ALPHA & OMEGA SEMICONDUCTOR

AOS Semiconductor Product Reliability Report

AO6400/AO6400L, rev B

Plastic Encapsulated Device

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This AOS product reliability report summarizes the qualification result for AO6400. 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 AO6400 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 AO6400 uses advanced trench technology to provide excellent $R_{DS(ON)}$, low gate charge and operation with gate voltages as low as 2.5V. This device is suitable for use as a load switch or in PWM applications. Standard product AO6400 is Pb-free (meets ROHS & Sony 259 specifications). AO6400 is a Green Product ordering option. AO6400 and AO6400L 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}	±12	V
Continuous Drain Current	T_A=25°C	I_D	6.9	A
	T_A=70°C		5.8	
Pulsed Drain Current		I_{DM}	35	
Power Dissipation	T_A=25°C	P_D	2	W
	T_A=70°C		1.44	
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	$R_{\theta JA}$	47.5	62.5	°C/W
Maximum Junction-to-Ambient	Steady-State		74	110	°C/W
Maximum Junction-to-Lead	Steady-State	$R_{\theta JL}$	37	50	°C/W

II. Die / Package Information:

	AO6400	AO6400L (Green Compound)
Process	Standard sub-micron low voltage N channel process	Standard sub-micron low voltage N channel process
Package Type	6 leads TSOP	6 leads TSOP
Lead Frame	Copper with Ag spot	Copper with Ag spot
Die Attach	Ag epoxy	Ag epoxy
Bond wire	Au 2mils	Au 2mils
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 AO6400 (Standard) & AO6400L (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: 18 lots** **Green: 7 lots**	**3685pcs**	**0**
HTGB	**Temp = 150°c, Vgs=100% of Vgsmax**	**168 / 500 hrs** **1000 hrs**	**9 lots** **(Note A*)**	**738pcs** **77+5 pcs / lot**	**0**
HTRB	**Temp = 150°c , Vds=80% of Vdsmax**	**168 / 500 hrs** **1000 hrs**	**9 lots** **(Note A*)**	**738pcs** **77+5 pcs / lot**	**0**
HAST	**130 +/- 2°c , 85%RH, 33.3 psi, Vgs = 80% of Vgs max**	**100 hrs**	**Standard: 16 lots** **Green: 6 lots** **(Note B**)**	**1210pcs** **50+5 pcs / lot**	**0**
Pressure Pot	**121°c , 15+/-1 PSIG, RH=100%**	**96 hrs**	**Standard: 13 lots** **Green: 7 lots** **(Note B**)**	**1100pcs** **50+5 pcs / lot**	**0**
Temperature Cycle	**-65°c to 150°c , air to air,**	**250 / 500 cycles**	**Standard: 18 lots** **Green: 7 lots** **(Note B**)**	**1375pcs** **50+5 pcs / lot**	**0**

III. Result of Reliability Stress for AO6400 (Standard) & AO6400L (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 AO6400 and AO6400L burn-in data up to the published date.
Note B: The pressure pot, temperature cycle and HAST reliability data for AO6400 and AO6400L comes from the AOS generic package qualification data.

IV. Reliability Evaluation

FIT rate (per billion): 2.4
MTTF = 47564years

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 (AO6400). 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 (9×164) (1000) (258)**]** = 2.4
MTTF = 10^9 / FIT = 4.16 x 10^8hrs =47564years

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 X 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**