



# ***AOS Semiconductor Product Reliability Report***

**AON2701/AON2701L, rev A**

**Plastic Encapsulated Device**

**ALPHA & OMEGA Semiconductor, Inc**

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

**Tel: (408) 830-9742**

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

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This AOS product reliability report summarizes the qualification result for AON2701. 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 AON2701 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 AON2701/L uses advanced trench technology to provide excellent  $R_{DS(ON)}$  and low gate charge. A Schottky diode is provided to facilitate the implementation of a bidirectional blocking switch, or for DC-DC conversion applications.

AON2701 and AON2701L are electrically identical.

-RoHS Compliant

-AON2701L is Halogen Free

| Absolute Maximum Ratings $T_A=25^\circ\text{C}$ unless otherwise noted |                        |            |            |                  |
|--|------------------------|------------|------------|------------------|
| Parameter  | Symbol                 | MOSFET     | Schottky   | Units            |
| Drain-Source Voltage   | $V_{DS}$               | -20        |            | V                |
| Gate-Source Voltage  | $V_{GS}$               | $\pm 8$    |            | V                |
| Continuous Drain Current   | $T_A=25^\circ\text{C}$ | -3         |            | A                |
|  | $T_A=70^\circ\text{C}$ | -2.3       |            |                  |
| Pulsed Drain Current   | $I_{DM}$               | -15        |            |                  |
| Schottky reverse voltage   | $V_{KA}$               |            | 20         | V                |
| Continuous Forward Current $I_A$                                       | $T_A=25^\circ\text{C}$ |            | 2.5        | A                |
|  | $T_A=70^\circ\text{C}$ | $I_F$      | 1.5        |                  |
| Pulsed Forward Current   | $I_{FM}$               |            | 15         |                  |
| Power Dissipation  | $T_A=25^\circ\text{C}$ | $P_D$      | 1.5        | W                |
|  | $T_A=70^\circ\text{C}$ |            | 0.95       |                  |
| Junction and Storage Temperature Range                                 | $T_J, T_{STG}$         | -55 to 150 | -55 to 150 | $^\circ\text{C}$ |

| Parameter: Thermal Characteristics MOSFET   |                     | Symbol          | Typ | Max | Units              |
|---|---------------------|-----------------|-----|-----|--------------------|
| Maximum Junction-to-Ambient                 | $T \leq 10\text{s}$ | $R_{\theta JA}$ | 35  | 45  | $^\circ\text{C/W}$ |
| Maximum Junction-to-Ambient                 | Steady-State        |                 | 65  | 85  | $^\circ\text{C/W}$ |
| Parameter: Thermal Characteristics Schottky |                     |                 |     |     |                    |
| Maximum Junction-to-Ambient                 | $T \leq 10\text{s}$ | $R_{\theta JA}$ | 36  | 47  | $^\circ\text{C/W}$ |
| Maximum Junction-to-Ambient                 | Steady-State        |                 | 67  | 87  | $^\circ\text{C/W}$ |

