

RELIABILITY REPORT
FOR

DS4301, Rev A2

Dallas Semiconductor

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Prepared by:

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Conclusion:

The following qualification successfully meets the quality and reliability standards required of all Dallas Semiconductor products and processes:

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In addition, Dallas Semiconductor's continuous reliability monitor program ensures that all outgoing product will continue to meet Maxim's quality and reliability standards. The current status of the reliability monitor program can be viewed at <http://www.maxim-ic.com/TechSupport/dsreliability.html>.

Device Description:

A description of this device can be found in the product data sheet. You can find the product data sheet at http://dbserv.maxim-ic.com/l_datasheet3.cfm.

Reliability Derating:

The Arrhenius model will be used to determine the acceleration factor for failure mechanisms that are temperature accelerated.

$$AfT = \exp((Ea/k) * (1/Tu - 1/Ts)) = tu/ts$$

AfT = Acceleration factor due to Temperature
tu = Time at use temperature (e.g. 55°C)
ts = Time at stress temperature (e.g. 125°C)
k = Boltzmann's Constant (8.617 x 10⁻⁵ eV/°K)
Tu = Temperature at Use (°K)
Ts = Temperature at Stress (°K)
Ea = Activation Energy (e.g. 0.7 ev)

The activation energy of the failure mechanism is derived from either internal studies or industry accepted standards, or activation energy of 0.7ev will be used whenever actual failure mechanisms or their activation energies are unknown. All deratings will be done from the stress ambient temperature to the use ambient temperature.

An exponential model will be used to determine the acceleration factor for failure mechanisms, which are voltage accelerated.

$$AfV = \exp(B * (Vs - Vu))$$

AfV = Acceleration factor due to Voltage
Vs = Stress Voltage (e.g. 7.0 volts)
Vu = Maximum Operating Voltage (e.g. 5.5 volts)
B = Constant related to failure mechanism type (e.g. 1.0, 2.4, 2.7, etc.)

The Constant, B, related to the failure mechanism is derived from either internal studies or industry accepted standards, or a B of 1.0 will be used whenever actual failure mechanisms or their B are unknown. All deratings will be done from the stress voltage to the maximum operating voltage. Failure rate data from the operating life test is reported using a Chi-Squared statistical model at the 60% or 90% confidence level (Cf).

The failure rate, Fr, is related to the acceleration during life test by:

$$Fr = X / (ts * AfV * AfT * N * 2)$$

X = Chi-Sq statistical upper limit
N = Life test sample size

Failure Rates are reported in FITs (Failures in Time) or MTTF (Mean Time To Failure). The FIT rate is related to MTTF by:

$$MTTF = 1/Fr$$

NOTE: MTTF is frequently used interchangeably with MTBF.

The calculated failure rate for this device/process is:

FAILURE RATE: **MTTF (YRS): 89402** **FITS: 1.3**

The parameters used to calculate this failure rate are as follows:

Cf: 60% **Ea: 0.7** **B: 0** **Tu: 25 °C** **Vu: 5.5 Volts**

The reliability data follows. At the start of this data is the device information. The next section is the detailed reliability data for each stress. The reliability data section includes the latest data available.

Device Information:

Process: D6W-2P2M,HPVt,E2,EPROGVt,TCZ ALOCOS:GOI
 Passivation: Passivation w/Nov TEOS Oxide-Nitride
 Die Size: 58 x 51
 Number of Transistors: 0
 Interconnect: Aluminum / 1% Silicon / 0.5% Copper
 Gate Oxide Thickness: 150 Å

