# AOS Semiconductor
# Product Reliability Report

## AOP607/AOP607L, rev C

**Plastic Encapsulated Device**


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This AOS product reliability report summarizes the qualification result for AOP607. 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 AOP607 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 AOP607 uses advanced trench technology MOSFETs to provide excellent $R_{DS\ (ON)}$ and low gate charge. The complementary MOSFETs may be used in H-bridge, Inverters and other applications. Standard Product AOP607 is Pb free (meets ROHS & Sony 259 specifications). AOP607L is a Green Product ordering option. AOP607 and AOP607L are electrically identical.

| **Absolute Maximum Ratings $T_A$=25°C unless otherwise noted** | | | | | |
|---|---|---|---|---|---|
| **Parameter** | | **Symbol** | **Max n-channel** | **Max p-channel** | **Units** |
| Drain-Source Voltage | | $V_{DS}$ | 60 | -60 | V |
| Gate-Source Voltage | | $V_{GS}$ | ±20 | ±20 | V |
| Continuous Drain Current | $T_A$=25°C | $I_D$ | 4.7 | -3.4 | A |
| | $T_A$=100°C | | 3.8 | -2.7 | |
| Pulsed Drain Current | | $I_{DM}$ | 20 | -20 | |
| Power Dissipation | $T_A$=25°C | $P_D$ | 2.5 | 2.5 | W |
| | $T_A$=100°C | | 1.6 | 1.6 | |
| Junction and Storage Temperature Range | | $T_J$, $T_{STG}$ | -55 to 150 | -55 to 150 | °C |

| **Thermal Characteristics: n-channel and p-channel** | | | | | | |
|---|---|---|---|---|---|---|
| **Parameter** | | **Symbol** | **Device** | **Typ** | **Max** | **Units** |
| Maximum Junction-to-Ambient | t ≤ 10s | $R_{\theta JA}$ | n-ch | 37 | 50 | °C/W |
| Maximum Junction-to-Ambient | Steady-State | | n-ch | 74 | 90 | °C/W |
| Maximum Junction-to-Lead | Steady-State | $R_{\theta JL}$ | n-ch | 28 | 40 | °C/W |
| Maximum Junction-to-Ambient | t ≤ 10s | $R_{\theta JA}$ | p-ch | 35 | 50 | °C/W |
| Maximum Junction-to-Ambient | Steady-State | | p-ch | 73 | 90 | °C/W |
| Maximum Junction-to-Lead | Steady-State | $R_{\theta JL}$ | p-ch | 32 | 40 | °C/W |

## II. Die / Package Information:

| | AOP607 | AOP607L (Green Compound) |
|---|---|---|
| **Process** | Standard sub-micron<br>low voltage N/P channel | Standard sub-micron<br>low voltage N/P channel |
| **Package Type** | DIP-8 | DIP-8 |
| **Lead Frame** | Cu, Ag spot | Cu, Ag spot |
| **Die Attach** | Ag Epoxy | Ag Epoxy |
| **Bond wire** | Au, 2 mils | Au, 2 mils |
| **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 AOP607 (Standard) & AOP607L (Green)

| Test Item | Test Condition | Time Point | Lot Attribution | Total Sample size | Number of Failures |
|---|---|---|---|---|---|
| Solder Reflow Precondition | Standard: 1hr PCT+3 cycle reflow@250°c<br>Green: 168hr 85°c /85%RH +3 cycle reflow@250°c | 0hr | Standard: 14 lots<br>Green: 4 lots | 2860 pcs | 0 |
| HTGB | Temp = 150°c , Vgs=100% of Vgsmax | 168 / 500 hrs<br>1000 hrs | 3 lots<br>(Note A*) | 246 pcs<br>77+5 pcs / lot | 0 |
| HTRB | Temp = 150°c , Vds=80% of Vdsmax | 168 / 500 hrs<br>1000 hrs | 3 lots<br>(Note A*) | 246 pcs<br>77+5 pcs / lot | 0 |
| HAST | 130 +/- 2°c , 85%RH, 33.3 psi, Vgs = 80% of Vgs max | 100 hrs | Standard: 14 lots<br>Green: 4 lots<br>(Note B**) | 990 pcs<br>50+5 pcs / lot | 0 |
| Pressure Pot | 121°c , 15+/-1 PSIG, RH=100% | 96 hrs | Standard: 14 lots<br>Green: 3 lots<br>(Note B**) | 935 pcs<br>50+5 pcs / lot | 0 |
| Temperature Cycle | -65°c to 150°c , air to air, | 250 / 500 cycles | Standard: 14 lots<br>Green: 3 lots<br>(Note B**) | 935 pcs<br>50+5 pcs / lot | 0 |

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## III. Result of Reliability Stress for AOP607 (Standard) & AOP607L (Green)

**Continues**

| **DPA** | **Internal Vision**<br>**Cross-section**<br>**X-ray** | **NA** | **5**<br>**5**<br>**5** | **5**<br>**5**<br>**5** | **0** |
|---|---|---|---|---|---|
| **CSAM** | | **NA** | **5** | **5** | **0** |
| **Bond Integrity** | **Room Temp**<br>**150°c bake**<br>**150°c bake** | **0hr**<br>**250hr**<br>**500hr** | **40**<br>**40**<br>**40** | **40 wires**<br>**40 wires**<br>**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 AOP607 and AOP607L burn-in data up to the published date.
**Note B:** The pressure pot, temperature cycle and HAST reliability data for AOP607 and AOP607L comes from the AOS generic package qualification data.

## IV. Reliability Evaluation

### FIT rate (per billion):18.5
### MTTF = 6170 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 (AOP607). 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)**]**
= $1.83 \times 10^9$ / [2 (164) (168) (258) + 2 (2×164) (500) (258)**]** = 18.5
**MTTF =** $10^9$ / FIT =$5.4 \times 10^7$hrs = 6170 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, $8.617164 \times 10^{-5}$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**