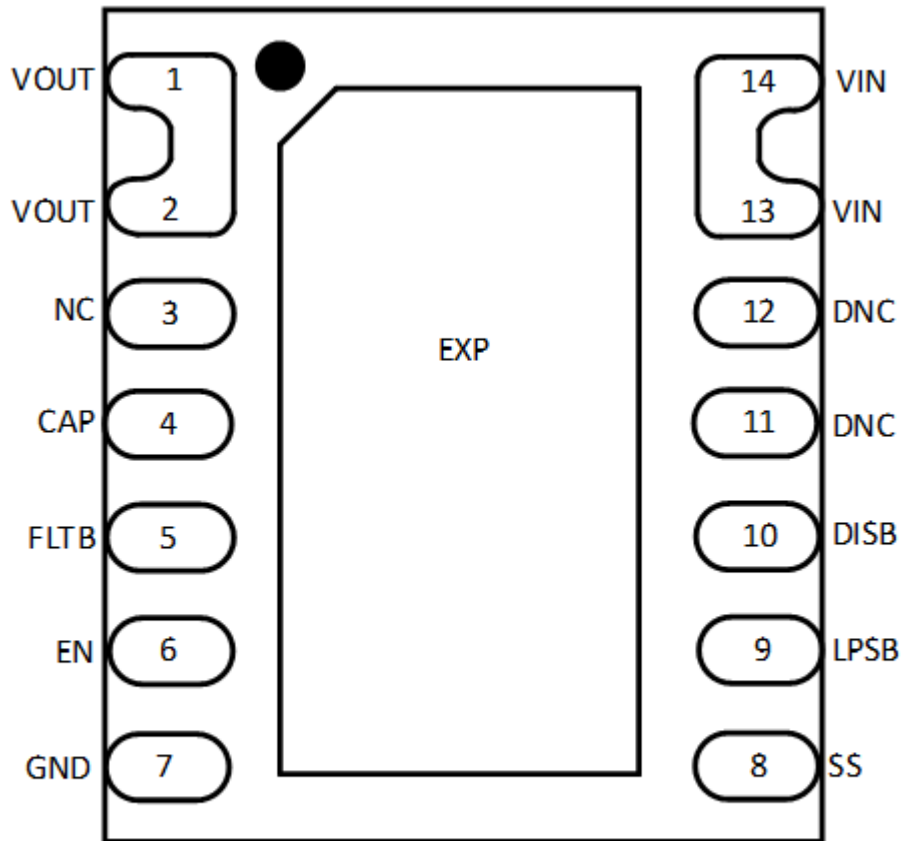
DFN3x3.5-14L
(Top Transparent View)