



AOS Semiconductor Product Reliability Report

AO4948/AO4948L, rev A

Plastic Encapsulated Device

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This AOS product reliability report summarizes the qualification result for AO4948. 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 AO4948 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 AO4948/L 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 monolithically integrated Schottky diode in parallel with the synchronous MOSFET to boost efficiency further. AO4948 and AO4948L are electrically identical.

- RoHS Compliant
- AO4948L is Halogen Free

Absolute Maximum Ratings $T_A=25^\circ\text{C}$ unless otherwise noted							
Parameter	Symbol	Max FET1		Max FET2		Units	
		10 sec	Steady-State	10 sec	Steady-State		
Drain-Source Voltage	V_{DS}	30		30		V	
Gate-Source Voltage	V_{GS}	± 20		± 20		V	
Continuous Drain Current ^{A,F}	$T_A=25^\circ\text{C}$	8.8	6.7	8.5	6.4	A	
	$T_A=70^\circ\text{C}$	7.1	5.3	6.8	5.1		
Pulsed Drain Current ^B	I_{DM}	60		40		A	
Avalanche Current ^B	I_{AR}	21		16		A	
Repetitive avalanche energy $L=0.3\text{mH}$ ^B	E_{AR}	66		38		mJ	
Power Dissipation ^A	$T_A=25^\circ\text{C}$	2	1.1	2	1.1	W	
	$T_A=70^\circ\text{C}$	1.3	0.7	1.3	0.7		
Junction and Storage Temperature Range	T_J, T_{STG}	-55 to 150		-55 to 150		$^\circ\text{C}$	
Thermal Characteristics FET1(Integrated Schottky Diode)							
Parameter	Symbol	Typ		Max		Units	
Maximum Junction-to-Ambient ^A	$R_{\theta JA}$	$t \leq 10\text{s}$	48		62.5		$^\circ\text{C/W}$
Maximum Junction-to-Ambient ^A		Steady-State	74		110		$^\circ\text{C/W}$
Maximum Junction-to-Lead ^C	$R_{\theta JL}$	32		40		$^\circ\text{C/W}$	
Thermal Characteristics FET2							
Parameter	Symbol	Typ		Max		Units	
Maximum Junction-to-Ambient ^A	$R_{\theta JA}$	$t \leq 10\text{s}$	48		62.5		$^\circ\text{C/W}$
Maximum Junction-to-Ambient ^A		Steady-State	74		110		$^\circ\text{C/W}$
Maximum Junction-to-Lead ^C	$R_{\theta JL}$	32		40		$^\circ\text{C/W}$	

II. Die / Package Information:

	AO4948	AO4948L (Green Compound)
Process	Standard sub-micron	Standard sub-micron
Package Type	Low voltage N channel process	Low voltage N channel process
Lead Frame	8 leads SOIC	8 leads SOIC
Die Attach	Cu, D/pad Ag spot	Cu, D/pad Ag spot
Bond wire	Ag epoxy	Ag epoxy
Mold Material	S: Cu 2mils; G: Au 1.3mils	S: Cu 2mils; G: Au 1.3mils
Flammability Rating	Epoxy resin with silica filler	Epoxy resin with silica filler
Backside Metallization	UL-94 V-0	UL-94 V-0
Moisture Level	Ti / Ni / Ag	Ti / Ni / Ag
	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 AO4948 (Standard) & AO4948L (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	-	Standard: 83 lots Green: 29 lots	17380 pcs	0
HTGB	Temp = 150°C , Vgs=100% of Vgsmax	168hrs 500 hrs 1000 hrs	1 lot (Note A*)	77 pcs 77 pcs / lot	0
HTRB	Temp = 150°C , Vds=80% of Vdsmax	168hrs 500 hrs 1000 hrs	1 lot (Note A*)	77 pcs 77 pcs / lot	0
HAST	130 +/- 2°C , 85%RH, 33.3 psi, Vgs = 80% of Vgs max	100 hrs	Standard: 81 lots Green: 16 lots (Note B**)	5335 pcs 55 pcs / lot	0
Pressure Pot	121°C , 29.7psi, RH=100%	96 hrs	Standard: 83 lots Green: 20 lots (Note B**)	5665 pcs 55 pcs / lot	0
Temperature Cycle	-65°C to 150°C , air to air	250 / 500 cycles	Standard: 87 lots Green: 29 lots (Note B**)	6380 pcs 55 pcs / lot	0

III. Result of Reliability Stress for AO4948 (Standard) & AO4948L (Green) Continues

DPA	Internal Vision Cross-section X-ray	NA	5	5	0
			5	5	
			5	5	
CSAM		NA	5	5	0
Bond Integrity	Room Temp 150°C bake 150°C bake	0hr	40	40 wires	0
		250hr	40	40 wires	
		500hr	40	40 wires	
Solderability	245°C	5 sec	15	15 leads	0

Note A: The HTGB and HTRB reliability data presents total of available AO4948 and AO4948L burn-in data up to the published date.

Note B: The pressure pot, temperature cycle and HAST reliability data for AO4948 and AO4948L comes from the AOS generic package qualification data.

IV. Reliability Evaluation

FIT rate (per billion): 137

MTTF = 833 years

The presentation of FIT rate for the individual product reliability is restricted by the actual burn-in sample size of the selected product (AO4948). Failure Rate Determination is based on JEDEC Standard JESD 85. FIT means one failure per billion hours.

$$\text{Failure Rate} = \text{Chi}^2 \times 10^9 / [2 (N) (H) (Af)] = 1.83 \times 10^9 / [2 \times 2 \times 77 \times 258] = 137$$

$$\text{MTTF} = 10^9 / \text{FIT} = 7.30 \times 10^6 \text{hrs} = 833 \text{ years}$$

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 = 55°C)

$$\text{Acceleration Factor [Af]} = \text{Exp} [Ea / k (1/Tj u - 1/Tj s)]$$

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 10⁻⁵eV / K