RELIABILITY REPORT
FOR
MAX4477AxA
PLASTIC ENCAPSULATED DEVICES

October 28, 2002

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

Written by  Reviewed by
Jim Pedicord  Bryan J. Preeshl
Quality Assurance  Quality Assurance
Reliability Lab Manager  Executive Director
Conclusion

The MAX4477 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 MAX4477 wide-band, low-noise, low-distortion operational amplifier offers Rail-to-Rail ® outputs and single-supply operation down to 2.7V. It draws 2.2mA of quiescent supply current per amplifier while featuring ultra-low distortion (0.0002% THD + N), as well as low input voltage noise density (4.5nV/vHz ) and low input current noise density (0.5fA/vHz ). These features make the device an ideal choice for applications that require low distortion and/or low noise. This amplifier has outputs which swing rail-to-rail and its input common-mode voltage range includes ground. The MAX447 is unity-gain stable with a gain-bandwidth product of 10MHz.

B. Absolute Maximum Ratings

<table>
<thead>
<tr>
<th>Item</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power Supply Voltage (V_{DD} to VSS)</td>
<td>0.3V to +6.0V</td>
</tr>
<tr>
<td>Analog Input Voltage (IN_+, IN_-)</td>
<td>(V_{SS} - 0.3V) to (V_{DD} + 0.3V)</td>
</tr>
<tr>
<td>/SHDN Input Voltage</td>
<td>(V_{SS} - 0.3V) to +6.0V</td>
</tr>
<tr>
<td>Output Short-Circuit Duration to Either Supply</td>
<td>Continuous</td>
</tr>
<tr>
<td>Operating Temperature Range</td>
<td>-40°C to +125°C</td>
</tr>
<tr>
<td>Junction Temperature</td>
<td>+150°C</td>
</tr>
<tr>
<td>Storage Temperature Range</td>
<td>-65°C to +150°C</td>
</tr>
<tr>
<td>Lead Temperature (soldering, 10s)</td>
<td>+300°C</td>
</tr>
<tr>
<td>Continuous Power Dissipation (TA=+70°C)</td>
<td>362mW</td>
</tr>
<tr>
<td>8-Pin µMAX</td>
<td>8-Pin SO</td>
</tr>
<tr>
<td></td>
<td>471mW</td>
</tr>
<tr>
<td>Derates above +70°C</td>
<td>4.5mW/°C</td>
</tr>
<tr>
<td>8-Pin µMAX</td>
<td>5.88mW/°C</td>
</tr>
</tbody>
</table>
II. Manufacturing Information

A. Description/Function: SOT23, Low-Noise, Low-Distortion, Wide-Band, Rail-to-Rail Op Amp

B. Process: S12 (Standard 1.2 micron silicon gate CMOS)

C. Number of Device Transistors: 2132

D. Fabrication Location: California or Oregon, USA

E. Assembly Location: Korea, Philippines, Malaysia or Thailand

F. Date of Initial Production: July, 2001

III. Packaging Information

A. Package Type: 8-Pin SO  8-Pin uMAX

B. Lead Frame: Copper  Copper

C. Lead Finish: Solder Plate  Solder Plate

D. Die Attach: Silver-filled Epoxy  Silver-filled Epoxy

E. Bondwire: Gold (1 mil dia.)  Gold (1 mil dia.)

F. Mold Material: Epoxy with silica filler  Epoxy with silica filler

G. Assembly Diagram: # 05-2501-0157  # 05-2501-0158

H. Flammability Rating: Class UL94-V0  Class UL94-V0

I. Classification of Moisture Sensitivity per JEDEC standard JESD22-112: Level 1  Level 1

IV. Die Information

A. Dimensions: 62 x 87 mils

B. Passivation: Si$_3$N$_4$/SiO$_2$ (Silicon nitride/ Silicon dioxide)

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

D. Backside Metallization: None

E. Minimum Metal Width: 1.2 microns (as drawn)

F. Minimum Metal Spacing: 1.2 microns (as drawn)

G. Bondpad Dimensions: 5 mil. Sq.

H. Isolation Dielectric: SiO$_2$

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

A. Quality Assurance Contacts:  
   Jim Pedicord (Reliability Lab Manager)  
   Bryan Preeshl (Executive Director)  
   Kenneth Huening (Vice President)

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 (λ) is calculated as follows:

   \[
   \lambda = \frac{1}{MTTF} = \frac{1.83}{192 \times 4389 \times 80 \times 2} 
   \]

