ALPHA & OMEGA SEMICONDUCTOR

AOS Semiconductor
Product Reliability Report

AOZ17517QI-02 rev A

Plastic Encapsulated Device

ALPHA & OMEGA Semiconductor, Inc

www.aosmd.com

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The AOS product reliability report summarizes the qualification results for AOZ17517QI-02 in QFN5x5A_32L 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 AOZ17517QI-02 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. AOZ17517QI-02 Reliability Stress Test Summary and Results

Test Item	Test Condition	Time Point	Sample Size / Lots	Number of Failures	Reference Standard
HTOL	**T_J = 125°C, V_{IN} = 24V**	**168 / 500 / 1000 hours**	**231 pcs (3 lots)**	**0**	**JESD22-A108**
Preconditioning (Note A)	**TA = 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} = 20V**	**96 hours**	**231 pcs (3 lots)**	**0**	**JESD22-A110**
Temperature Cycle	**T_A = -65°C to 150°C, air to air**	**500 / 1000 cycles**	**231 pcs (3 lots)**	**0**	**JESD22-A104**
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**	**0**	**JESD22-A102**
HTGB (MOSFET)	**T_J = 150°C, V_{GS} = 10V**	**168 / 500 /1000 hours**	**231 (3 lots)**	**0**	**JESD22-A108**
HTRB (MOSFET)	**T_J = 150°C, V_{DS} = 28.5V**	**168 / 500/1000 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) 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): 1.393
MTTF = 717.9 million hrs=81952.622 years
Condition: V_o = 20V, T_o = 55°C, $V_{S(IC)}$ = 24V, $V_{S(MOSFET)}$ = 28.5V, $T_{S(IC)}$ = 125°C and $T_{S(MOSFET)}$ = 150°C
Accumulated Sample Size x Hours: MOSFET = 480,000, IC = 1,240,320

The failure rate (λ) is calculated as follows:
$\lambda = \chi^2[CL,(2f+2)]\ /2 \times [1/(SS \times t \times AF)]$; [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 $\chi^2[CL,(2f+2)]$ /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) :
$AF = AF_T \times AF_V = \exp[(E_a/k) \times (1/T_0-1/T_s)] \times \exp[\beta\ (Vs-Vo)]$ 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 = 20V, T_o = 55°C, E_a = 0.7eV, $V_{s(IC)}$ = 24V, $V_{s(MOSFET)}$ = 28.5V, $T_{s(IC)}$ = 125°C and $T_{s(MOSFET)}$ = 150°C, β = 0.5 (silicon defect)

$$AF(DriverIC) = exp\left[\left(\frac{0.7}{8.617E-5}\right)\bullet\left(\frac{1}{273+55}-\frac{1}{273+125}\right)\right]\bullet exp[\,0.5\bullet(24V-20V)]$$

$$AF(MOSFET) = exp\left[\left(\frac{0.7}{8.617E-5}\right)\bullet\left(\frac{1}{273+55}-\frac{1}{273+150}\right)\right]\bullet exp[\,0.5\bullet(28.5V-20V)]$$

Substituting the values in equation 1, we have

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

λ = 1.393 10^{-9} hr $^{-1}$ or 1.393 FIT; MTTF = (1/ λ) = 717.9 million hrs = 81952.622 years

The calculation shows failure rate is 1.393 FIT, MTTF is 717.9 million hours under typical operating conditions.

III. AOZ17517QI-02 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, +/-200mA, 1.27x OV**	**10**	**0**	**JESD78**
Latch Up	**T_A = 125°C, +/-200mA, 1.27x OV**	**10**	**0**	**JESD78**

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