



ALPHA & OMEGA
SEMICONDUCTOR

AOS Semiconductor Product Reliability Report

**AOZ1016AI/1017AI/1015AI/1019AI/1075AI/1081AI/
1017DI/1094DI, rev 8**

Plastic Encapsulated Device

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This AOS product reliability report summarizes the qualification result for AOZ1016AI/1017AI/1015AI/1019AI/1075AI/1081AI/1017DI/1094DI.

Review of the electrical test results confirmed that AOZ1016AI/1017AI/1015AI/1019AI/1075AI/1081AI/1017DI/1094DI pass AOS quality and reliability requirements for final product and package release.

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I. Product Description:

The AOZ1016AI is a high frequency 2A buck regulator with internal Schottky diode. AOZ1017AI is a 3A buck regulator and AOZ1017DI is a 4A buck regulator with external Schottky diode. AOZ1015AI is a 1.5A buck regulator with internal Schottky diode. AOZ1019AI is a 2A buck regulator with external Schottky diode. AOZ1075AI is a 1.2A buck regulator with internal Schottky diode. AOZ1081AI is a 1.8A buck regulator with internal Schottky diode. AOZ1094DI is a 5A buck regulator with external Schottky diode. These products are offered in a SO-8 or 5x4DFN-8 package and are rated over a -40°C to +85°C ambient temperature range.

Absolute Maximum Ratings	
Parameter	
Supply Voltage (V_{IN})	18V
LX, EN to AGND	$V_{IN} + 0.3V$
FB, COMP to AGND	6V
Storage Temperature (T_s)	-65°C to +150°C
Operating Junction Temperature (T_J)	+150°C
Thermal Characteristics	
Package Thermal Resistance ($R_{\theta JA}$)	87°C/W

II. Package and Die Information:

Product ID	AOZ1016AI/1017AI/1015AI/1019AI/1075AI/1081AI (AOZ1017DI/1094DI)
Process	0.5um 5/18V 2P2M process
Package Type	SO-8 (5x4DFN-8)
Die Size	1532 x 970 μm^2
L/F material	A194FH
Die attach material	84-3J epoxy (IC), 84-1LMISR4 (Discrete)
Bond wire	Au, 1-mil/2-mil
Mold Material	MP8000CH4 or G700HC

III. Qualification Tests Requirements

- 2 lots of AOZ1016AI up to 500 hrs of Burn-In for new product final release.
- AOZ1015AI/1017AI/1019AI/1075AI are either same IC die as AOZ1016AI or minor metal change from AOZ1016AI and can be qualified by extension.
- 1 lot of AOZ1081AI up to 500 hrs of Burn-In for new product final release.
- 1 lot of AOZ1094DI 168 hrs of Burn-In for new product final release.
- Waive package stress test as lead-frames for AOZ1016AI/1017AI/1015AI are the same as AOZ1010AI and can be qual'd by extension. Lead-frame for AOZ1019AI is the same as AOZ1300AI and can be qual'd by extension.
- 2 lots of AOZ1014DIL, 250 temperature cycles and 96 hrs Pressure Pot for 5x4DFN-8 package release.

IV. Qualification Tests Result

Test Item	Test Condition	Sample Size	Result	Comment
HTOL	Per JESD 22-A108-B $V_{IN} = 16V$ $T_j = 125^{\circ}C$	3 lots	pass	One AOZ1016AI lot (BD004), 120 units passed HTOL 500 hrs test. One AOZ1016AI lot (BD006), 60 units passed HTOL 500 hrs test. One AOZ1081AI lot (BA001), 60 units passed HTOL 500 hrs test. One AOZ1094DI lot (ZA8V11), 60 units passed HTOL 168 hrs test.
ESD (HBM, MM)	Per JESD 22-A114, JESD 22-A115-A, JESD 22-C101-C	3 units each mode	pass	3 units (BD008) AOZ1016AI passed 2KV HBM, 3 units (BD008) AOZ1016AI passed 200V MM. 3 units (BD011) AOZ1017AI passed 2KV HBM, 3 units (BD011) AOZ1017AI passed 200V MM. 3 units (BD004) AOZ1015AI passed 2KV HBM, 3 units (BD004) AOZ1015AI passed 200V MM. 3 units (BD003) AOZ1019AI passed 2KV HBM. 3 units (BD003) AOZ1019AI passed 200V MM. 3 units (BD002) AOZ1075AI passed 2KV HBM, 3 units (BD002) AOZ1075AI passed 200V MM. 3 units (BA001) AOZ1081AI passed 2KV HBM, 3 units (BA001) AOZ1081AI passed 200V MM. 3 units (ZA8T11) AOZ1017DI passed 2KV HBM, 3 units (ZA8T11) AOZ1017DI passed 200V MM. 3 units (ZA8V11) AOZ1094DI passed 2KV HBM, 3 units (ZA8V11) AOZ1094DI passed 200V MM.
Latch-up	Per JESD 78A	10 units	pass	5 units (BD003) AOZ1016AI passed latch-up test. 5 units (BD009) AOZ1017AI passed latch-up test.

