# AOS Semiconductor Product Reliability Report 

# AOZ1016AI/1017AI/1015AI/1019AI/1075AI/1081AI/ 1017DI/1094DI, rev8 

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 3 A buck regulator and AOZ1017DI is a 4A buck regulator with external Schottky diode. AOZ1015AI is a 1.5 A 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 $-40^{\circ} \mathrm{C}$ to $+85^{\circ} \mathrm{C}$ ambient temperature range.

| Absolute Maximum Ratings |  |
| :--- | :---: |
| Parameter |  |
| Supply Voltage $\left(\mathrm{V}_{\mathrm{IN}}\right)$ | 18 V |
| LX, EN to AGND | $\mathrm{V}_{\mathrm{IN}}+0.3 \mathrm{~V}$ |
| FB, COMP to AGND | 6 V |
| Storage Temperature (Ts) | $-65^{\circ} \mathrm{C}$ to $+150^{\circ} \mathrm{C}$ |
| Operating Junction Temperature $\left(\mathrm{T}_{\mathrm{J}}\right)$ | $+150^{\circ} \mathrm{C}$ |
| Thermal Characteristics |  |
| Package Thermal Resistance $\left(\mathrm{R}_{\Theta J \mathrm{~A}}\right)$ |  |

## II. Package and Die Information:

| Product ID | AOZ1016AI/1017AI/1015AI/1019AI/1075AI/1081AI (AOZ1017DI/1094DI) |
| :--- | :---: |
| Process | $0.5 \mathrm{um} \mathrm{5/18V2P2M} \mathrm{process}$ |
| Package Type | SO-8 (5x4DFN-8) |
| Die Size | $1532 \times 970 \mathrm{um}^{2}$ |
| 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 AOZ1081Al 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 <br> Size | Result | Comment |
| :---: | :---: | :---: | :---: | :---: |
| HTOL | $\begin{aligned} & \text { Per JESD 22-A108-B } \\ & \mathrm{V}_{\text {in }}=16 \mathrm{~V} \\ & \mathrm{~T}_{\mathrm{j}}=125^{\circ} \mathrm{C} \end{aligned}$ | 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. <br> 3 units (BD011) AOZ1017AI passed 2KV HBM, 3 units (BD011) <br> AOZ1017AI passed 200V MM. <br> 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) |  |  |  |  |  |  |
| :--- | :--- | :--- | :--- | :--- | :---: | :---: |

## 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 $(\lambda)$ is calculated as follows:

$$
\begin{aligned}
& \lambda=\left(\chi^{2}[C L,(2 f+2)] / 2\right) \times(1 / S S \times t \times A F) \ldots \ldots . .[\text { eqn 1] where } C L=\% \text { of confidence level } \\
& \text { f = number of failure } \\
& \text { SS = sample size } \\
& \text { t = stress time }
\end{aligned}
$$

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

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

$$
\begin{array}{lll}
\mathrm{AF}=\exp \left\{\left(\mathrm{E}_{\mathrm{a}} / \mathrm{k}\right) \times\left[1 / \mathrm{T}_{0}-1 / \mathrm{T}_{\mathrm{s}}\right]\right\} & \text { where } & \mathrm{E}_{\mathrm{a}}=\text { activation energy } \\
& \mathrm{k}=\text { Boltzman constant } \\
& \mathrm{T}_{0}=\text { operating } \mathrm{T}_{\mathrm{J}} \\
& \mathrm{~T}_{\mathrm{s}}=\text { stress } \mathrm{T}_{\mathrm{J}}
\end{array}
$$

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 $t=500 \mathrm{hr}$. and assuming under typical operating environment, $\mathrm{T}_{0}=55^{\circ} \mathrm{C} ; \mathrm{E}_{\mathrm{a}}=0.7 \mathrm{eV}$ and $\mathrm{T}_{\mathrm{s}}=140^{\circ} \mathrm{C}$

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

Substituting the values in equation 1 , we have

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

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: $\mathbf{0 . 1}$ \% for electrical and visual. Guaranteed Outgoing Defect Rate: < $\mathbf{5 0} \mathbf{~ p p m}$
Quality Sample Plan: conform to Mil-Std -105D

