



# ***AOS Semiconductor Product Reliability Report***

**AOZ5517QI-02** rev A

**Plastic Encapsulated Device**

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The AOS product reliability report summarizes the qualification results for AOZ5517QI-02 in QFN5x5-31L 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 AOZ5517QI-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. Reliability Stress Test Summary and Results

Test Item	Test Condition	Time Point	Sample Size / Lots	Number of Failures	Reference Standard
HTOL	$T_J = 150^{\circ}\text{C}$ , $V_{IN} = 28\text{V}$	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 @ $260^{\circ}\text{C}$ (MSL 1)	168hours	924 pcs (3 lots)	0	JESD22-A113
HAST	$T_A = 130^{\circ}\text{C}$ , RH = 85%, P = 33.3psia, $V_{IN} = 30\text{V}$	96 hours	231 pcs (3 lots)	0	JESD22-A110
Autoclave	$T_A = 121^{\circ}\text{C}$ , RH = 100%, P = 29.7psia	96 hours	231 pcs (3 lots)	0	JESD22-A102
Temperature Cycle	$T_A = -65^{\circ}\text{C}$ to $150^{\circ}\text{C}$ , air to air	250 / 500 cycles	231 pcs (3 lots)	0	JESD22-A104
HTSL	$T_A = 150^{\circ}\text{C}$	1000 hours	231 pcs (3 lots)	0	JESD22-A103
Power Cycling	$V_{IN} = 24\text{V}$ , $V_{OUT} = 1.0\text{V}$ , $F_{SW}$ = 600kHz, $I_{OUT} = 22\text{A}$ , VCC cycled 0V-5V @ 1hz	24hrs, >86k cycles	10 pcs (3 lots)	0	AOS Standard
HTGB (MOSFET)	$T_J = 150^{\circ}\text{C}$ , $V_{GS} = 12\text{V}$	168 / 500 / 1000 hours	231 (3 lots)	0	JESD22-A108
HTRB (MOSFET)	$T_J = 150^{\circ}\text{C}$ , $V_{DS} = 30\text{V}$	168 / 500 / 1000 hours	231 (3 lots)	0	JESD22-A108
HT3RB (MOSFET)	$T_A = 130^{\circ}\text{C}$ , RH = 85%, P = 33.3psia, $V_{DS} = 30\text{V}$	168 / 500 / 1000 hours	231 (3 lots)	0	JESD22-A101
Validation	3 cycle reflow @ $260^{\circ}\text{C}$ + 250 cycles @ $T_A = -65^{\circ}\text{C}$ to $150^{\circ}\text{C}$	250 cycles	3000 (3 lots)	0	AOS Standard

**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): 0.460**

**MTTF = 2,174.7 million hrs**

**Condition:**  $V_o = 25V$ ,  $T_o = 55^\circ C$ ,  $V_{s(DriverIC)} = 28V$ ,  $V_{s(MOSFET)} = 30V$  and  $T_s = 150^\circ C$

**Sample Size:** MOSFET = 6,153, Driver IC = 3,874

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

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

- 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  $\chi^2[CL, (2f+2)] / 2$  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) :

$$AF = AF_T \times AF_V = \exp[(E_a/k) \times (1/T_o - 1/T_s)] \times \exp[\beta (V_s - V_o)] \text{ where}$$

- $E_a$  = 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,  $V_o = 25V$ ,  $T_o = 55^\circ C$ ,  $E_a = 0.7eV$ ,  $V_{s(DriverIC)} = 28V$ ,  $V_{s(MOSFET)} = 30V$ ,  $T_s = 150^\circ C$ ,  $\beta = 0.5$  (silicon defect)

$$AF(DriverIC) = \exp\left[\left(\frac{0.7}{8.617E-5}\right) \cdot \left(\frac{1}{273+55} - \frac{1}{273+150}\right)\right] \cdot \exp[0.5 \cdot (28V - 25V)]$$

$$AF(MOSFET) = \exp\left[\left(\frac{0.7}{8.617E-5}\right) \cdot \left(\frac{1}{273+55} - \frac{1}{273+150}\right)\right] \cdot \exp[0.5 \cdot (30V - 25V)]$$

