



# ***AOS Semiconductor Reliability Report***

## ***Reliability Annual Report\_2011***

**ALPHA & OMEGA Semiconductor, Inc**

**[www.aosmd.com](http://www.aosmd.com)**

## Commitment to Excellence at Quality & Reliability

To achieve this vision, AOS continuously strive for the excellence in design, manufacturing, reliability and proactively response to the customer's feedback.

AOS ensures that all the product quality and reliability exceed the customer's expectation by constantly assessing any potential risk, identifying cause of the suspected failures, driving corrective actions and developing prevention plan within the committed time through the continuously improvement.

This AOS product reliability report summarizes AOS Product Reliability result of Year 2011. The published product reliability data combines the results from new product Qualification Test Plan and routine Reliability Monitor Program activities. Accelerated environmental tests are performed on a specific sample size, and then followed by electrical test at end point. The released product will be categorized by the process family and be monitored on a monthly for short term program and quarterly basis for long term program. Table 1 lists the generic reliability qualification requirements and conditions for process / product in plastic package:

Table 1: AOS Generic Reliability Qualification Requirements

Test Item	Test Condition	Time Point	Sample Size	Acc/Reject & LTPD
<b>HTGB</b>	Temp = 150°C, Vgs=100% of Vgsmax	168 / 500 / 1000 hrs	77 pcs / lot	0/1 <3%
<b>HTRB</b>	Temp = 150°C, Vds=80% of Vdsmax	168 / 500 / 1000 hrs	77 pcs / lot	0/1 <3%
<b>Pre-condition</b>	168hr 85°C /85RH @250°C or 260 °C (depending on the package size)	-	209 pcs / lot	0/1 <3%
<b>HAST</b>	130°C, 85%RH, 33.3 psi, Vgs = 100% of Vgs max,	100 hrs	55 pcs / lot	0/1, <5%
<b>Pressure Pot</b>	121°C, 29.7 psi, RH=100%	96 hrs	77 pcs / lot	0/1, <3%
<b>Temperature Cycle</b>	-65 to 150 deg C, air to air, 3 cycles per hour	500 cycles	77 pcs / lot	0/1, <3%

### **High Temperature Gate Bias & High Temperature Reverse Bias (HTGB&RB)**

HTGB burn-in stress is used to stress gate oxide at the elevated temperature environment hence any of the gate oxide integrity issue can be identified. HTRB burn-in stress is used to verify junction degradation under the maximum operation temperature. Through HTGB & HTRB B/I stress test, the device lifetime in field operation & long term device level reliability can be determined. FIT rate is calculated by applying the Arrhenius equation with the activation energy of 0.7eV and 60% of upper confidence level at 55 deg C operating conditions.

### **Solder reflow precondition (pre-con)**

Solder reflow precondition is the test that simulates shipment and storage of package in uncontrollable environment. Precondition is the pre requirement for the mechanical related reliability tests, such as Temperature Cycle, Pressure Pot (PCT) and Highly Accelerated Stress TEST (HAST). The routine of the test including parts are soaked in moisture in 85%RH, 85 deg C environment for 168 hrs. Then they will be run through a solder reflow oven 3 times to simulate the SMT stress condition.

### **Temperature Cycling (TC)**

Temperature cycling test is to evaluate the mechanical integrity of the package and the interaction between the die and the package. This is an air to air test at temperature range from -65°C to 150°C and stress duration is from 250 cycles to 500 cycles, 3 cycles per hour.

### **Pressure Pot (PCT)**

PCT test is the test that measures the ability of the device withstand to moisture and contaminant environment. The test is done under enclosed chamber with the condition 121°C, 29.7 psi, 100%RH and stress duration is 96 hrs.

### **Highly Accelerated Stress Test (HAST)**

Highly accelerated stress test is to stress the devices under high humidity, high pressure environment under DC bias condition. If ionic contamination involved, the corrosion from metal layer can be accelerated by the HAST stress condition.

The following tables summarize the qualification results based on the device / process families and the package types, respectively.

## Summary of AOS Device / Process Qualification Monitor Results

To present the actual FIT rate from the different process and device technologies, AOS categorized the device / process family FIT rate by N channel and P channel.

Table 2 listed the summary of HTGB and HTRB results.

