

# **AOS Semiconductor**

## **Product Reliability Report**

**AOT424/AOT424L, rev A**

**Plastic Encapsulated Device**

**ALPHA & OMEGA Semiconductor, Inc**

**495 Mercury Drive  
Sunnyvale, CA 94085  
U.S.**

**Tel: (408) 830-9742**

**[www.aosmd.com](http://www.aosmd.com)**

**Jan 28, 2005**

This AOS product reliability report summarizes the qualification result for AOT424. Accelerated environmental tests are performed on a specific sample size, and then followed by electrical test at end point. Review of final electrical test result confirms that AOT424 passes AOS quality and reliability requirements. The released product will be categorized by the process family and be monitored on a quarterly basis for continuously improving the product quality.

## Table of Contents:

- I. Product Description
- II. Package and Die information
- III. Environmental Stress Test Summary and Result
- IV. Reliability Evaluation
- V. Quality Assurance Information

## I. Product Description:

Absolute Maximum Ratings $T_A=25^\circ\text{C}$ unless otherwise noted				
Parameter		Symbol	Maximum	Units
Drain-Source Voltage		$V_{DS}$	30	V
Gate-Source Voltage		$V_{GS}$	$\pm 20$	V
Continuous Drain Current <sup>B,G</sup>	$T_C=25^\circ\text{C}$ <sup>G</sup>	$I_D$	110	A
	$T_C=100^\circ\text{C}$ <sup>B</sup>		88	
Pulsed Drain Current		$I_{DM}$	200	
Avalanche Current <sup>C</sup>		$I_{AR}$	30	A
Repetitive avalanche energy $L=0.1\text{mH}$ <sup>C</sup>		$E_{AR}$	112	mJ
Power Dissipation <sup>B</sup>	$T_C=25^\circ\text{C}$	$P_D$	100	W
	$T_C=100^\circ\text{C}$		50	
Junction and Storage Temperature Range		$T_J, T_{STG}$	-55 to 175	$^\circ\text{C}$

Thermal Characteristics					
Parameter		Symbol	Typ	Max	Units
Maximum Junction-to-Ambient <sup>A</sup>	$t = 10\text{s}$	$R_{\theta JA}$	14.2	20	$^\circ\text{C/W}$
Maximum Junction-to-Ambient <sup>A</sup>	Steady-State		39	50	$^\circ\text{C/W}$
Maximum Junction-to-Case <sup>C</sup>	Steady-State	$R_{\theta JC}$	0.8	1.5	$^\circ\text{C/W}$

## II. Die / Package Information:

	<b>AOT424</b>	<b>AOT424L (Green Compound)</b>
<b>Process</b>	Standard sub-micron low voltage N channel process	Standard sub-micron low voltage N channel process
<b>Package Type</b>	3 leads TO220	3 leads TO220
<b>Lead Frame</b>	Copper with Ni pad	Copper with Ni pad
<b>Die Attach</b>	Soft solder	Soft solder
<b>Bond wire</b>	Al wire, 5&15 mils	Al wire, 5&15 mils
<b>Mold Material</b>	Epoxy resin with silica filler	Epoxy resin with silica filler
<b>Filler % (Spherical/Flake)</b>	50/50	100/0
<b>Flammability Rating</b>	UL-94 V-0	UL-94 V-0
<b>Backside Metallization</b>	Ti / Ni / Ag	Ti / Ni / Ag
<b>Moisture Level</b>	Up to Level 1 *	Up to Level 1 *

Note \* based on info provided by assembler and mold compound supplier

## III. Result of Reliability Stress for AOT424 (Standard) & AOT424L (Green)

Test Item	Test Condition	Time Point	Lot Attribution	Total Sample size	Number of Failures
Solder Reflow Precondition	Normal: 1hr PCT+3 cycle IR reflow @240 ° c (260° c for Green)	0hr	Normal: 7 lots	715pcs	0
HTGB	Temp = 150 C, Vgs=100% of Vgsmax	168 / 500 hrs	Normal: 3 lots  (Note A*)	246pcs  77+5 pcs / lot	0
HTRB	Temp = 150 C, Vds=80% of Vdsmax	168 / 500 hrs	Normal: 3 lots  (Note A*)	246pcs  77+5 pcs / lot	0
HAST	130 +/- 2 C, 85%, 33.3 psi, Vgs = 80% of Vgs max	100 hrs	Normal: 7 lots	385pcs  50+5 pcs / lot	0
Pressure Pot	121 C, 15+/-1 PSIG, RH=100%	96 hrs	Normal: 3 lots	165pcs  50+5 pcs / lot	0
Temperature Cycle	-65 to 150 deg C, air to air, 0.5hr per cycle	250 / 500 cycles	Normal: 3 lots	165pcs  50+5 pcs / lot	0

