



AOS Semiconductor Product Reliability Report

AOTF409/AOTF409L, rev A

Plastic Encapsulated Device

ALPHA & OMEGA Semiconductor, Inc

**495 Mercury Drive
Sunnyvale, CA 94085
U.S.**

Tel: (408) 830-9742

www.aosmd.com

Jul 2, 2008

This AOS product reliability report summarizes the qualification result for AOTF409. 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 AOTF409 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 AOTF409/L uses advanced trench technology to provide excellent RDS(ON), low gate charge and low gate resistance. With the excellent thermal resistance of the TO220FL package, this device is well suited for high current load applications. AOTF409 and AOTF409L are electrically identical.

- RoHS Compliant
- AOTF409L Halogen Free

Absolute Maximum Ratings $T_A=25^{\circ}\text{C}$ unless otherwise noted				
Parameter		Symbol	Maximum	Units
Drain-Source Voltage		V_{DS}	40	V
Gate-Source Voltage		V_{GS}	± 20	V
Continuous Drain Current	$T_C=25^{\circ}\text{C}$	I_D	40	A
	$T_C=100^{\circ}\text{C}$		30	
Pulsed Drain Current		I_{DM}	120	
Avalanche Current		I_{AR}	22	A
Power Dissipation	$T_C=25^{\circ}\text{C}$	P_D	33	W
	$T_C=100^{\circ}\text{C}$		16.7	W/ $^{\circ}\text{C}$
Junction and Storage Temperature Range		T_J, T_{STG}	-55 to 175	$^{\circ}\text{C}$

Thermal Characteristics				
Parameter	Symbol	Typ	Max	Units
Maximum Junction-to-Ambient	$R_{\theta JA}$	50	65	$^{\circ}\text{C}/\text{W}$
Maximum Junction-to-Case	$R_{\theta JC}$	3	4.5	$^{\circ}\text{C}/\text{W}$

II. Die / Package Information:

	AOTF409	AOTF409L (Green Compound)
Process	Standard sub-micron Low voltage N channel process	Standard sub-micron Low voltage N channel process
Package Type	3 leads TO220FL	3 leads TO220FL
Lead Frame	Bare Cu	Bare Cu
Die Attach	Soft solder	Soft solder
Bond wire	S: Al 8 mils; G: Al 5mils	S: Al 8 mils; G: Al 5mils
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 AOTF409 (Standard) & AOTF409L (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: 11 lots	1915pcs	0
HTGB	Temp = 150°C , Vgs=100% of Vgsmax	168 / 500 hrs 1000 hrs	1 lot (Note A*)	82pcs 77+5 pcs / lot	0
HTRB	Temp = 150°C , Vds=80% of Vdsmax	168 / 500 hrs 1000 hrs	1 lot (Note A*)	82pcs 77+5 pcs / lot	0
HAST	130 +/- 2°C , 85%RH, 33.3 psi, Vgs = 80% of Vgs max	100 hrs	Standard : 5 lots (Note B**)	275pcs 50+5 pcs / lot	0
Pressure Pot	121°C , 29.7psi, 100%RH	96 hrs	Standard :11 lots (Note B**)	902pcs 77+5 pcs / lot	0
Temperature Cycle	-65°C to 150°C , air to air,	250 / 500 cycles	Standard : 9 lots (Note B**)	738pcs 77+5 pcs / lot	0

III. Result of Reliability Stress for AOTF409 (Standard) & AOTF409L (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	245°C	5 sec	15	15 leads	0

Note A: The HTGB and HTRB reliability data presents total of available AOTF409 and AOTF409L burn-in data up to the published date.

Note B: The pressure pot, temperature cycle, HAST and HTS reliability data for AOTF409 and AOTF409L comes from the AOS generic package qualification data.

IV. Reliability Evaluation

FIT rate (per billion): 43
MTTF = 2654 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 (AOTF409). Failure Rate Determination is based on JEDEC Standard JESD 85. FIT means one failure per billion hours.

$$\text{Failure Rate} = \text{Chi}^2 \times 10^9 / [2 (N) (H) (Af)] = 1.83 \times 10^9 / [2 (164) (500) (258)] = 43$$

$$\text{MTTF} = 10^9 / \text{FIT} = 2.32 \times 10^7 \text{hrs} = 2654 \text{ years}$$

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)

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, $8.617164 \times 10^{-5} \text{eV} / \text{K}$



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**