ELECTRICAL CHARACTERIZATION

| DESCRIPTION | DATE CODE | CONDITION | READPOINT | QUANTITY | FAILS |
|-----------------|-----------|-----------------------------|-----------|----------|----------|
| ESD SENSITIVITY | 0330 | EOS/ESD S5.1 HBM 500 VOLTS | 1 PUL'S | 3 | 0 |
| ESD SENSITIVITY | 0330 | EOS/ESD S5.1 HBM 1000 VOLTS | 1 PUL'S | 3 | 0 |
| ESD SENSITIVITY | 0330 | EOS/ESD S5.1 HBM 4000 VOLTS | 1 PUL'S | 3 | 3 |
| ESD SENSITIVITY | 0330 | EOS/ESD S5.1 HBM 8000 VOLTS | 1 PUL'S | 3 | 3 |
| ESD SENSITIVITY | 0330 | EOS/ESD S5.1 HBM 2000 VOLTS | 1 PUL'S | 12 | 0 |
| LATCH-UP | 0330 | JESD78, I-TEST 85C | | 6 | 0 |
| LATCH-UP | 0330 | JESD78, Vsupply TEST 85C | | 6 | 0 |
| Total: | | | | | 6 |

OPERATING LIFE

| DESCRIPTION | DATE CODE | CONDITION | READPOINT | QUANTITY | FAILS |
|-------------------|-----------|-------------------------------|-----------|----------|-------|
| HIGH VOLTAGE LIFE | 0301 | 125C, 6.0V (PSA) &12.0V (PSB) | 1016 HRS | 77 | 0 |
| HIGH VOLTAGE LIFE | 0303 | 125C, 6.0 VOLTS | 1000 HRS | 77 | 0 |
| HIGH VOLTAGE LIFE | 0305 | 125C, 6.0 VOLTS | 1000 HRS | 77 | 1 |
| HIGH VOLTAGE LIFE | 0305 | 125C, 6.0 VOLTS | 1000 HRS | 45 | 0 |
| HIGH VOLTAGE LIFE | 0306 | 125C, 6.0 VOLTS | 1000 HRS | 77 | 0 |
| HIGH VOLTAGE LIFE | 0306 | 125C, 6.0 VOLTS | 1000 HRS | 74 | 0 |
| HIGH VOLTAGE LIFE | 0306 | 125C, 6.0 VOLTS | 1000 HRS | 77 | 0 |
| HIGH VOLTAGE LIFE | 0306 | 125C, 6.0 VOLTS | 1000 HRS | 77 | 0 |

| | | | | | |
|---------------------|------|-------------------------------|----------|---------------|----------|
| HIGH VOLTAGE LIFE | 0306 | 125C, 6.0V (PSA) &12.0V (PSB) | 1000 HRS | 77 | 0 |
| HIGH VOLTAGE LIFE | 0307 | 125C, 6.0 VOLTS | 1000 HRS | 80 | 0 |
| HIGH VOLTAGE LIFE | 0307 | 125C, 6.0 VOLTS | 1000 HRS | 80 | 0 |
| HIGH TEMP OP LIFE | 0312 | 125C, 5.5 VOLTS | 1000 HRS | 45 | 0 |
| HIGH TEMP OP LIFE | 0312 | 125C, 5.5 VOLTS | 1000 HRS | 80 | 0 |
| HIGH TEMP OP LIFE | 0315 | 125C, 5.5 VOLTS | 1000 HRS | 45 | 0 |
| HIGH TEMP OP LIFE | 0316 | 125C, 5.5 VOLTS | 1000 HRS | 77 | 0 |
| HIGH VOLTAGE LIFE | 0316 | 125C, 6.0 VOLTS | 1000 HRS | 45 | 0 |
| HIGH TEMP OP LIFE | 0320 | 125C, 3.6 VOLTS | 1000 HRS | 77 | 0 |
| HIGH TEMP OP LIFE | 0323 | 125C, 5.5 VOLTS | 1000 HRS | 80 | 0 |
| HIGH TEMP OP LIFE | 0325 | 125C, 5.5 VOLTS | 1000 HRS | 77 | 0 |
| HIGH TEMP OP LIFE | 0325 | 125C, 5.5 VOLTS | 1000 HRS | 77 | 0 |
| HIGH VOLTAGE LIFE | 0327 | 125C, 5.5 VOLTS | 1000 HRS | 45 | 0 |
| HIGH TEMP REVERSE B | 0330 | 125C, 5.5 VOLTS | 1000 HRS | 45 | 0 |
| HIGH TEMP REVERSE B | 0330 | 125C, 5.5 VOLTS | 1000 HRS | 45 | 0 |
| HIGH TEMP REVERSE B | 0330 | 125C, 5.5 VOLTS | 1000 HRS | 45 | 0 |
| HIGH TEMP OP LIFE | 0330 | 125C, 5.5 VOLTS | 1000 HRS | 77 | 0 |
| | | | | Total: | 1 |