### III. Result of Reliability Stress for AOT424 (Standard) & AOT424L (Green)

Continues

<b>DPA</b>	<b>Internal Vision Cross-section X-ray</b>	<b>NA</b>	<b>5 5 5</b>	<b>5 5 5</b>	<b>0</b>
<b>CSAM</b>		<b>NA</b>	<b>5</b>	<b>5</b>	<b>0</b>
<b>Bond Integrity</b>	<b>Room Temp 150° C bake 150° C bake</b>	<b>0hr 250hr 500hr</b>	<b>40 40 40</b>	<b>40 wires 40 wires 40 wires</b>	<b>0</b>
<b>Solderability</b>	<b>230° C</b>	<b>5 sec</b>	<b>15</b>	<b>15 leads</b>	<b>0</b>
<b>Die shear</b>	<b>150° C</b>	<b>0hr</b>	<b>10</b>	<b>10</b>	<b>0</b>

**Note A:** The HTGB and HTRB reliability data presents total of available AOT424 and **AOT424L** burn-in data up to the published date.

### IV. Reliability Evaluation

**FIT rate (per billion): 18.5**

**MTBF = 6171 years**

AOS reliability group also routinely monitors the product reliability up to 1000 hr at and performs the necessary failure analysis on the units failed for reliability test(s).

The presentation of FIT rate for the individual product reliability is restricted by the actual burn-in sample size of the selected product (AOT424). Failure Rate Determination is based on JEDEC Standard JESD 85. FIT means one failure per billion hours.

$$\text{Failure Rate} = \text{Chi}^2 \times 10^9 / [2 (N) (H) (Af)]$$

$$= 1.83 \times 10^9 / [2 (328) (500) (258.24) + 2 (164) (168) (258.24)] = 18.5$$

$$\text{MTBF} = 10^9 / \text{FIT} = 5.4 \times 10^7 \text{ hrs} = 6171 \text{ years}$$

**Chi<sup>2</sup>** = Chi Squared Distribution, determined by the number of failures and confidence interval

**N** = Total Number of units from HTRB and HTGB tests

**H** = Duration of HTRB/HTGB testing

**Af** = Acceleration Factor from Test to Use Conditions (Ea = 0.7eV and Tuse = 55C)

Acceleration Factor [**Af**] = **Exp** [Ea / k ( 1/Tj u - 1/Tj s )]

**Acceleration Factor ratio list:**

	<b>55 deg C</b>	<b>70 deg C</b>	<b>85 deg C</b>	<b>100 deg C</b>	<b>115 deg C</b>	<b>130 deg C</b>	<b>150 deg C</b>
<b>Af</b>	<b>258</b>	<b>87</b>	<b>32</b>	<b>13</b>	<b>5.64</b>	<b>2.59</b>	<b>1</b>

**Tj s** = Stressed junction temperature in degree (Kelvin), K = C+273.16

**Tj u** =The use junction temperature in degree (Kelvin), K = C+273.16

**k** = Boltzman's constant, 8.617164 X 10 E<sup>-5</sup>V / K



## V. Quality Assurance Information

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

Guaranteed Outgoing Defect Rate: **< 25 ppm**

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

### Contacts:

Wei Liu, Engineer of Failure Analysis and Reliability

[wliu@aosmd.com](mailto:wliu@aosmd.com)

Fred Chang, Manager of Failure Analysis and Reliability

[fchang@aosmd.com](mailto:fchang@aosmd.com)

Wilson Ma, Senior Director of Quality Assurance

[wma@aosmd.com](mailto:wma@aosmd.com)