



# **AOS Semiconductor Product Reliability Report**

**AOL1440/AOL1440L, rev A**

**Plastic Encapsulated Device**

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This AOS product reliability report summarizes the qualification result for AOL1440. 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 AOL1440 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 AOL1440 uses advanced trench technology to provide excellent  $R_{DS(ON)}$ , shoot-through immunity and body diode characteristics. This device is ideally suited for use as a low side switch in CPU core power conversion. Standard Product AOL1440 is Pb-free (meets ROHS & Sony 259 specifications). AOL1440L is a Green Product ordering option. AOL1440 and AOL1440L are electrically identical.

Absolute Maximum Ratings $T_A=25^\circ\text{C}$ unless otherwise noted				
Parameter		Symbol	Maximum	Units
Drain-Source Voltage		$V_{DS}$	25	V
Gate-Source Voltage		$V_{GS}$	$\pm 30$	V
Continuous Drain Current	$T_A=25^\circ\text{C}$	$I_D$	85	A
	$T_A=100^\circ\text{C}$		66	
Pulsed Drain Current		$I_{DM}$	200	
Continuous Drain Current	$T_A=25^\circ\text{C}$	$I_{DSM}$	25	
	$T_A=70^\circ\text{C}$		20	
Avalanche Current		$I_{AR}$	30	A
Repetitive avalanche energy $L=0.3\text{mH}$		$E_{AR}$	135	mJ
Power Dissipation	$T_A=25^\circ\text{C}$	$P_D$	75	W
	$T_A=100^\circ\text{C}$		37	
Power Dissipation	$T_A=25^\circ\text{C}$	$P_{DSM}$	5	W
	$T_A=70^\circ\text{C}$		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	$T \leq 10\text{s}$	$R_{\theta JA}$	19	25	$^\circ\text{C/W}$
	Steady-State		45	55	$^\circ\text{C/W}$
Maximum Junction-to-Lead	Steady-State	$R_{\theta JL}$	1.5	2	$^\circ\text{C/W}$

## II. Die / Package Information:

	<b>AOL1440</b>	<b>AOL1440L (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>	<i>Ultra</i> SO-8™	<i>Ultra</i> SO-8™
<b>Lead Frame</b>	Copper	Copper
<b>Die Attach</b>	Soft solder	Soft solder
<b>Bond wire</b>	AL, 5&12mils	AL, 5&12 mils
<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 AOL1440 (Standard) & AOL1440L (Green)

Test Item	Test Condition	Time Point	Lot Attribution	Total Sample size	Number of Failures
<b>Solder Reflow Precondition</b>	Standard: 1hr PCT+3 cycle reflow@260°c Green: 168hr 85°c /85%RH +3 cycle reflow@260°c	0hr	Standard: 11 lots	1705 pcs	0
<b>HTGB</b>	Temp = 150°c , Vgs=100% of Vgsmax	168 / 500 hrs 1000 hrs	2 lots (Note A*)	164 pcs 77+5 pcs / lot	0
<b>HTRB</b>	Temp = 150°c , Vds=80% of Vdsmax	168 / 500 hrs 1000 hrs	2 lots (Note A*)	164 pcs 77+5 pcs / lot	0
<b>HAST</b>	130 +/- 2°c , 85%RH, 33.3 psi, Vgs = 80% of Vgs max	100 hrs	Standard: 11 lots (Note B**)	605 pcs 50+5 pcs / lot	0
<b>Pressure Pot</b>	121°c , 29.7psi, RH=100%	96 hrs	Standard: 11 lots (Note B**)	605 pcs 50+5 pcs / lot	0
<b>Temperature Cycle</b>	-65°c to 150°c , air to air,	250 / 500 cycles	Standard: 9 lots (Note B**)	495 pcs 50+5 pcs / lot	0

### III. Result of Reliability Stress for AOL1440 (Standard) & AOL1440L (Green) Continues

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

**Note A:** The HTGB and HTRB reliability data presents total of available AOL1440 and AOL1440L burn-in data up to the published date.

**Note B:** The pressure pot, temperature cycle and HAST reliability data for AOL1440 and AOL1440L comes from the AOS generic package qualification data up to the published date.

### IV. Reliability Evaluation

**FIT rate (per billion): 32**  
**MTTF = 3567years**

In general, 500 hrs of HTGB, 150 deg C accelerated stress testing is equivalent to 15 years of lifetime at 55deg 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 (AOL1440). Failure Rate Determination is based on JEDEC Standard JESD 85. FIT means one failure per billion hours.

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

$$= 1.83 \times 10^9 / [2 (164) (168) (258) + 2 (164) (500) (258)] = 32$$

$$\text{MTTF} = 10^9 / \text{FIT} = 3.12 \times 10^7 \text{ hrs} = 3567 \text{ years}$$

**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**] =  $\text{Exp} [Ea / k (1/Tj u - 1/Tj s)]$

**Acceleration Factor ratio list:**

	55 deg C	70 deg C	85 deg C	100 deg C	115 deg C	130 deg C	150 deg C
<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**