W/E ENDURANCE AND DATA RET'N

| DESCRIPTION | DATE CODE | CONDITION | READPOINT | QUANTITY | FAILS |
|--------------------|-----------|---------------------------------|-----------|----------|-------|
| WRITE CYCLE STRESS | 0301 | 85 C, 6.0 V (PSA): 12.0 V (PSB) | 30 KCYS | 77 | 0 |
| STORAGE LIFE | | 150C | 1000 HRS | 75 | 0 |
| WRITE CYCLE STRESS | 0303 | 85 C , 5.25 VOLTS | 20 KCYS | 77 | 0 |
| STORAGE LIFE | | 150C | 1000 HRS | 77 | 0 |
| WRITE CYCLE STRESS | 0303 | 25 C, 5.25 VOLTS | 50 KCYS | 77 | 0 |
| STORAGE LIFE | | 150C | 1000 HRS | 77 | 0 |
| WRITE CYCLE STRESS | 0303 | 25 C, 5.25 VOLTS | 40 KCYS | 77 | 0 |
| WRITE CYCLE STRESS | 0305 | 85 C, 6.0 VOLTS | 50 KCYS | 77 | 0 |
| STORAGE LIFE | | 150C | 1000 HRS | 77 | 0 |
| WRITE CYCLE STRESS | 0306 | 85 C, 6.0 V (PSA): 12.0 V (PSB) | 30 KCYS | 77 | 0 |
| STORAGE LIFE | | 150C | 1000 HRS | 77 | 0 |
| WRITE CYCLE STRESS | 0312 | 85 C, 5.5 VOLTS | 30 KCYS | 77 | 0 |
| STORAGE LIFE | | 150C | 1000 HRS | 72 | 0 |
| WRITE CYCLE STRESS | 0314 | 70 C, 5.5 VOLTS | 30 KCYS | 77 | 0 |
| STORAGE LIFE | | 150C | 1000 HRS | 77 | 0 |
| WRITE CYCLE STRESS | 0315 | 70 C, 5.5 VOLTS | 30 KCYS | 77 | 0 |
| STORAGE LIFE | | 150C | 1000 HRS | 77 | 0 |
| WRITE CYCLE STRESS | 0316 | 85 C, 5.5 VOLTS | 25 KCYS | 77 | 0 |
| STORAGE LIFE | | 150C | 1000 HRS | 74 | 0 |
| WRITE CYCLE STRESS | 0316 | 85 C, 6.0 VOLTS | 30 KCYS | 77 | 0 |

| | | | | | |
|--------------------|------|-----------------|----------|----------|----------|
| STORAGE LIFE | 0316 | 150C | 1000 HRS | 77 | 0 |
| WRITE CYCLE STRESS | 0325 | 85 C, 5.5 VOLTS | 30 KCYS | 77 | 0 |
| STORAGE LIFE | | 150C | 1000 HRS | 76 | 0 |
| WRITE CYCLE STRESS | 0327 | 70 C, 5.5 VOLTS | 30 KCYS | 77 | 0 |
| STORAGE LIFE | | 150C | 1000 HRS | 77 | 0 |
| WRITE CYCLE STRESS | 0330 | 70 C, 5.5 VOLTS | 30 KCYS | 77 | 0 |
| STORAGE LIFE | | 150C | 1000 HRS | 76 | 0 |
| Total: | | | | 0 | 0 |

FAILURE RATE: **MTTF (YRS): 89402** **FITS: 1.3**

The single Operating Life failure (date code 0305) failed lcc due to a random particle defect (FA 30011394).