



# **AOS Semiconductor**

## **Product Reliability Report**

**AOD488/AOD488L, rev A**

**Plastic Encapsulated Device**

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This AOS product reliability report summarizes the qualification result for AOD488. 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 AOD488 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.

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### I. Product Description:

The AOD488 uses advanced trench technology and design to provide excellent  $R_{DS(ON)}$  with low gate charge. This device is suitable for use in PWM, load switching and general purpose applications. Standard Product AOD488 is Pb-free (meets ROHS & Sony 259 specifications). AOD488L is a Green Product ordering option. AOD488 and AOD488L are electrically identical.

Absolute Maximum Ratings $T_A=25^\circ\text{C}$ unless otherwise noted				
Parameter		Symbol	Maximum	Units
Drain-Source Voltage		$V_{DS}$	40	V
Gate-Source Voltage		$V_{GS}$	$\pm 20$	V
Continuous Drain Current	$T_A=25^\circ\text{C}$	$I_D$	20	A
	$T_A=100^\circ\text{C}$		15	
Pulsed Drain Current		$I_{DM}$	50	
Avalanche Current		$I_{AR}$	12	A
Power Dissipation	$T_A=25^\circ\text{C}$	$P_D$	20	W
	$T_A=100^\circ\text{C}$		10	
Power Dissipation	$T_A=25^\circ\text{C}$	$P_{DSM}$	2	W
	$T_A=70^\circ\text{C}$		1.3	
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	$T \leq 10\text{s}$	$R_{\theta JA}$	17.4	30	$^\circ\text{C/W}$
	Steady-State		50	60	$^\circ\text{C/W}$
Maximum Junction-to-Lead	Steady-State	$R_{\theta JL}$	4	7.5	$^\circ\text{C/W}$

## II. Die / Package Information:

	<b>AOD488</b>	<b>AOD488L (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 TO252	3 leads TO252
<b>Lead Frame</b>	Copper	Copper
<b>Die Attach</b>	Soft solder	Soft solder
<b>Bond wire</b>	1.3 mils Au and 12mils Al	1.3 mils Au and 12mils Al
<b>Mold Material</b>	Epoxy resin with silica filler	Epoxy resin with silica filler
<b>Filler % (Spherical/Flake)</b>	90/10	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 AOD488 (Standard) & AOD488L (Green)

Test Item	Test Condition	Time Point	Lot Attribution	Total Sample size	Number of Failures
Solder Reflow Precondition	Standard: 1hr PCT+3 cycle reflow@260°c Green: 168hr 85°c /85%RH +3 cycle reflow@260°c	0hr	Standard: 26 lots Green: 3 lots	4675pcs	0
HTGB	Temp = 150°c , Vgs=100% of Vgsmax	168 / 500 hrs 1000 hrs	2 lots  (Note A*)	164pcs 77+5 pcs / lot	0
HTRB	Temp = 150°c , Vds=80% of Vdsmax	168 / 500 hrs 1000 hrs	2 lots  (Note A*)	164pcs 77+5 pcs / lot	0
HAST	130 +/- 2°c , 85%RH, 33.3 psi, Vgs = 80% of Vgs max	100 hrs	Standard : 26 lots Green: 3 lots  (Note B**)	1595pcs 50+5 pcs / lot	0
Pressure Pot	121°c , 29.7psi, RH=100%	96 hrs	Standard : 25 lots Green: 3 lots  (Note B**)	1540pcs 50+5 pcs / lot	0
Temperature Cycle	-65°c to 150°c , air to air,	250 / 500 cycles	Standard : 25 lots Green: 3 lots  (Note B**)	1540pcs 50+5 pcs / lot	0

### III. Result of Reliability Stress for AOD488 (Standard) & AOD488L (Green)

Continues

<b>DPA</b>	<b>Internal Vision Cross-section X-ray</b>	<b>NA</b>	<b>5</b>	<b>5</b>	<b>0</b>
			<b>5</b>	<b>5</b>	
			<b>5</b>	<b>5</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</b>	<b>40</b>	<b>40 wires</b>	<b>0</b>
		<b>250hr</b>	<b>40</b>	<b>40 wires</b>	
		<b>500hr</b>	<b>40</b>	<b>40 wires</b>	
<b>Solderability</b>	<b>245°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 AOD488 and AOD488L burn-in data up to the published date.

**Note B:** The pressure pot, temperature cycle and HAST reliability data for AOD488 and AOD488L comes from the AOS generic package qualification data.

### IV. Reliability Evaluation

**FIT rate (per billion): 11**

**MTTF = 10569 years**

In general, 500 hrs of HTGB, 150 deg C accelerated stress testing is equivalent to 15 years of lifetime at 55 deg C operating conditions (by applying the Arrhenius equation with an activation energy of 0.7eV and 60% of upper confidence level on the failure rate calculation). 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 (AOD488). Failure Rate Determination is based on JEDEC Standard JESD 85. FIT means one failure per billion hours.

$$\text{Failure Rate} = \text{Chi}^2 \times 10^9 / [2 (N) (H) (Af)] = 1.83 \times 10^9 / [2 (2 \times 164) (168) (1000)] = 11$$

$$\text{MTTF} = 10^9 / \text{FIT} = 9.25 \times 10^7 \text{ hrs} = 10569 \text{ years}$$

**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 = 55°C)

Acceleration Factor [**Af**] =  $\text{Exp} [E_a / k (1/T_j u - 1/T_j s)]$

**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** = Boltzmann's constant, 8.617164 X 10<sup>-5</sup>eV / 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**