RELIABILITY REPORT
FOR
MAX9591ETU+
PLASTIC ENCAPSULATED DEVICES

March 8, 2010

MAXIM INTEGRATED PRODUCTS
120 SAN GABRIEL DR.
SUNNYVALE, CA 94086

Approved by
Richard Aburano
Quality Assurance
Manager, Reliability Operations
Conclusion

The MAX9591ETU+ successfully meets the quality and reliability standards required of all Maxim products. In addition, Maxim’s continuous reliability monitoring program ensures that all outgoing product will continue to meet Maxim’s quality and reliability standards.

Table of Contents

I. Device Description V. Quality Assurance Information
II. Manufacturing Information VI. Reliability Evaluation
III. Packaging Information IV. Die Information
.....Attachments

I. Device Description

A. General

The MAX9591 provides 14 programmable voltage references and four static voltage references for gamma correction in TFT-LCD displays. Two register banks are provided to store two sets of gamma reference values that are programmed into the banks through an I²C interface. The outputs can switch between gamma reference values in 0.5µs. The 14 programmable reference voltages are divided evenly into seven upper and seven lower voltages for the upper and lower gamma curves of LCD column drivers. Each gamma reference voltage has an 8-bit digital-to-analog converter (DAC) with an isolation buffer associated with it to ensure stable operation. Therefore, the reference voltages remain stable without synchronizing to the LCD horizontal timing. In addition, each buffer is able to provide a high current that further ensures a stable voltage when critical levels and patterns are displayed. The reference voltages ramp up proportional to AVDD during startup and gamma buffers wake up in high impedance until all of the registers are written. This protects the LCD column drivers from high transient currents and reverse bias conditions. The MAX9591 is available in a 38-pin TQFN package and is specified for operation over the -40°C to +85°C temperature range.
II. Manufacturing Information

A. Description/Function: 14 Programmable Gamma Reference Buffers with Four Static References for TFT-LCD Displays

B. Process: S4

C. Number of Device Transistors: 

D. Fabrication Location: Texas

E. Assembly Location: UTL Thailand

F. Date of Initial Production: April 25, 2008

III. Packaging Information

A. Package Type: 38-pin TQFN 5x7

B. Lead Frame: Copper

C. Lead Finish: 100% matte Tin

D. Die Attach: Conductive Epoxy

E. Bondwire: Au (1.0 mil dia.)

F. Mold Material: Epoxy with silica filler

G. Assembly Diagram: 

H. Flammability Rating: Class UL94-V0

I. Classification of Moisture Sensitivity per JEDEC standard J-STD-020-C Level 1

J. Single Layer Theta Ja: 38°C/W

K. Single Layer Theta Jc: 1.4°C/W

L. Multi Layer Theta Ja: 28°C/W

M. Multi Layer Theta Jc: 1.4°C/W

IV. Die Information

A. Dimensions: 97 X 105 mils

B. Passivation: Si3N4/SiO2 (Silicon nitride/ Silicon dioxide

C. Interconnect: Aluminum/Si (Si = 1%)

D. Backside Metallization: None

E. Minimum Metal Width: Metal1 = 0.5 / Metal2 = 0.6 / Metal3 = 0.6 microns (as drawn)

F. Minimum Metal Spacing: Metal1 = 0.45 / Metal2 = 0.5 / Metal3 = 0.6 microns (as drawn)

G. Bondpad Dimensions: 5 mil. Sq.

H. Isolation Dielectric: SiO2

I. Die Separation Method: Wafer Saw
V. Quality Assurance Information

A. Quality Assurance Contacts: Richard Aburano (Manager, Reliability Operations)
   Bryan Preeshl (Managing Director of QA)

B. Outgoing Inspection Level: 0.1% for all electrical parameters guaranteed by the Datasheet.
   0.1% For all Visual Defects.

C. Observed Outgoing Defect Rate: < 50 ppm

D. Sampling Plan: Mil-Std-105D

VI. Reliability Evaluation

A. Accelerated Life Test

   The results of the 135°C biased (static) life test are shown in Table 1. Using these results, the Failure Rate ($\lambda$) is calculated as follows:

   $$\lambda = \frac{1}{MTTF} = \frac{1.83}{192 \times 4340 \times 45 \times 2}$$

   (where 4340 = Temperature Acceleration factor assuming an activation energy of 0.8eV)

   $$\lambda = 23.9 \times 10^{-9}$$

   $$\lambda = 23.9 \text{ F.I.T. (60% confidence level @ 25°C)}$$

   The following failure rate represents data collected from Maxim’s reliability monitor program. Maxim performs quarterly 1000 hour life test monitors on its processes. This data is published in the Product Reliability Report found at http://www.maxim-ic.com/. Current monitor data for the S4 Process results in a FIT Rate of 4.6 @ 25°C and 79.2 @ 55°C (0.8 eV, 60% UCL)

B. Moisture Resistance Tests

   The industry standard 85°C/85%RH or HAST testing is monitored per device process once a quarter.

C. E.S.D. and Latch-Up Testing

   The DV17 die type has been found to have all pins able to withstand a transient pulse of

   - ESD-HBM: +/- 2500V per JEDEC JESD22-A114
   - ESD-CDM: +/- 750V per JEDEC JESD22-C101
   - ESD-MM: +/- 250V per JEDEC JESD22-A115

  Latch-Up testing has shown that this device withstands a current of +/-250 mA and overvoltage per JEDEC JESD78.
# Table 1
Reliability Evaluation Test Results

**MAX9591ETU+**

<table>
<thead>
<tr>
<th>TEST ITEM</th>
<th>TEST CONDITION</th>
<th>FAILURE IDENTIFICATION</th>
<th>SAMPLE SIZE</th>
<th>NUMBER OF FAILURES</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Static Life Test</strong> (Note 1)</td>
<td>Ta = 135°C</td>
<td>DC Parameters &amp; functionality</td>
<td>45</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Biased</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Time = 192 hrs.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Moisture Testing</strong> (Note 2)</td>
<td>Ta = 85°C</td>
<td>DC Parameters &amp; functionality</td>
<td>77</td>
<td>0</td>
</tr>
<tr>
<td>85/85</td>
<td>RH = 85%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Biased</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Time = 1000hrs.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Mechanical Stress</strong> (Note 2)</td>
<td>Temperature -65°C/150°C</td>
<td>DC Parameters &amp; functionality</td>
<td>77</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Cycle</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1000 Cycles</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Method 1010</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note 1: Life Test Data may represent plastic DIP qualification lots.
Note 2: Generic Package/Process data