ALPHA & OMEGA SEMICONDUCTOR

AOS Semiconductor Product Reliability Report

AO4430/AO4430L, rev B

Plastic Encapsulated Device

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This AOS product reliability report summarizes the qualification result for AO4430. 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 AO4430 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 AO4430 uses advanced trench technology to provide excellent $R_{DS(ON)}$, shoot-through immunity, body diode characteristics and ultra-low gate resistance. This device is ideally suited for use as a low side switch in Notebook CPU core power conversion. Standard Product AO4430 is Pb free (meets ROHS & Sony 259 specifications). AO4430L is a Green Product ordering option. AO4430 and AO4430L are electrically identical.

Absolute Maximum Ratings T_A=25°C unless otherwise noted				
Parameter		**Symbol**	**Maximum**	**Units**
Drain-Source Voltage		V_{DS}	30	V
Gate-Source Voltage		V_{GS}	±20	V
Continuous Drain Current	T_A=25°C	I_D	18	A
	T_A=70°C		15	
Pulsed Drain Current		I_{DM}	80	
Power Dissipation	T_A=25°C	P_D	3	W
	T_A=70°C		2.1	
Junction and Storage Temperature Range		T_J, T_{STG}	-55 to 150	°C

Thermal Characteristics					
Parameter		**Symbol**	**Typ**	**Max**	**Units**
Maximum Junction-to-Ambient	T ≤ 10s	$R_{\theta JA}$	31	40	°C/W
Maximum Junction-to-Ambient	Steady-State		59	75	°C/W
Maximum Junction-to-Lead	Steady-State	$R_{\theta JL}$	16	24	°C/W

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II. Die / Package Information:

	AO4430	AO4430L (Green Compound)
Process	Standard sub-micron low voltage N channel process	Standard sub-micron low voltage N channel process
Package Type	8 leads SOIC	8 leads SOIC
Lead Frame	Copper with Ag Plate	Copper with Ag Plate
Die Attach	Ag epoxy	Ag epoxy
Bond wire	Au 2mils	Au 2 mils
Mold Material	Epoxy resin with silica filler	Epoxy resin with silica filler
Filler % (Spherical/Flake)	90/10	100/0
Flammability Rating	UL-94 V-0	UL-94 V-0
Backside Metallization	Ti / Ni / Ag	Ti / Ni / Ag
Moisture Level	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 AO4430 (Standard) & AO4430L (Green)

Test Item	Test Condition	Time Point	Lot Attribution	Total Sample size	Number of Failures
Solder Reflow Precondition	**Standard: 1hr PCT+3 cycle IR reflow@260 °C Green: 168hr 85°C /85RH +3 cycle IR reflow@260 °c**	**0hr**	**Standard: 81 lots Green: 23 lots**	**14410 pcs**	**0**
HTGB	**Temp = 150 ° C, Vgs=100% of Vgsmax**	**168 / 500 hrs 1000 hrs**	**4 lots (Note A*)**	**328 pcs 77+5 pcs / lot**	**0**
HTRB	**Temp = 150 ° C, Vds=80% of Vdsmax**	**168 / 500 hrs 1000 hrs**	**4 lots (Note A*)**	**328 pcs 77+5 pcs / lot**	**0**
HAST	**130 +/- 2 ° C, 85%, 33.3 psi, Vgs = 80% of Vgs max**	**100 hrs**	**Standard: 52 lots Green: 16 lots (Note B**)**	**3740 pcs 50+5 pcs / lot**	**0**
Pressure Pot	**121 ° C, 15+/-1 PSIG, RH=100%**	**96 hrs**	**Standard: 70 lots Green: 20 lots (Note B**)**	**4950 pcs 50+5 pcs / lot**	**0**
Temperature Cycle	**-65 to 150 °C, air to air, 0.5hr per cycle**	**250 / 500 cycles**	**Standard: 81 lots Green: 23 lots (Note B**)**	**5720 pcs 50+5 pcs / lot**	**0**

III. Result of Reliability Stress for AO4430 (Standard) & AO4430L (Green)
Continues

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

Note A: The HTGB and HTRB reliability data presents total of available AO4430 and AO4430L burn-in data up to the published date.
Note B: The pressure pot, temperature cycle and HAST reliability data for AO4430 and AO4430L comes from the AOS generic green compound package qualification data.

IV. Reliability Evaluation

FIT rate (per billion): 7
MTTF = 16307 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 (AO4430). Failure Rate Determination is based on JEDEC Standard JESD 85. FIT means one failure per billion hours.

Failure Rate = $Chi^2 \times 10^9$ **/ [**2 (N) (H) (Af)**]**
= 1.83×10^9 / **[**2 (3×164) (1000) (258) +2 (164) (168) (258)**]** =7
MTTF = 10^9 / FIT = 1.42×10^8hrs = 16307years

Chi² = 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**] = **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
Af	**258**	**87**	**32**	**13**	**5.64**	**2.59**	**1**

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, 8.617164×10^{-5}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**