**Table 2:**

Process	Equivalent Hrs	Total (years)	# of failure	FIT Rate
N channel	8.51E+09	971276	0	0.12
P channel	2.37E+09	270997	0	0.42

## Summary of AOS Package Qualification Monitor Results

DFN Family	PCT	TC	HAST
<b>Total stress hours / cycles</b>	<b>997920</b>	<b>7084000</b>	<b>698500</b>
<b># of failure / S.S.</b>	<b>0/10395</b>	<b>0/14168</b>	<b>0/6985</b>
N channel	6545	9548	5005
P channel	3003	3773	1485
Complementary	847	847	495
Subtotal	<b>10395</b>	<b>14168</b>	<b>6985</b>

SO8	PCT	TC	HAST
<b>Total stress hours / cycles</b>	<b>332640</b>	<b>2772000</b>	<b>121000</b>
<b># of failure / S.S.</b>	<b>0/3465</b>	<b>0/5544</b>	<b>0/1210</b>
N channel	2079	2695	550
P channel	1386	2541	660
Complementary	0	308	0
Subtotal	<b>3465</b>	<b>5544</b>	<b>1210</b>

SOT23	PCT	TC	HAST
<b>Total stress hours / cycles</b>	<b>73920</b>	<b>770000</b>	<b>60500</b>
<b># of failure / S.S.</b>	<b>0/770</b>	<b>0/1540</b>	<b>0/605</b>
N channel	693	847	550
P channel	77	693	55
Complementary	n/a	n/a	n/a
Subtotal	<b>770</b>	<b>1540</b>	<b>605</b>

**Summary of AOS Package Qualification Monitor Results**  
 Cont.

<b>SOT223</b>	<b>PCT</b>	<b>TC</b>	<b>HAST</b>
<b>Total stress hours / cycles</b>	<b>36960</b>	<b>154000</b>	<b>33000</b>
<b># of failure / S.S.</b>	<b>0/385</b>	<b>0/308</b>	<b>0/330</b>
N channel	308	308	220
P channel	77	0	110
Complementary	n/a	n/a	n/a
<b>Subtotal</b>	<b>385</b>	<b>308</b>	<b>330</b>

<b>SC70</b>	<b>PCT</b>	<b>TC</b>	<b>HAST</b>
<b>Total stress hours / cycles</b>	<b>29568</b>	<b>154000</b>	<b>n/a</b>
<b># of failure / S.S.</b>	<b>0/308</b>	<b>0/308</b>	<b>n/a</b>
N channel	0	0	0
P channel	308	308	0
Complementary	0	0	0
<b>Subtotal</b>	<b>308</b>	<b>308</b>	<b>0</b>

<b>SC89</b>	<b>PCT</b>	<b>TC</b>	<b>HAST</b>
<b>Total stress hours / cycles</b>	<b>36960</b>	<b>192500</b>	<b>n/a</b>
<b># of failure / S.S.</b>	<b>0/385</b>	<b>0/385</b>	<b>n/a</b>
N channel	385	385	0
P channel	0	0	0
Complementary	0	0	0
<b>Subtotal</b>	<b>385</b>	<b>385</b>	<b>0</b>

<b>TO220</b>	<b>PCT</b>	<b>TC</b>	<b>HAST</b>
<b>Total stress hours / cycles</b>	<b>362208</b>	<b>2579500</b>	<b>253000</b>
<b># of failure / S.S.</b>	<b>0/3773</b>	<b>0/5159</b>	<b>0/2530</b>
N channel	3234	4235	1980
P channel	539	924	550
Complementary	n/a	n/a	n/a
<b>Subtotal</b>	<b>3773</b>	<b>5159</b>	<b>2530</b>

**Summary of AOS Package Qualification Monitor Results  
 Cont.**

<b>TO220F</b>	<b>PCT</b>	<b>TC</b>	<b>HAST</b>
<b>Total stress hours / cycles</b>	<b>813120</b>	<b>4581500</b>	<b>313500</b>
<b># of failure / S.S.</b>	<b>0/8470</b>	<b>0/9163</b>	<b>0/3135</b>
N channel	6699	6853	2365
P channel	1771	2310	770
Complementary	n/a	n/a	n/a
<b>Subtotal</b>	<b>8470</b>	<b>9163</b>	<b>3135</b>

<b>TO247</b>	<b>PCT</b>	<b>TC</b>	<b>HAST</b>
<b>Total stress hours / cycles</b>	<b>125664</b>	<b>808500</b>	<b>27500</b>
<b># of failure / S.S.</b>	<b>0/1309</b>	<b>0/1617</b>	<b>0/275</b>
N channel	1232	1309	220
P channel	77	308	55
Complementary	n/a	n/a	n/a
<b>Subtotal</b>	<b>1309</b>	<b>1617</b>	<b>275</b>

