AOS Semiconductor
Product Reliability Report

AO3701/AO3701L, rev A

Plastic Encapsulated Device

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This AOS product reliability report summarizes the qualification result for AO3701. 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 AO3701 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 AO3701 uses advanced trench technology to provide excellent $R_{DS(ON)}$ and low gate charge. A Schottky diode is provided to facilitate the implementation of a bidirectional blocking switch, or for DC-DC conversion applications. It is ESD protected. Standard Product AO3701 is Pb-free (meets ROHS & Sony 259 specifications). AO3701L is a Green Product ordering option. AO3701 and AO3701L are electrically identical.

Absolute Maximum Ratings T_A=25°C unless otherwise noted

Parameter		Symbol	MOSFET	Schottky	Units
Drain-Source Voltage		V_{DS}	-20		V
Gate-Source Voltage		V_{GS}	± 12		V
Continuous Drain Current	T_A=25°C	I_D	-3		A
	T_A=70°C		-2.3		
Pulsed Drain Current		I_{DM}	-10		
Schottky reverse voltage		V_{KA}		20	V
Continuous Forward Current	T_A=25°C	I_F		2	A
	T_A=70°C			1	
Pulsed Forward Current		I_{FM}		10	
Power Dissipation	T_A=25°C	P_D	1.14	0.92	W
	T_A=70°C		0.72	0.59	
Junction and Storage Temperature Range		T_J, T_{STG}	-55 to 150	-55 to 150	°C

Parameter: Thermal Characteristics MOSFET		Symbol	Typ	Max	Units
Maximum Junction-to-Ambient	T ≤ 10s	$R_{\theta JA}$	80.3	110	°C/W
Maximum Junction-to-Ambient	Steady-State		117	150	°C/W
Maximum Junction-to-Lead	Steady-State	$R_{\theta JC}$	43	80	°C/W

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Thermal Characteristics Schottky		Symbol	Typ	Max	Units
Maximum Junction-to-Ambient	T ≤ 10s	$R_{\theta JA}$	109.4	135	°C/W
Maximum Junction-to-Ambient	Steady-State		136.5	175	°C/W
Maximum Junction-to-Lead	Steady-State	$R_{\theta JC}$	58.5	80	°C/W

II. Die / Package Information:

	AO3701	**AO3701L (Green Compound)**
Process	Standard sub-micron Low voltage P channel process	Standard sub-micron Low voltage P channel process
Package Type	SOT23-5L LP	SOT23-5L LP
Lead Frame	Copper with Ag spot	Copper with Ag spot
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 AO3701 (Standard) & AO3701L (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: 2 lots**	**220 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%RH, 33.3 psi, Vgs = 80% of Vgs max**	**100 hrs**	**Standard: 0 lot** **(Note B**)**	**0 pcs** **50+5 pcs / lot**	**0**
Pressure Pot	**121°c , 15+/-1 PSIG, RH=100%**	**96 hrs**	**Standard: 2 lots** **(Note B**)**	**110 pcs** **50+5 pcs / lot**	**0**
Temperature Cycle	**-65°c to 150°c , air to air,**	**250 / 500 cycles**	**Standard: 2 lots** **(Note B**)**	**110 pcs** **50+5 pcs / lot**	**0**

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III. Result of Reliability Stress for AO3701 (Standard) & AO3701L (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 AO3701 and AO3701L burn-in data up to the published date.
Note B: The pressure pot, temperature cycle and HAST reliability data for AO3701 and AO3701L comes from the AOS generic package qualification data.

IV. Reliability Evaluation

FIT rate (per billion): 7.2
MTTF = 15854 years

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 (AO3701). 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 (2×164) (500) (258) +2 (2×164) (1000) (258)**]** = 7.2

MTTF = 10^9 / FIT = 1.38×10^8hrs = 15854 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**