



AOS Semiconductor Product Reliability Report

AO7412/AO7412L, rev A

Plastic Encapsulated Device

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This AOS product reliability report summarizes the qualification result for AO7412. 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 AO7412 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.

Table of Contents:

- I. Product Description
- II. Package and Die information
- III. Environmental Stress Test Summary and Result
- IV. Reliability Evaluation
- V. Quality Assurance Information

I. Product Description:

The AO7412 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 SOT23 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 AO7412 is Pb-free (meets ROHS & Sony 259 specifications). AO7412L is a Green Product ordering option. AO7412 and AO7412L 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}	± 12	V
Continuous Drain Current ^A	$T_A=25^\circ\text{C}$	I_D	2.1	A
	$T_A=70^\circ\text{C}$		1.7	
Pulsed Drain Current ^B		I_{DM}	10	
Power Dissipation ^A	$T_A=25^\circ\text{C}$	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	$T \leq 10\text{s}$	$R_{\theta JA}$	175	200	$^\circ\text{C/W}$
	Steady-State		200	250	
Maximum Junction-to-Lead	Steady-State	$R_{\theta JL}$	130	160	

II. Die / Package Information:

	AO7412	AO7412L (Green Compound)
Process	Standard sub-micron low voltage N channel process	Standard sub-micron low voltage N channel process
Package Type	SC-70 6L	SC-70 6L
Lead Frame	Alloy 42 Ag spot	Alloy 42 Ag spot
Die Attach	Silver epoxy	Silver epoxy
Bondwire	1.3 mils Au wire	1.3 mils Au wire
Mold Material	Epoxy resin with silica filler	Epoxy resin with silica filler
Filler % (Spherical/Flake)	50/50	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 AO7412 (Standard) & AO7412L (Green)

Test Item	Test Condition	Time Point	Lot Attribution	Total Sample size	Number of Failures
Solder Reflow Precondition	Normal: 1hr PCT+3 cycle IR reflow@260 °c Green: 168hr 85°C /85RH +3 cycle IR reflow @260 °c	0hr	Normal: 2 lots Green: 3 lots	770 pcs	0
HTGB	Temp = 150 C, Vgs=100% of Vgsmax	168 / 500 hrs 1000 hrs	Normal: 1 lots Green: 1 lot (Note A*)	164 pcs 77+5 pcs / lot	0
HTRB	Temp = 150 C, Vds=80% of Vdsmax	168 / 500 hrs 1000 hrs	Normal: 1 lots Green: 1 lot (Note A*)	164 pcs 77+5 pcs / lot	0
HAST	130 +/- 2 C, 85%, 33.3 psi, Vgs = 80% of Vgs max	100 hrs	Normal: 1 lots Green: 3 lots (Note B**)	220 pcs 50+5 pcs / lot	0
Pressure Pot	121 C, 15+/-1 PSIG, RH=100%	96 hrs	Normal: 2 lots Green: 3 lots (Note B**)	275 pcs 50+5 pcs / lot	0
Temperature Cycle	-65 to 150 deg C, air to air, 0.5hr per cycle	250 / 500 cycles	Normal: 2 lots Green: 3 lots (Note B**)	275 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
Die shear	150°C	0hr	10	10	0

Note A: The HTGB and HTRB reliability data presents total of available AO7412 and AO7412L burn-in data up to the published date.

Note B: The pressure pot, temperature cycle and HAST reliability data for AO7412L comes from the AOS generic green compound package qualification data.

IV. Reliability Evaluation

FIT rate (per billion): 14

MTTF = 8154 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 (AO7412). Failure Rate Determination is based on JEDEC Standard JESD 85. FIT means one failure per billion hours.

$$\begin{aligned} \text{Failure Rate} &= \text{Chi}^2 \times 10^9 / [2 (N) (H) (Af)] \\ &= 1.83 \times 10^9 / [2 (164) (500) (258) + 2 (164) (1000) (258)] \\ &= 14 \end{aligned}$$

$$\text{MTTF} = 10^9 / \text{FIT} = 7.14 \times 10^7 \text{hrs} = 8154 \text{ years}$$

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 = 55C)

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 = Boltzman's constant, 8.617164 X 10E -5eV / 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**

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