<b>TO251A</b>	<b>PCT</b>	<b>TC</b>	<b>HAST</b>
<b>Total stress hours / cycles</b>	<b>88704</b>	<b>616000</b>	<b>33000</b>
<b># of failure / S.S.</b>	<b>0/924</b>	<b>0/1232</b>	<b>0/330</b>
N channel	847	1155	275
P channel	77	77	55
Complementary	n/a	n/a	n/a
<b>Subtotal</b>	<b>924</b>	<b>1232</b>	<b>330</b>

<b>TO252 (DPAK)</b>	<b>PCT</b>	<b>TC</b>	<b>HAST</b>
<b>Total stress hours / cycles</b>	<b>206976</b>	<b>1270500</b>	<b>154000</b>
<b># of failure / S.S.</b>	<b>0/2156</b>	<b>0/2541</b>	<b>0/1540</b>
N channel	2079	2387	1430
P channel	77	154	110
Complementary	0	0	0
<b>Subtotal</b>	<b>2156</b>	<b>2541</b>	<b>1540</b>

**Summary of AOS Package Qualification Monitor Results**  
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<b>TO262</b>	<b>PCT</b>	<b>TC</b>	<b>HAST</b>
<b>Total stress hours / cycles</b>	<b>36960</b>	<b>154000</b>	<b>27500</b>
<b># of failure / S.S.</b>	<b>0/385</b>	<b>0/308</b>	<b>0/275</b>
N channel	308	231	220
P channel	77	77	55
Complementary	n/a	n/a	n/a
<b>Subtotal</b>	<b>385</b>	<b>308</b>	<b>275</b>

<b>TO262F</b>	<b>PCT</b>	<b>TC</b>	<b>HAST</b>
<b>Total stress hours / cycles</b>	<b>59136</b>	<b>346500</b>	<b>44000</b>
<b># of failure / S.S.</b>	<b>0/616</b>	<b>0/693</b>	<b>0/440</b>
N channel	616	693	440
P channel	0	0	0
Complementary	n/a	n/a	n/a
<b>Subtotal</b>	<b>616</b>	<b>693</b>	<b>440</b>

<b>TO263 (D2PAK)</b>	<b>PCT</b>	<b>TC</b>	<b>HAST</b>
<b>Total stress hours / cycles</b>	<b>81312</b>	<b>500500</b>	<b>38500</b>
<b># of failure / S.S.</b>	<b>0/847</b>	<b>0/1001</b>	<b>0/385</b>
N channel	847	1001	385
P channel	0	0	0
Complementary	n/a	n/a	n/a
<b>Subtotal</b>	<b>847</b>	<b>1001</b>	<b>385</b>

<b>TSOP6</b>	<b>PCT</b>	<b>TC</b>	<b>HAST</b>
<b>Total stress hours / cycles</b>	<b>7392</b>	<b>115500</b>	<b>5500</b>
<b># of failure / S.S.</b>	<b>0/77</b>	<b>0/231</b>	<b>0/55</b>
N channel	77	154	0
P channel	0	77	55
Complementary	0	0	0
<b>Subtotal</b>	<b>77</b>	<b>231</b>	<b>55</b>

**Summary of AOS Package Qualification Monitor Results**  
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<b>TSSOP8</b>	<b>PCT</b>	<b>TC</b>	<b>HAST</b>
<b>Total stress hours / cycles</b>	<b>22176</b>	<b>192500</b>	<b>n/a</b>
<b># of failure / S.S.</b>	<b>0/231</b>	<b>0/385</b>	<b>n/a</b>
N channel	231	385	0
P channel	0	0	0
Complementary	n/a	n/a	n/a
<b>Subtotal</b>	<b>231</b>	<b>385</b>	<b>0</b>

<b>Ultra SO8</b>	<b>PCT</b>	<b>TC</b>	<b>HAST</b>
<b>Total stress hours / cycles</b>	<b>7392</b>	<b>77000</b>	<b>11000</b>
<b># of failure / S.S.</b>	<b>0/77</b>	<b>0/154</b>	<b>0/110</b>
N channel	77	154	110
P channel	0	0	0
Complementary	n/a	n/a	n/a
<b>Subtotal</b>	<b>77</b>	<b>154</b>	<b>110</b>

<b>WLCSP</b>	<b>PCT</b>	<b>TC</b>	<b>HAST</b>
<b>Total stress hours / cycles</b>	<b>29568</b>	<b>115500</b>	<b>16500</b>
<b># of failure / S.S.</b>	<b>0/308</b>	<b>0/231</b>	<b>0/165</b>
N channel	154	77	55
P channel	154	154	110
Complementary	0	0	0
<b>Subtotal</b>	<b>308</b>	<b>231</b>	<b>165</b>