AOS Semiconductor
Product Reliability Report

AOZ3013PI

Rev 1.0

Plastic Encapsulated Device

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This AOS product reliability report summarizes the qualification result for AOZ3013PI (epad SO8 package).

Review of the electrical test results confirm that AOZ3013PI passed AOS quality and reliability requirements for product manufacturing release (RTM). The continuous qualification testing and reliability monitoring program ensure that all outgoing products will continue to meet AOS quality and reliability standards.

Table of Contents:

I. Product Description:

AOZ3013PI is high efficiency, simple to use, 3A synchronous buck regulator.
AOZ3013PI are Au&Cu mixed bonding wire version of AOZ3011PI product. Both are derivatives of AOZ105x product family and AOZ103x product family with improved manufacturability – updated LX pad location to eliminate down bonding.

AOZ3013PI works from a 4.5V to 18V input voltage range, and output voltage adjustable down to 0.8V. It is offered in epad SO-8 package.

Absolute Maximum Ratings	
Parameter	
Supply Voltage (V_{IN})	20V
LX to AGND	-0.7V to V_{IN}+0.3 V
LX to AGND	-5V to 22V(20ns)
EN to AGND	-0.3V to V_{IN}+0.3 V
FB to AGND	-0.3V to 6 V
COMP to AGND	-0.3V to 6 V
PGND to AGND	-0.3V to 0.3 V
Junction Temperature (T_J)	+150°C
Storage Temperature (T_S)	-65°C to +150°C
Thermal Characteristics	
Package Thermal Resistance (Θ_{JA})	50°C/W (typ.)

II. Package and Die Information:

Product ID	AOZ3013PI (epad SO-8)
Process	UMC 5V/20V 2P3M 23BV
Lead Frame	A194FH
Die Attach	8006NS(WBC)/ 84-3J (controller IC) / 84-1 LMISR4
Bond wire	Au&Cu
Mold Material	G630AY
MSL	Level 2

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III. Qualification Tests Requirement

- 1 lot of AOZ3013PI 168-hr Burn-in (HTOL)
- 1 lot of AOZ3013PI ESD test
- 17 lots of HTOL results (including previously released products with same processing) for final release to manufacturing.
- 4 lots of package qual testing for SO8_EP1 for final release to manufacturing.

IV. Qualification Tests Results

Test Item	Test Condition	Sample Size	Result	Comment
HTOL	Per JESD 22-A108_B Temp = 125 °C	1 lot of AOZ3013PI	Passed	1 AOZ3013PI lot (BA014) passed 168hrs.
		3 lots of AOZ3011PI	Passed	2 AOZ3011PI lots (BA001) passed 500 hrs. 1 AOZ3011PI lot (BA004) passed 500 hrs.
		1 lot of AOZ3017PI	Passed	1 AOZ3017PI lot (BA002) passed 500hrs.
		1 lot AOZ1051PI	Passed	1 AOZ1051PI lot (BA004) passed 500 hrs.
		1 lot AOZ1051PI	Passed	1 AOZ1051PI lot (BA007) passed 168 hrs.
		1 lot AOZ1096PI	Passed	1 AOZ1096PI lot (BAB01) passed 168 hrs.
		1 lot AOZ1033AI	Passed	1 AOZ1033AI lot (BA001) passed 168 hrs.
		1 lot AOZ1034PI	Passed	1 AOZ1034PI lot (BA011) passed 168 hrs.
		1 lot AOZ1034PI	Passed	1 AOZ1034PI lot (BA013) passed 1000 hrs.
		1 lot AOZ1036PI	Passed	1 AOZ1036PI lot (BA020) passed 168 hrs.
		1 lot AOZ1038PI	Passed	1 AOZ1038PI lot (BA006) passed 168 hrs.
		3 lots AOZ1037PI	Passed	3 AOZ1037PI lots (BA003/BA006/BA011) passed 500 hrs.
		1 lot AOZ1037PI	Passed	1 AOZ1037PI lot (BA013) passed 168 hrs.
		1 lot AOZ1031AI	Passed	1 AOZ1031AI lots (BA030) passed 168 hrs.
ESD (HBM, MM, CDM)	Per JESD 22-A114, JESD 22-A115-A,	1 AOZ3013PI lot 1 AOZ3013PI lot 1 AOZ3013PI lot	Passed Passed Passed	1 AOZ3013PI lot (BA014) passed 2KV HBM 1 AOZ3013PI lot (BA014) passed 200V MM 1 AOZ3013PI lot (BA014) passed 1000V CDM
Latch-up	Per JESD 78	1 AOZ3013PI lot	Passed	1 AOZ3013PI lot (BA014) passed Latch-up