   (Chi square value for MTTF upper limit)

   Temperature Acceleration factor assuming an activation energy of 0.8eV

   \[
   \lambda = 13.57 \times 10^{-9} 
   \]

   \[
   \lambda = 13.57 \text{ F.I.T.} \quad (60\% \text{ confidence level @ } 25^\circ\text{C})
   \]

   This low failure rate represents data collected from Maxim’s reliability monitor program. In addition to routine production Burn-In, Maxim pulls a sample from every fabrication process three times per week and subjects it to an extended Burn-In prior to shipment to ensure its reliability. The reliability control level for each lot to be shipped as standard product is 59 F.I.T. at a 60% confidence level, which equates to 3 failures in an 80 piece sample. Maxim performs failure analysis on any lot that exceeds this reliability control level. Attached Burn-In Schematic (Spec. # 06-5757) shows the static Burn-In circuit. Maxim also performs quarterly 1000 hour life test monitors. This data is published in the Product Reliability Report (RR-1M).

B. Moisture Resistance Tests

   Maxim pulls pressure pot samples from every assembly process three times per week. Each lot sample must meet an LTPD = 20 or less before shipment as standard product. Additionally, the industry standard 85°C/85%RH testing is done per generic device/package family once a quarter.

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

   The OX49 die type has been found to have all pins able to withstand a transient pulse of ±2000V Mil-Std-883 Method 3015 (reference attached ESD Test Circuit). Latch-Up testing has shown that this device withstands a current of ±250mA and/or ±20V.
## Table 1
Reliability Evaluation Test Results

MAX4477AxA

<table>
<thead>
<tr>
<th>TEST ITEM</th>
<th>TEST CONDITION</th>
<th>FAILURE IDENTIFICATION</th>
<th>PACKAGE</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>SO</td>
<td>80</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Biased &amp; functionality</td>
<td>Time = 192 hrs.</td>
<td>uMAX</td>
<td>80</td>
<td>0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Moisture Testing</strong> (Note 2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pressure Pot</td>
</tr>
<tr>
<td></td>
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<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>85/85</td>
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<td></td>
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<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Mechanical Stress</strong> (Note 2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature Cycle</td>
</tr>
<tr>
<td>1000 Cycles</td>
</tr>
</tbody>
</table>

Note 1: Life Test Data may represent plastic DIP qualification lots.
Note 2: Generic Package/Process data
TABLE II. Pin combination to be tested. 1/ 2/

<table>
<thead>
<tr>
<th></th>
<th>Terminal A (Each pin individually connected to terminal A with the other floating)</th>
<th>Terminal B (The common combination of all like-named pins connected to terminal B)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>All pins except V&lt;sub&gt;PS1&lt;/sub&gt; 3/</td>
<td>All V&lt;sub&gt;PS1&lt;/sub&gt; pins</td>
</tr>
<tr>
<td>2.</td>
<td>All input and output pins</td>
<td>All other input-output pins</td>
</tr>
</tbody>
</table>

1/ Table II is restated in narrative form in 3.4 below.
2/ No connects are not to be tested.
3/ Repeat pin combination I for each named Power supply and for ground (e.g., where V<sub>PS1</sub> is V<sub>DD</sub>, V<sub>CC</sub>, V<sub>SS</sub>, V<sub>BB</sub>, GND, +V<sub>S</sub>, -V<sub>S</sub>, V<sub>REF</sub>, etc).

3.4 Pin combinations to be tested.

a. Each pin individually connected to terminal A with respect to the device ground pin(s) connected to terminal B. All pins except the one being tested and the ground pin(s) shall be open.

b. Each pin individually connected to terminal A with respect to each different set of a combination of all named power supply pins (e.g., V<sub>SS1</sub>, or V<sub>SS2</sub> or V<sub>SS3</sub> or V<sub>CC1</sub>, or V<sub>CC2</sub>) connected to terminal B. All pins except the one being tested and the power supply pin or set of pins shall be open.

c. Each input and each output individually connected to terminal A with respect to a combination of all the other input and output pins connected to terminal B. All pins except the input or output pin being tested and the combination of all the other input and output pins shall be open.

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Mil Std 883D
Method 3015.7
Notice 8
DEVICES: MAX 4477/4489
MAX. EXPECTED CURRENT = 20mA

NOTES:

ONCE PER SOCKET

ONCE PER BOARD

DRAWN BY: HAK TAN