RELIABILITY REPORT
FOR

DS80C390, Rev C3

Dallas Semiconductor

4401 South Beltwood Parkway
Dallas, TX 75244-3292

Prepared by:

Ken Wendel
Reliability Engineering Manager
Dallas Semiconductor
4401 South Beltwood Pkwy.
Dallas, TX 75244-3292
Email: ken.wendel@dalsemi.com
ph: 972-371-3726
fax: 972-371-6016
mbl: 214-435-6610
Conclusion:
The following qualification successfully meets the quality and reliability standards required of all Dallas Semiconductor products and processes:

DS80C390, Rev C3

Device Description:
A description of the device used in this qualification 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.

\[ Af_T = \exp((E_a/k) \times (1/T_u - 1/T_s)) = t_u/t_s \]
\[ Af_T = \text{Acceleration factor due to Temperature} \]
\[ t_u = \text{Time at use temperature (e.g. 55°C)} \]
\[ t_s = \text{Time at stress temperature (e.g. 125°C)} \]
\[ k = \text{Boltzmann's Constant (8.617 x 10^{-5} eV/°K)} \]
\[ T_u = \text{Temperature at Use (°K)} \]
\[ T_s = \text{Temperature at Stress (°K)} \]
\[ E_a = \text{Activation Energy (e.g. 0.7 ev)} \]

The activation energy of the failure mechanism is derived from either internal studies or industry accepted standards, or activation energy of 0.7 ev 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.

\[ Af_V = \exp(B \times (V_s - V_u)) \]
\[ Af_V = \text{Acceleration factor due to Voltage} \]
\[ V_s = \text{Stress Voltage (e.g. 7.0 volts)} \]
\[ V_u = \text{Maximum Operating Voltage (e.g. 5.5 volts)} \]
\[ B = \text{Constant related to failure mechanism type (e.g. 1.0, 2.4, 2.7, etc.)} \]

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:

\[ Fr = X / (t_s \times Af_V \times Af_T \times N \times 2) \]
\[ X = \text{Chi-Squared statistical upper limit} \]
\[ N = \text{Life test sample size} \]
Failure Rates are reported in FITs (Failures in Time) or MTTF (Mean Time To Failure). The FIT rate is related to MTTF by:

\[ \text{MTTF} = \frac{1}{\text{Fr}} \]

NOTE: MTTF is frequently used interchangeably with MTBF.

The calculated failure rate for this device/process/assembly is:

**FAILURE RATE:** \[ \frac{1}{\text{Fr}} = 2.4 \]

**MTTF (YRS):** 47667

**FITS:** 2.4

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. A at the start of this data is the device information. This is a description of the device for this report. Following this is the assembly information. This section includes a description of the assembly vehicle used to generate this reliability data for both qualifications and monitors. The next section is the detailed reliability data for each stress found in the qualification / monitor. If there are additional assemblies used as part of this report, a description of each will follow which includes the respective reliability data for that assembly. The reliability data section includes the latest data available.

**Device Information:**

- **Device:** DS80C390
- **Process:** 1P, 3M, 0.5um, Sil.P1, Ti/TiN M1+M2+M3
- **Passivation:** Passivation w/Nov TEOS Oxide-Nitride
- **Die Size:** 206 x 204
- **Number of Transistors:** 1200000
- **Interconnect:** Aluminum / 1% Silicon / 0.5% Copper
- **Gate Oxide Thickness:**

**Assembly Information:**

- **Qualification Vehicle:** DS80C390
- **Assembly Site:** ATK (Amkor, K)
- **Pin Count:** 64
- **Package Type:** LQFP
- **Body Size:** 10x10x1.4
- **Mold Compound:** Sumitomo 7320CR
- **Lead Frame:** C18045 w/Ag Spot
- **Lead Finish:** SnPb Plate
- **Die Attach:** 84-1 LMISR4 Epoxy Silverfilled Ablebond
- **Bond Wire / Size:** Au / 1.2 mil
- **Theta JA:** 40
- **Flammability:** UL 94-V0
- **Moisture Sensitivity** (JEDEC J-STD20A)
- **Date Code Range:** 0051 to 0403

**OPERATING LIFE**

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>DATE CODE</th>
<th>CONDITION</th>
<th>READPOINT</th>
<th>QTY</th>
<th>FAILS</th>
<th>FA#</th>
</tr>
</thead>
<tbody>
<tr>
<td>INFANT LIFE</td>
<td>0051</td>
<td>125C, 6.0 VOLTS</td>
<td>48 HRS</td>
<td>116</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>HIGH VOLTAGE LIFE</td>
<td>0051</td>
<td>125C, 6.0 VOLTS</td>
<td>1000 HRS</td>
<td>114</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>HIGH TEMP OP LIFE</td>
<td>0403</td>
<td>125C, 5.5 VOLTS</td>
<td>1000 HRS</td>
<td>77</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>
### Assembly Information:

- **Qualification Vehicle:** DS80C390
- **Assembly Site:** ATP (Amkor, PI)
- **Pin Count:** 68
- **Package Type:** PLCC
- **Body Size:** 950x950x3.87
- **Mold Compound:** Nitto MP8000C
- **Lead Finish:** SnPb Plate
- **Die Attach:** 8361J Epoxy Silverfilled Ablebond
- **Bond Wire / Size:** Au / 1.0 mil
- **Theta JA:** 68
- **Theta JC:** 19
- **Flammability:** UL 94-V0
- **Moisture Sensitivity:** Level 4