## II. Die / Package Information:

|                                   | AON2701  | AON2701L (Green Compound)                            |
|-----------------------------------|--|--|
| <b>Process</b>                    | Standard sub-micron<br>Low voltage P channel process | Standard sub-micron<br>Low voltage P channel process |
| <b>Package Type</b>               | DFN 2x2_6L   | DFN 2x2_6L   |
| <b>Lead Frame</b>                 | Cu194, NiPdAu  | Cu194, NiPdAu  |
| <b>Die Attach</b>                 | Ag epoxy   | Ag epoxy   |
| <b>Bond wire</b>                  | Au 2mils   | Au 2 mils  |
| <b>Mold Material</b>              | Epoxy resin with silica filler                       | Epoxy resin with silica filler                       |
| <b>Filler % (Spherical/Flake)</b> | 90/10  | 100/0  |
| <b>Flammability Rating</b>        | UL-94 V-0  | UL-94 V-0  |
| <b>Backside Metallization</b>     | Ti / Ni / Ag   | Ti / Ni / Ag   |
| <b>Moisture Level</b>             | 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 AON2701 (Standard) & AON2701L (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<br>Green: 168hr 85°C /85%RH +3 cycle reflow @260°C | 0hr                           | Standard: 2 lots<br>Green: 3 lots<br><br>(Note B**) | 1040 pcs                      | 0                  |
| HTGB                       | Temp = 150°C ,<br>Vgs=100% of Vgsmax  | 168 / 500 hrs<br><br>1000 hrs | 1 lot<br><br>(Note A*)                              | 82 pcs<br><br>77+5 pcs / lot  | 0                  |
| HTRB                       | Temp = 150°C ,<br>Vds=80% of Vdsmax   | 168 / 500 hrs<br><br>1000 hrs | 1 lot<br><br>(Note A*)                              | 82 pcs<br><br>77+5 pcs / lot  | 0                  |
| HAST                       | 130 +/- 2°C , 85%RH,<br>33.3 psi, Vgs = 80% of Vgs max                                    | 100 hrs                       | Standard: 1 lots<br>Green: 3 lots<br><br>(Note B**) | 220 pcs<br><br>50+5 pcs / lot | 0                  |
| Pressure Pot               | 121°C , 29.7psi,<br>100%RH  | 96 hrs                        | Standard: 2 lots<br>Green: 3 lots<br><br>(Note B**) | 410 pcs<br><br>77+5 pcs / lot | 0                  |
| Temperature Cycle          | -65°C to 150°C ,<br>air to air  | 250 / 500 cycles              | Standard: 2 lots<br>Green: 3 lot<br><br>(Note B**)  | 410 pcs<br><br>77+5 pcs / lot | 0                  |

### III. Result of Reliability Stress for AON2701 (Standard) & AON2701 L (Green) Continues

|                       |  |                                |                         |   |          |
|-----------------------|--|--------------------------------|-------------------------|---|----------|
| <b>DPA</b>            | <b>Internal Vision<br/>Cross-section<br/>X-ray</b> | <b>NA</b>                      | <b>5<br/>5<br/>5</b>    | <b>5<br/>5<br/>5</b>                      | <b>0</b> |
| <b>CSAM</b>           |  | <b>NA</b>                      | <b>5</b>                | <b>5</b>                                  | <b>0</b> |
| <b>Bond Integrity</b> | <b>Room Temp<br/>150°c bake<br/>150°c bake</b>     | <b>0hr<br/>250hr<br/>500hr</b> | <b>40<br/>40<br/>40</b> | <b>40 wires<br/>40 wires<br/>40 wires</b> | <b>0</b> |
| <b>Solderability</b>  | <b>245°c</b>                                       | <b>5 sec</b>                   | <b>15</b>               | <b>15 leads</b>                           | <b>0</b> |

**Note A:** The HTGB and HTRB reliability data presents total of available AON2701 and AON2701L burn-in data up to the published date.

**Note B:** The pressure pot, temperature cycle and HAST reliability data for AON2701 and AON2701L comes from the AOS generic package qualification data.

### IV. Reliability Evaluation

**FIT rate (per billion): 128**

**MTTF = 891 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 (AON2701). Failure Rate Determination is based on JEDEC Standard JESD 85. FIT means one failure per billion hours.

$$\text{Failure Rate} = \text{Chi}^2 \times 10^9 / [2 (N) (H) (Af)] = 1.83 \times 10^9 / [2 (164) (168) (258)] = 128$$

$$\text{MTTF} = 10^9 / \text{FIT} = 7.81 \times 10^6 \text{hrs} = 891 \text{ years}$$

**Chi<sup>2</sup>** = 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] =  $\text{Exp} [E_a / k (1/T_j - 1/T_u)]$

**Acceleration Factor ratio list:**

|           | <b>55 deg C</b> | <b>70 deg C</b> | <b>85 deg C</b> | <b>100 deg C</b> | <b>115 deg C</b> | <b>130 deg C</b> | <b>150 deg C</b> |
|-----------|-----------------|-----------------|-----------------|------------------|------------------|------------------|------------------|
| <b>Af</b> | <b>258</b>      | <b>87</b>       | <b>32</b>       | <b>13</b>        | <b>5.64</b>      | <b>2.59</b>      | <b>1</b>         |

**Tjs** = Stressed junction temperature in degree (Kelvin), K = C+273.16

**Tju** = The use junction temperature in degree (Kelvin), K = C+273.16

**k** = Boltzmann's constant, 8.617164 X 10<sup>-5</sup>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**