SO-8 Package Qualification Data (qual by extension using AOZ1010AI data)				
Pre-Conditioning	Per JESD 22-A113 85C /85%RH, 3 cyc reflow@260 C	3 lots	pass	One AOZ1010A lot (FA7C8), 170 units and 2 other AOZ1010A lots (F857N and F856K), 144 units each, passed preconditioning.
HAST	130 +/- 2 C, 85%RH, 33.3 psi, at VCC min power dissipation	1 lot (60 /lot)	pass	One AOZ1010A lot (FA7C8), 60 units, passed. (Only one lot of data is available but there are many SO8 package qual. HAST data available from discrete FET for reference. (e.g. AO4403/4413/4912/4446/4610/4800/4818 etc.)
Temperature Cycle	-65 C to +150 C, air to air (2cyc/hr)	1 lot (55 /lot) 2 lots (77 /lot)	pass	One AOZ1010A lot (FA7C8), 55 units and 2 other AOZ1010A lots (F857N and F856K), 77 units each, passed TC 500 hrs.
Pressure Pot	121 C, 15+/-1 PSIG, RH= 100%	1 lot (55 /lot) 2 lots (77 /lot)	pass	One AOZ1010A lot (FA7C8), 55 units and 2 other AOZ1010A lots (F857N and F856K), 77 units each, passed PCT 96 hrs.
5x4DFN-8 Package Qualification Data				
Pre-Conditioning	Per JESD 22-A113 85C /85%RH, 3 cyc reflow@260 C	2 lots	pass	Two AOZ1014DIL lots (BA003, BA004), 82 units each, passed preconditioning.
Temperature Cycle	-65 C to +150 C, air to air (2cyc/hr)	2 lots	pass	Two AOZ1014DIL lots (BA003, BA004), 82 units each, passed 250 temperature cycles.
Pressure Pot	121 C, 15+/-1 PSIG, RH= 100%	2 lots	pass	Two AOZ1014DIL lots (BA003, BA004), 82 units each, passed 96 hrs Pressure Pot.

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): 18
MTBF = 6342 years

The failure rate (λ) is calculated as follows:

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

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

Looking up the $\chi^2/2$ table for zero failure (in HTOL) 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:

$$AF = \exp\left\{\left(\frac{E_a}{k}\right) \times \left[\frac{1}{T_0} - \frac{1}{T_s}\right]\right\}$$

where E_a = activation energy
 k = Boltzman constant
 T_0 = operating T_J
 T_s = stress T_J

Taking the result of HTOL with SS (Total of 9 lots, 2 lots AOZ1010, 2 lots AOZ1014, 2 lots AOZ1016, 2 lots AOZ1020 and 1 lot AOZ1021) = 634 and $t = 500$ hr. and assuming under typical operating environment, $T_0 = 55^\circ\text{C}$; $E_a = 0.7\text{eV}$ and $T_s = 140^\circ\text{C}$

$$AF = \exp \left\{ (0.7/8.617 \times 10^{-5}) \times [1/(273+55) - 1/(273+140)] \right\} = 164$$

Substituting the values in equation 1, we have

$$\lambda = 0.92 \times \left\{ \frac{1}{(634 \times 500 \times 164)} \right\} = 1.77\text{E-}8 \text{ hr}^{-1} \text{ or } 18 \text{ FIT } [\text{MTBF} = (1000/\lambda) \text{ million hrs.}]$$

The calculation shows that under typical operating environment, the device failure rate is less than 18 FIT or an MTBF of over 55.56 million hours.

The qualification test results confirm that AOZ1016AI/1017AI/1015AI/1019AI/1075AI/1081AI/1017DI/1094DI passed AOS quality and reliability requirements for product manufacturing release.

VI. Quality Assurance Information

Acceptable Quality Level for outgoing inspection: **0.1 %** for electrical and visual. Guaranteed Outgoing

Defect Rate: **< 50 ppm**

Quality Sample Plan: conform to **Mil-Std -105D**