SO8_EP1 Package Qual Data				
HTOL	**Per JESD 22-A108_B Temp = 125 °C**	**4 lots**	**Passed**	**4 AOZ3013PI lots (BA003/BA004/BA005/BA007) passed 500hr. BI.**
Pre-Conditioning	**Per JESD 22-A113 85 C^0/85%RH, 3 cyc reflow@260 ^{0}C**	**4 lots**	**Passed**	**4 AOZ3013PI lots (BA003/BA004/BA005/BA007) passed preconditioning.**
HAST	**130±2°C, 85%RH, 33.3PSI, at Vcc min power dissipation**	**4 lots**	**Passed**	**4 AOZ3013PI lots (BA003/BA004/BA005/BA007) passed HAST 100 hrs.**
Temperature Cycle	**-65°C to +150°C air to air (2cyc/hr)**	**4 lots**	**Passed**	**4 AOZ3013PI lots (BA003/BA004/BA005/BA007) passed TC 500.**
Pressure Pot	**121°C, 15±1 PSIG, RH= 100%**	**4 lots**	**Passed**	**4 AOZ3013PI lots (BA003/BA004/BA005/BA007) passed PCT 96hr.**

V. Reliability Evaluation

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

FIT rate (per billion): 10.8
MTTF = 92.59 million hrs.

The failure rate (λ) is calculated as follows:

$$\lambda = \frac{\chi^2[CL,(2f+2)]}{2} \times \frac{1}{SS \times t \times AF}$$ …….. [Equation 1]

Where CL = % of confidence level
f = number of failure
SS = sample size
t = stress time

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

The Acceleration Factor (AF) is calculated from the following formula:

$$AF = \exp\left[\left(\frac{E_A}{k}\right)\bullet\left(\frac{1}{T_O}-\frac{1}{T_S}\right)\right] \qquad \ldots\ldots\ldots \text{ [Equation 2]}$$

Where E_A = activation energy
k = Boltzmann constant
T_O = operating T_J
T_S = stress T_J

Applying typical operating environment, T_O = 55°C; E_A = 0.7eV and T_S = 140°C

$$AF = \exp\left[\left(\frac{0.7}{8.617E-5}\right)\bullet\left(\frac{1}{273+55}-\frac{1}{273+140}\right)\right] = 164$$

Taking the result of HTOL (AOZ3013 Lot and previous similar products - see HTOL results in section IV), the total device stress time

Substituting the values in equation 1, we have

$$\lambda = 0.92 \times \frac{1}{(1\times 80\times 168 + 8\times 80\times 168 + 8\times 80\times 500 + 1\times 80\times 1000)\times 164}$$ = 1.08E-8 hr $^{-1}$ or **10.8 FIT**

MTTF = (1/ λ) = 92.59 million hours or 10570 years

The calculation shows that under typical operating environment, the device failure rate is less than 10.8 FIT or an MTTF of over 92.59 million hour.

The qualification test results confirm that AOZ3013PI passed AOS quality and reliability requirements for product manufacturing release (RTM).

VI. Revision History

Revision	Release Date	Comments
1.0	Oct 8, 2013	Initial Release