

RELIABILITY REPORT
FOR MAX13331GEE/V+
PLASTIC ENCAPSULATED DEVICES

March 18, 2009

MAXIM INTEGRATED PRODUCTS

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Conclusion

The MAX13331GEE/V+ 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 MAX13330/MAX13331 stereo headphone amplifiers are designed for automotive applications requiring output short-circuit and ESD protection to battery/ground with diagnostics. These devices use Maxim's unique, patented DirectDrive® architecture to produce a ground-referenced output from a single supply, eliminating the need for large DC-blocking capacitors, saving board space and component height. The gain of the amplifier is set internally (-1.5V/V) on the MAX13330 or adjusted externally with resistors on the MAX13331. The MAX13330/MAX13331 deliver 120mW per channel into a 16 Ω load or 135mW into a 32 Ω load and have a low 0.01% THD+N. Low output impedance and the efficient integrated charge pump allows the device to drive loads as low as 8 Ω , enabling the use of small loudspeakers. An 80dB at 217Hz PSRR allows these devices to operate from noisy digital supplies without an additional linear regulator. These devices include ± 15 kV Human Body Model ESD protection and short-circuit protection up to +45V at the headphone outputs. Comprehensive click-and-pop circuitry suppresses audible clicks and pops on startup and shutdown. A low-power shutdown mode reduces the supply current to 3 μ A (typ). The MAX13330/MAX13331 are specified from -40°C to +105°C AEC-Q100 Level 2 automotive temperature range and are available in a 16-pin QSOP package.

II. Manufacturing Information

A. Description/Function:	Automotive DirectDrive® Headphone Amplifiers with Output Protection and Diagnostics
B. Process:	S4
C. Number of Device Transistors:	2833
D. Fabrication Location:	California
E. Assembly Location:	ATP Philippines, UTL Thailand
F. Date of Initial Production:	October 25, 2008

III. Packaging Information

A. Package Type:	16-pin QSOP
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:	120°C/W
K. Single Layer Theta Jc:	37°C/W
L. Multi Layer Theta Ja:	103.7°C/W
M. Multi Layer Theta Jc:	37°C/W

IV. Die Information

A. Dimensions:	76 X 79 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:	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:	SiO ₂
I. Die Separation Method:	Wafer Saw

V. Quality Assurance Information

A. Quality Assurance Contacts:	Ken Wendel (Director, 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 (λ) is calculated as follows:

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

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

$$\lambda = 22.4 \times 10^{-9}$$

$$\lambda = 22.4 \text{ F.I.T. (60\% confidence level @ 25°C)}$$

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 0.28 @ 25C and 4.85 @ 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 AA01-1 die type has been found to have all pins able to withstand a HBM transient pulse of +/-2500 V per JEDEC JESD22-A114-D. Latch-Up testing has shown that this device withstands a current of +/-250 mA, 1.5x VCCMax Overvoltage per JESD78.

Table 1
Reliability Evaluation Test Results

MAX13331GEE/V+

TEST ITEM	TEST CONDITION	FAILURE IDENTIFICATION	SAMPLE SIZE	NUMBER OF FAILURES
Static Life Test (Note 1)	Ta = 135°C Biased Time = 192 hrs.	DC Parameters & functionality	48	0
Moisture Testing (Note 2) 85/85	Ta = 85°C RH = 85% Biased Time = 1000hrs.	DC Parameters & functionality	77	0
Mechanical Stress (Note 2) Temperature Cycle	-65°C/150°C 1000 Cycles Method 1010	DC Parameters & functionality	77	0

Note 1: Life Test Data may represent plastic DIP qualification lots.

Note 2: Generic Package/Process data