



# **AOS Semiconductor Product Reliability Report**

**AO7405/AO7405L, rev B**

**Plastic Encapsulated Device**

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This AOS product reliability report summarizes the qualification result for AO7405/AO7405L. 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 AO7405/AO7405L 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 AO7405 uses advanced trench technology to provide excellent  $R_{DS(ON)}$ , low gate charge, and operation with gate voltages as low as 2.5V, in the small SOT363 footprint. It can be used for a wide variety of applications, including load switching, low current inverters and low current DC-DC converters. Standard Product AO7405 is Pb-free (meets ROHS & Sony 259 specifications). AO7405L is a Green Product ordering option. AO7405 and AO7405L are electrically identical.

Absolute Maximum Ratings $T_A=25^\circ\text{C}$ unless otherwise noted				
Parameter		Symbol	Maximum	Units
Drain-Source Voltage		$V_{DS}$	-30	V
Gate-Source Voltage		$V_{GS}$	$\pm 12$	V
Continuous Drain Current	$T_A=25^\circ\text{C}$	$I_D$	-1.6	A
	$T_A=70^\circ\text{C}$		-1.3	
Pulsed Drain Current		$I_{DM}$	-10	
Power Dissipation	$T_A=25^\circ\text{C}$	$P_D$	0.625	W
	$T_A=70^\circ\text{C}$		0.4	
Junction and Storage Temperature Range		$T_J, T_{STG}$	-55 to 150	$^\circ\text{C}$

Thermal Characteristics					
Parameter		Symbol	Typ	Max	Units
Maximum Junction-to-Ambient	$T \leq 10\text{s}$	$R_{\theta JA}$	160	200	$^\circ\text{C/W}$
	Steady-State		180	220	
Maximum Junction-to-Lead	Steady-State	$R_{\theta JL}$	130	160	

## II. Die / Package Information:

	<b>AO7405</b>	<b>AO7405L (Green Compound)</b>
<b>Process</b>	Standard sub-micron low voltage P channel process	Standard sub-micron low voltage P channel process
<b>Package Type</b>	SC-70 3L	SC-70 3L
<b>Lead Frame</b>	Alloy 42 Ag spot	Alloy 42 Ag spot
<b>Die Attach</b>	Silver epoxy	Silver epoxy
<b>Bondwire</b>	1.3mils Au wire	1.3mils Au wire
<b>Mold Material</b>	Epoxy resin with silica filler	Epoxy resin with silica filler
<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 AO7405 (Standard) & AO7405L (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/85RH +3 cycle reflow@260°C	0hr	Standard: 4 lots Green: 4 lots	1265 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: 4 lots Green: 4 lots  (Note B**)	440 pcs  50+5 pcs / lot	0
Pressure Pot	121°C, 29.7psi, RH=100%	96 hrs	Standard: 4 lots Green: 3 lots  (Note B**)	385 pcs  50+5 pcs / lot	0
Temperature Cycle	-65°C to 150°C, air to air, 0.5hr per cycle	250 / 500 cycles	Standard: 4 lots Green: 4 lots  (Note B**)	440 pcs  50+5 pcs / lot	0
DPA	Internal Vision Cross-section X-ray	NA	5 5 5	5 pcs 5 pcs 5 pcs	0
CSAM		NA	5	5 pcs	0

<b>Bond Integrity</b>	Room Temp	0hr	40	40 wires	<b>0</b>
	150 c bake	250hr	40	40 wires	
	150 c bake	500hr	40	40 wires	
<b>Solderability</b>	230 c	5 sec	15	15 leads	<b>0</b>
<b>Die shear</b>	150 c	0hr	10	10 pcs	<b>0</b>

**Note A:** The HTGB and HTRB reliability data presents total of available AO7405 and AO7405L burn-in data up to the published date.

**Note B:** The pressure pot, temperature cycle and HAST reliability data for AO7405 and AO7405L comes from the AOS generic package qualification data.

#### IV. Reliability Evaluation

**FIT rate (per billion): 11.7**

**MTTF = 9757 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 (AO7405). Failure Rate Determination is based on JEDEC Standard JESD 85. FIT means one failure per billion hours.

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

$$= 1.83 \times 10^9 / [2 (2 \times 164) (168) (258) + 2 (164) (500) (258) + 2 (164) (1000) (258)] = 11.7$$

$$\text{MTTF} = 10^9 / \text{FIT} = 8.54 \times 10^7 \text{hrs} = 9757 \text{years}$$

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

**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**