RELIABILITY REPORT
FOR
MAX9860ETG+
PLASTIC ENCAPSULATED DEVICES

May 14, 2010

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

Approved by
Don Lipps
Quality Assurance Manager, Reliability Engineering
Conclusion

The MAX9860ETG+ 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.

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I. Device Description

A. General

The MAX9860 is a low-power, voiceband, mono audio codec designed to provide a complete audio solution for wireless voice headsets and other mono voice audio devices. Using an on-chip bridge-tied load mono headphone amplifier, the MAX9860 can output 30mW into a 32 Ω earpiece while operating from a single 1.8V power supply. Very low power consumption makes it an ideal choice for battery-powered applications. The MAX9860’s flexible clocking circuitry utilizes common system clock frequencies ranging from 10MHz to 60MHz, eliminating the need for an external PLL and multiple crystal oscillators. Both the ADC and DAC support sample rates of 8kHz to 48kHz in either synchronous or asynchronous operation. Both master and slave timing modes are supported. Two differential microphone inputs are available with a user-programmable preamplifier and programmable gain amplifier. Automatic gain control with selectable attack/release times and signal threshold allows maximum dynamic range. A noise gate with selectable threshold provides a means to quiet the channel when no signal is present. Both the DAC and ADC digital filters provide full attenuation for out-of-band signals as well as a 5th order GSM-compliant digital highpass filter. A digital side tone mixer provides loopback of the microphones/ADC signal to the DAC/headphone output. Serial DAC and ADC data is transferred over a flexible digital I²S-compatible interface that also supports TDM mode. Mode settings, volume control, and shutdown are programmed through a 2-wire, I²C-compatible interface. The MAX9860 is fully specified over the -40°C to +85°C extended temperature range and is available in a low-profile, 4mm x 4mm, 24-pin thin QFN package.
II. Manufacturing Information

A. Description/Function: 16-Bit Mono Audio Voice Codec
B. Process: TS18
C. Number of Device Transistors: 248324
D. Fabrication Location: Singapore
E. Assembly Location: China
F. Date of Initial Production: 10/24/2008

III. Packaging Information

A. Package Type: 24-pin TQFN 4x4
B. Lead Frame: Copper
C. Lead Finish: 100% matte Tin
D. Die Attach: Conductive
E. Bondwire: Au (1 mil dia.)
F. Mold Material: Epoxy with silica filler
G. Assembly Diagram: #05-9000-2922
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: 48°C/W
K. Single Layer Theta Jc: 2.7°C/W
L. Multi Layer Theta Ja: 36°C/W
M. Multi Layer Theta Jc: 2.7°C/W

IV. Die Information

A. Dimensions: 60.6X80.7 mils
B. Passivation: Si₃N₄/SiO₂ (Silicon nitride/ Silicon dioxide)
C. Interconnect: Al/0.5%Cu with Ti/TiN Barrier
D. Backside Metallization: None
E. Minimum Metal Width: 0.18µm
F. Minimum Metal Spacing: 0.18µm
G. Bondpad Dimensions: 5 mil. Sq.
H. Isolation Dielectric: SiO₂
I. Die Separation Method: Wafer Saw
V. Quality Assurance Information

A. Quality Assurance Contacts: Don Lipps (Manager, Reliability Engineering)  
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:

\[
\lambda = \frac{1}{MTTF} = \frac{1.83}{192 \times 4340 \times 48 \times 2} \quad \text{(Chi square value for MTTF upper limit)}
\]

\[
\text{(where 4340 = Temperature Acceleration factor assuming an activation energy of 0.8eV)}
\]

\[
\lambda = 22.9 \times 10^{-9}
\]

\[
\lambda = 22.9 \text{ F.i.T. (60% confidence level @ 25°C)}
\]

The following failure rate represents data collected from Maxim’s reliability monitor program. Maxim performs quarterly life test monitors on its processes. This data is published in the Reliability Report found at http://www.maxim-ic.com/qa/reliability/monitor. Cumulative monitor data for the TS18 Process results in a FIT Rate of 0.24 @ 25C and 4.14 @ 55C (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 AU87 die type has been found to have all pins able to withstand a HBM transient pulse of +/-2500V per JEDEC JESD22-A114. Latch-Up testing has shown that this device withstands a current of +/-100mA.
# Table 1
Reliability Evaluation Test Results

MAX9860ETG+

<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>Static Life Test</td>
<td>Ta = 135°C, Biased</td>
<td>DC Parameters &amp; functionality</td>
<td>48</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Time = 192 hrs.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Moisture Testing</td>
<td>Ta = 130°C, Biased</td>
<td>DC Parameters &amp; functionality</td>
<td>77</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>RH = 85%, Time = 96hrs.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mechanical Stress</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 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