### Electrical Characterization

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>DATE CODE</th>
<th>CONDITION</th>
<th>READPOINT</th>
<th>QTY</th>
<th>FAILS</th>
<th>FA#</th>
</tr>
</thead>
<tbody>
<tr>
<td>ESD SENSITIVITY</td>
<td>0404</td>
<td>EOS/ESD S5.1 HBM 500 VOLTS</td>
<td>1</td>
<td>PUL'S</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>ESD SENSITIVITY</td>
<td>0404</td>
<td>EOS/ESD S5.1 HBM 1000 VOLTS</td>
<td>1</td>
<td>PUL'S</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>ESD SENSITIVITY</td>
<td>0404</td>
<td>EOS/ESD S5.1 HBM 2000 VOLTS</td>
<td>1</td>
<td>PUL'S</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>ESD SENSITIVITY</td>
<td>0404</td>
<td>EOS/ESD S5.1 HBM 4000 VOLTS</td>
<td>1</td>
<td>PUL'S</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>ESD SENSITIVITY</td>
<td>0404</td>
<td>EOS/ESD S5.1 HBM 8000 VOLTS</td>
<td>1</td>
<td>PUL'S</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>LATCH-UP</td>
<td>0404</td>
<td>JESD78, I-TEST 125C</td>
<td>6</td>
<td></td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>LATCH-UP</td>
<td>0404</td>
<td>JESD78, Vsupply TEST 125C</td>
<td>6</td>
<td></td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

**Total:** 9

---

### MOISTURE SENSITIVITY LEVEL 2

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>DATE CODE</th>
<th>CONDITION</th>
<th>READPOINT</th>
<th>QTY</th>
<th>FAILS</th>
<th>FA#</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Date Code Range:** 9918 to 9936
### Operating Life

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>DATE CODE</th>
<th>CONDITION</th>
<th>READPOINT</th>
<th>QTY</th>
<th>FAILS</th>
<th>FA#</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infant Life</td>
<td>9918</td>
<td>125C, 6.0 Volts</td>
<td>48 HRS</td>
<td>300</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>High Voltage Life</td>
<td>9918</td>
<td>125C, 6.0 Volts</td>
<td>1000 HRS</td>
<td>116</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Infant Life</td>
<td>9936</td>
<td>125C, 6.0 Volts</td>
<td>48 HRS</td>
<td>77</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>High Voltage Life</td>
<td>9936</td>
<td>125C, 6.0 Volts</td>
<td>1000 HRS</td>
<td>75</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

**Total:** 0

### Package Tests

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>DATE CODE</th>
<th>CONDITION</th>
<th>READPOINT</th>
<th>QTY</th>
<th>FAILS</th>
<th>FA#</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solderability (Sn/Pb)</td>
<td>9918</td>
<td>MIL-STD-883-2003</td>
<td>3</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>X-Ray</td>
<td>9918</td>
<td>MIL-STD-883-2012: Top &amp; Side View</td>
<td>6</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physical Dimensions</td>
<td></td>
<td>MIL-STD-883-2016</td>
<td>6</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mark Permanency</td>
<td></td>
<td>MIL-STD-883-2015</td>
<td>6</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lead Integrity</td>
<td></td>
<td>MIL-STD-883-2004: Cond B2</td>
<td>6</td>
<td>0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Total:** 0

### Preconditioning Level 3

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>DATE CODE</th>
<th>CONDITION</th>
<th>READPOINT</th>
<th>QTY</th>
<th>FAILS</th>
<th>FA#</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storage Life</td>
<td>9918</td>
<td>125C</td>
<td>24 HRS</td>
<td>304</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Moisture Soak</td>
<td></td>
<td>30C/60% R.H.</td>
<td>240 HRS</td>
<td>304</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Convection Reflow</td>
<td></td>
<td>235C +5/-0C</td>
<td>3 PASS</td>
<td>304</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

**Total:** 0

### Temperature Cycle

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>DATE CODE</th>
<th>CONDITION</th>
<th>READPOINT</th>
<th>QTY</th>
<th>FAILS</th>
<th>FA#</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temp Cycle</td>
<td>9918</td>
<td>-55C TO 125C</td>
<td>1000 CYS</td>
<td>77</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

**Total:** 0

### Temperature Humidity Bias

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>DATE CODE</th>
<th>CONDITION</th>
<th>READPOINT</th>
<th>QTY</th>
<th>FAILS</th>
<th>FA#</th>
</tr>
</thead>
<tbody>
<tr>
<td>HAST</td>
<td>9918</td>
<td>130C, 85% R.H., 5.5V</td>
<td>100 HRS</td>
<td>63</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

**Total:** 0

### Unbiased Moisture Resistance

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>DATE CODE</th>
<th>CONDITION</th>
<th>READPOINT</th>
<th>QTY</th>
<th>FAILS</th>
<th>FA#</th>
</tr>
</thead>
<tbody>
<tr>
<td>HAST, No Bias</td>
<td>9918</td>
<td>130C, 85% R.H.</td>
<td>200 HRS</td>
<td>38</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

**Total:** 0

**Failure Rate:**

- MTTF (YRS): 47667
- Fits: 2.4