

# **AOS Semiconductor**

## **Product Reliability Report**

**AO4900/AO4900L, rev A**

**Plastic Encapsulated Device**

**ALPHA & OMEGA Semiconductor, Inc**

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This AOS product reliability report summarizes the qualification result for AO4900. 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 AO4900 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 AO4900 uses advanced trench technology to provide excellent  $R_{DS(ON)}$  and low gate charge. The two MOSFETs make a compact and efficient switch and synchronous rectifier combination for use in DCDC converters. A Schottky diode is co-packaged in parallel with the synchronous MOSFET to boost efficiency further. AO4900L (Green Product) is offered in a lead-free package.

Absolute Maximum Ratings $T_A=25^\circ\text{C}$ unless otherwise noted				
Parameter	Symbol	MOSFET	Schottky	Units
Drain-Source Voltage	$V_{DS}$	30		V
Gate-Source Voltage	$V_{GS}$	$\pm 12$		V
Continuous Drain Current <sup>A</sup>	$T_A=25^\circ\text{C}$	$I_D$		A
	$T_A=70^\circ\text{C}$			
		5.8		
Pulsed Drain Current <sup>B</sup>	$I_{DM}$	40		
Schottky reverse voltage	$V_{KA}$		30	V
Continuous Forward Current <sup>A</sup>	$T_A=25^\circ\text{C}$	$I_F$		A
	$T_A=70^\circ\text{C}$			
		2		
Pulsed Forward Current <sup>B</sup>	$I_{FM}$		40	
Power Dissipation <sup>A</sup>	$T_A=25^\circ\text{C}$	$P_D$		W
	$T_A=70^\circ\text{C}$			
		1.44	1.44	
Junction and Storage Temperature Range	$T_J, T_{STG}$	-55 to 150	-55 to 150	$^\circ\text{C}$

Thermal Characteristics		Symbol	Typ	Max	Units
Maximum Junction-to-Ambient	$t = 10\text{s}$	$R_{\theta JA}$	48	62.5	$^\circ\text{C/W}$
	Steady-State		74	110	
Maximum Junction-to-Lead	Steady-State	$R_{\theta JL}$	35	40	

Thermal Characteristics Schottky		Symbol	Typ	Max	Units
Maximum Junction-to-Ambient	T = 10s	R <sub>θJA</sub>	47.5	62.5	°C/W
Maximum Junction-to-Ambient	Steady-State		71	110	
Maximum Junction-to-Lead	Steady-State	R <sub>θJL</sub>	32	40	

## II. Die / Package Information:

	<b>AO4900</b>	<b>AO4900L (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>	8 lead SOIC	8 lead SOIC
<b>Lead Frame</b>	Copper with Solder Plate	Copper with Solder Plate
<b>Die Attach</b>	Silver epoxy	Silver epoxy
<b>Bondwire</b>	2 mils Au wire	2 mils Au wire
<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 AO4900 (Standard) & AO4900L (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: 2 lots Green: 1 lot	495 pcs	0
HTGB	Temp = 150 C, Vgs=100% of Vgsmax	168 / 500 hrs  1000 hrs	Normal: 2 lots Green: 1 lot  (Note A*)	246 pcs  77+5 pcs / lot	0
HTRB	Temp = 150 C, Vds=80% of Vdsmax	168 / 500 hrs  1000 hrs	Normal: 2 lots Green: 1 lot  (Note A*)	246 pcs  77+5 pcs / lot	0
HAST	130 +/- 2 C, 85%, 33.3 psi, Vgs = 80% of Vgs max	100 hrs	Normal: 2 lots Green: 1 lot  (Note B**)	165 pcs  50+5 pcs / lot	0
Pressure Pot	121 C, 15+/-1 PSIG, RH=100%	96 hrs	Normal: 2 lots Green: 1 lot  (Note B**)	165 pcs  50+5 pcs / lot	0
Temperature Cycle	-65 to 150 deg C, air to air, 0.5hr per cycle	250 / 500 cycles	Normal: 2 lots Green: 1 lot  (Note B**)	165 pcs  50+5 pcs / lot	0

<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 AO4900 and **AO4900L** burn-in data up to the published date.

**Note B:** The pressure pot, temperature cycle and HAST reliability data for **AO4900L** comes from the AOS generic green compound package qualification data.

#### IV. Reliability Evaluation

**FIT rate (per billion): 7.20**

**MTBF = 15854 years**

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 (AO4900). Failure Rate Determination is based on JEDEC Standard JESD 85. FIT means one failure per billion hours.

$$\text{Failure Rate} = \text{Chi}^2 \times 10^9 / [2 (N) (H) (Af)] = 1.83 \times 10^9 / [2 (492) (1000) (258.24)] = 7.20$$

$$\text{MTBF} = 10^9 / \text{FIT} = 1.39 \times 10^8 \text{ hrs} = 15854 \text{ years}$$

**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 10E -5eV / 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**

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