ALPHA & OMEGA SEMICONDUCTOR

AOS Semiconductor Product Reliability Report

AO4912/AO4912L, rev B

Plastic Encapsulated Device

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This AOS product reliability report summarizes the qualification result for AO4912. 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 AO4912passes 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:

The AO4912 uses advanced trench technology to provide excellent $R_{DS(ON)}$ and low gate charge. The two MOSFETs make a compact and efficient switch and synchronous rectifier combination for use in DC-DC converters. A Schottky diode is co-packaged in parallel with the synchronous MOSFET to boost efficiency further Standard Product AO4912 is Pb-free (meets ROHS & Sony 259 specifications). AO4912L is a Green Product ordering option. AO4912 and AO4912L are electrically identical.

Absolute Maximum Ratings T_A=25°C unless otherwise noted					
Parameter		**Symbol**	**Max Q1**	**Max Q2**	**Units**
Drain-Source Voltage		V_{DS}	30	30	V
Gate-Source Voltage		V_{GS}	±20	±12	V
Continuous Drain Current	T_A=25°C	I_D	8.5	7	A
	T_A=70°C		6.8	6.4	
Pulsed Drain Current		I_{DM}	40	30	
Power Dissipation	T_A=25°C	P_D	2	2	W
	T_A=70°C		1.28	1.28	
Junction and Storage Temperature Range		T_J, T_{STG}	-55 to 150	-55 to 150	°C

Parameter		**Symbol**	**Maximum Schottky**	**Units**
Reverse Voltage		V_{DS}	30	V
Continuous Forward Current	T_A=25°C	I_F	3	A
	T_A=70°C		2.2	
Pulsed Forward Current [B]		I_{FM}	20	
Power Dissipation	T_A=25°C	P_D	2	W
	T_A=70°C		1.28	
Junction and Storage Temperature Range		T_J, T_{STG}	-55 to 150	°C

Thermal Characteristics MOSFET Q1		Symbol	Typ	Max	Units
Maximum Junction-to-Ambient	t ≤ 10s	$R_{\theta JA}$	48	62.5	°C/W
Maximum Junction-to-Ambient	Steady-State		74	110	
Maximum Junction-to-Lead	Steady-State	$R_{\theta JL}$	35	40	

Thermal Characteristics MOSFET Q2		Symbol	Typ	Max	Units
Maximum Junction-to-Ambient	t ≤ 10s	$R_{\theta JA}$	48	62.5	°C/W
Maximum Junction-to-Ambient	Steady-State		74	110	
Maximum Junction-to-Lead	Steady-State	$R_{\theta JL}$	35	40	

Thermal Characteristics Schottky		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		71	110	
Maximum Junction-to-Lead	Steady-State	$R_{\theta JL}$	32	40	

II. Die / Package Information:

	AO4912	**AO4912L (Green Compound)**
Process	Standard sub-micron low voltage N channel process	Standard sub-micron low voltage N channel process
Package Type	8 lead SOIC	8 lead SOIC
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

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III. Result of Reliability Stress for AO4912 (Standard) & AO4912L (Green)

Test Item	Test Condition	Time Point	Lot Attribution	Total Sample size	Number of Failures
Solder Reflow Precondition	Standard: 1hr PCT+3 cycle IR reflow@260 °c Green: 168hr 85/85 THB+3 cycle IR reflow@260 °c	0hr	Standard: 49 lots Green: 16 lots	9625 pcs	0
HTGB	Temp = 150°c, Vgs=100% of Vgsmax	168 / 500 hrs 1000 hrs	1 lot (note A*)	82 pcs 77+5 pcs / lot	0
HTRB	Temp = 150°c, Vds=80% of Vdsmax	168 / 500 hrs 1000 hrs	1 lot (note A*)	82 pcs 77+5 pcs / lot	0
HAST	130 +/- 2°c, 85%, 33.3 psi, Vgs = 80% of Vgs max	100 hrs	Standard 33 lots Green: 13 lots (note B**)	2530 pcs 50+5 pcs / lot	0
Pressure Pot	121°c, 15+/-1 PSIG, RH=100%	96 hrs	Standard: 49 lots Green: 16 lots (note B**)	3575 pcs 50+5 pcs / lot	0
Temperature Cycle	-65 to 150°c, air to air, 0.5hr per cycle	250 / 500 cycles	Standard: 49 lots Green: 15 lots (note B**)	3520 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 AO4912and AO4912L burn-in data up to the published date.
Note B: The pressure pot, temperature cycle and HAST reliability data for AO4912and AO4912L comes from the AOS generic package qualification data.

IV. Reliability Evaluation
FIT rate (per billion): 21
MTTF = 5436 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 (AO4912). 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) (1000) (258)**]** = 21
MTTF = 10^9 / FIT =4.76×10^7hrs =5436 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 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**