ALPHA & OMEGA SEMICONDUCTOR

AOS Semiconductor
Product Reliability Report

AOP605/AOP605L, rev B

Plastic Encapsulated Device

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This AOS product reliability report summarizes the qualification result for AOP605. 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 AOP605passes 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 AOP605 uses advanced trench technology to provide excellent $R_{DS(ON)}$ and low gate charge. The complementary MOSFETs form a high-speed power inverter, suitable for a multitude of applications. Standard Product AOP605 is Pb-free (meets ROHS & Sony 259 specifications). AOP605L is a Green Product ordering option. AOP605 and AOP605L are electrically identical.

Absolute Maximum Ratings T_A=25°C unless otherwise noted					
Parameter		**Symbol**	**Max n-channel**	**Max p-channel**	**Units**
Drain-Source Voltage		V_{DS}	30	-30	V
Gate-Source Voltage		V_{GS}	±20	±20	V
Continuous Drain Current	T_A=25°C	I_D	7.5	-6.6	A
	T_A=70°C		6	-5.3	
Pulsed Drain Current		I_{DM}	30	-30	
Power Dissipation	T_A=25°C	P_D	2.5	2.5	W
	T_A=70°C		1.6	1.6	
Junction and Storage Temperature Range		T_J, T_{STG}	-55 to 150	-55 to 150	°C

Thermal Characteristics : n-channel, Schottky and p-channel						
Parameter		**Symbol**	**Device**	**Typ**	**Max**	**Units**
Maximum Junction-to-Ambient	t ≤ 10s	$R_{\theta JA}$	n-ch	40	50	°C/W
Maximum Junction-to-Ambient	Steady-State		n-ch	67	80	
Maximum Junction-to-Lead	Steady-State	$R_{\theta JL}$	n-ch	33	40	
Maximum Junction-to-Ambient	t ≤ 10s	$R_{\theta JA}$	p-ch	38	50	
Maximum Junction-to-Ambient	Steady-State		p-ch	66	80	
Maximum Junction-to-Lead	Steady-State	$R_{\theta JL}$	p-ch	30	40	

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II. Die / Package Information:

	AOP605	AOP605L (Green Compound)
Process	Standard sub-micron low voltage complementary process	Standard sub-micron
Package Type	8 lead PDIP	8 lead PDIP
Lead Frame	Copper with Solder Plate	Copper with Solder Plate
Die Attach	Silver epoxy	Silver epoxy
Bond wire	2 mils Au wire	2 mils Au wire
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 AOP605 (Standard) & AOP605L (Green)

Test Item	Test Condition	Time Point	Lot Attribution	Total Sample size	Number of Failures
Solder Reflow Precondition	Standard: 1hr PCT+3 cycle reflow@250°c Green: 168hr 85°c /85%RH +3 cycle reflow@250°c	0hr	Standard: 11 lots Green: 4 lots	2365 pcs	0
HTGB	Temp = 150°c, Vgs=100% of Vgsmax	168 / 500 hrs 1000 hrs	6 lots (Note A*)	492 pcs 77+5 pcs / lot	0
HTRB	Temp = 150°c, Vds=80% of Vdsmax	168 / 500 hrs 1000 hrs	6 lots (Note A*)	492 pcs 77+5 pcs / lot	0
HAST	130 +/- 2°c, 85%RH, 33.3 psi, Vgs = 80% of Vgs max	100 hrs	Standard: 11 lots Green: 4 lots (Note B**)	825 pcs 50+5 pcs / lot	0
Pressure Pot	121°c, 15+/-1 PSIG, RH=100%	96 hrs	Standard: 11 lots Green: 3 lots (Note B**)	770 pcs 50+5 pcs / lot	0
Temperature Cycle	-65°c to 150 °c, air to air	250 / 500 cycles	Standard: 11 lots Green: 3 lots (Note B**)	770 pcs 50+5 pcs / lot	0
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**

Note A: The HTGB and HTRB reliability data presents total of available AOP605and AOP605L burn-in data up to the published date.
Note B: The pressure pot, temperature cycle and HAST reliability data for AOP605and AOP605L comes from the AOS generic package qualification data.

IV. Reliability Evaluation

FIT rate (per billion): 10
MTTF = 11415 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 (AOP605). 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 (164) (168) (258) + 2 (2×164) (500) (258) + 2 (164) (1000) (258)**]** = 10

MTTF = 10^9 / FIT = 1.0×10^8hrs =11415 years

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**