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

$$0.92 \cdot \frac{2}{\text{Sample Size} \cdot \text{Stress Duration} \cdot AF(MOSFET)} + \frac{1}{\text{sample Size} \cdot \text{Stress Duration} \cdot AF(DriverIC)} \text{ hr}^{-1}$$

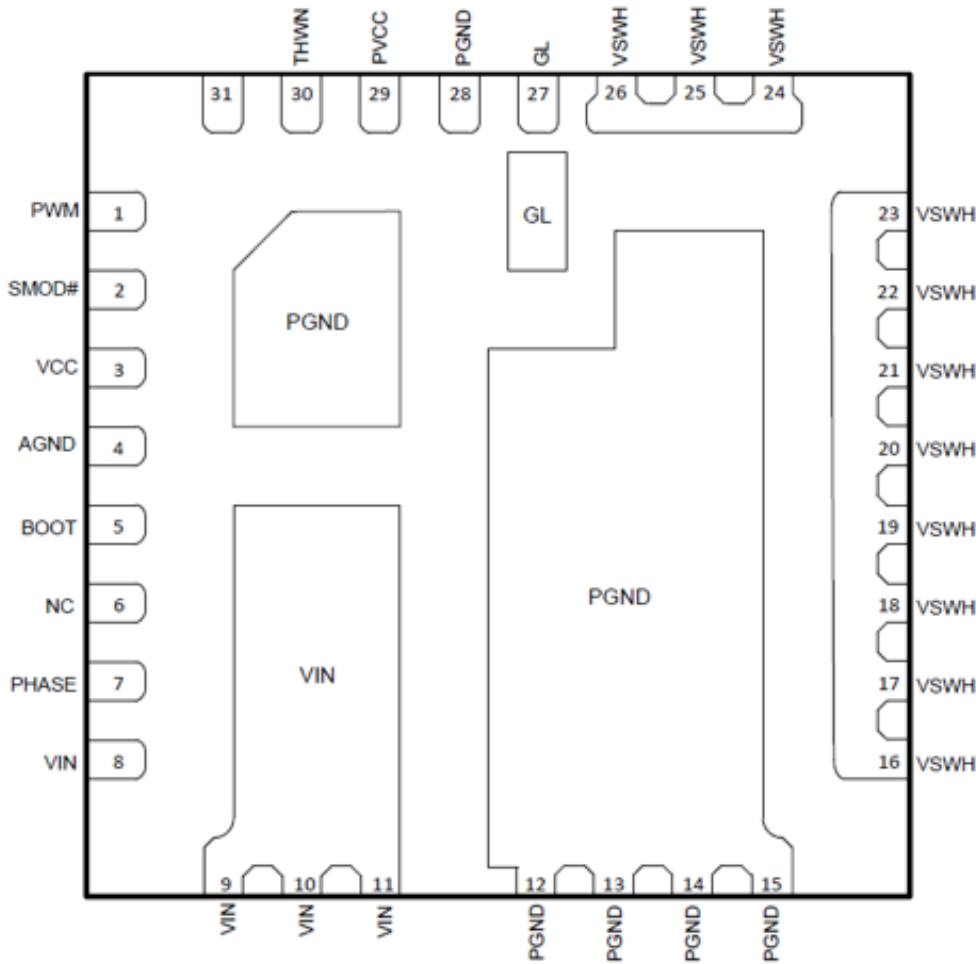
$\lambda = 0.460 \cdot 10^{-9} \text{ hr}^{-1}$  or 0.460 FIT; MTTF =  $(1/\lambda) = 2,174.7$  million hrs = 248,251 years

The calculation shows failure rate is 0.460 FIT, MTTF is 2,174.7 million hours under typical operating conditions.

### III. ESD and Latch Up Test Results

Test	Test Conditions	Total Sample Size	Number of Failures	Reference Standard
Electrostatic Discharge Human Body Model	T <sub>A</sub> = 25°C, +/-2kV	10	0	JESD-A114
Electrostatic Discharge Charged Device Model	T <sub>A</sub> = 25°C, +/-1kV	10	0	JESD-C101
Latch Up	T <sub>A</sub> = 25°C, +/-100mA, 1.5x OV	10	0	JESD78
Latch Up	T <sub>A</sub> = 85°C, +/-100mA, 1.5x OV	10	0	JESD78

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



**QFN5x5-31L**  
**(Top View)**