RELIABILITY REPORT

FOR

MAX9934FART+

CHIP SCALE PACKAGE

August 25, 2011

**MAXIM INTEGRATED PRODUCTS**

120 SAN GABRIEL DR.

SUNNYVALE, CA 94086

| **Approved by** |
|---|
| Sokhom Chum |
| Quality Assurance |
| Reliability Engineer |

**Conclusion**

The MAX9934FART+ 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 MAX9934 high-precision, low-voltage, high-side current-sense amplifier is ideal for both bidirectional (charge/discharge) and unidirectional current measurements in battery-powered portable and laptop devices. Input offset voltage (VOS) is a low 10µV (max) at +25°C across the -0.1V to 5.5V input common-mode voltage range, and is independent of VCC. Its precision input specification allows the use of very small sense-voltages (typically ±10mV full-scale) for minimally invasive current sensing. The output of the MAX9934 is a current proportional to input VSENSE and is available in either 25µA/mV or 5µA/mV gain options (GM) with gain accuracy better than 0.25% (max) at +25°C. A chip select (CS) allows multiplexing of several MAX9934 current outputs to a single microcontroller ADC channel (see the *Typical Operating Circuit*). CS is compatible with 1.8V and 3.3V logic systems. The MAX9934 is designed to operate from a 2.5V to 3.6V VCC supply, and draws just 120µA (typ) quiescent current. When powered down (VCC = 0V), RS+ and RS- draw less than 0.1nA (typ) leakage current to reduce battery load. The MAX9934 is robust and protected from input faults of up to ±6V input differential voltage between RS+ and RS-. The MAX9934 is specified for operation over the -40°C to +125°C temperature range and is available in 8-pin µMAX® or a 6-bump UCSP(tm) (1mm x 1.5mm x 0.6mm), making it ideal for space-sensitive applications.

## II. Manufacturing Information

| | |
|---|---|
| A. Description/Function: | High-Precision, Low-Voltage, Current-Sense Amplifier with Current Output and Chip Select for Multiplexing |
| B. Process: | S4 |
| C. Number of Device Transistors: | 4201 |
| D. Fabrication Location: | Texas |
| E. Assembly Location: | Texas |
| F. Date of Initial Production: | October 25, 2009 |

## III. Packaging Information

| | |
|---|---|
| A. Package Type: | 6-bumps, 2x3 array UCSP |
| B. Lead Frame: | N/A |
| C. Lead Finish: | N/A |
| D. Die Attach: | None |
| E. Bondwire: | N/A (N/A mil dia.) |
| F. Mold Material: | Epoxy with silica filler |
| G. Assembly Diagram: | #05-9000-3533 |
| 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: | N/A |
| K. Single Layer Theta Jc: | N/A |
| L. Multi Layer Theta Ja: | 259.5°C/W |
| M. Multi Layer Theta Jc: | N/A |

## IV. Die Information

| | |
|---|---|
| A. Dimensions: | 61 X 41 mils |
| B. Passivation: | $Si_3N_4/SiO_2$ (Silicon nitride/ Silicon dioxide) |
| C. Interconnect: | Al with Ti/TiN Barrier |
| 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: | |
| H. Isolation Dielectric: | $SiO_2$ |
| I. Die Separation Method: | Wafer Saw |

## V. Quality Assurance Information

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|---|---|
| A. Quality Assurance Contacts: | Richard Aburano (Manager, Reliability Engineering)<br>Don Lipps (Manager, Reliability Engineering)<br>Bryan Preeshl (Vice President of QA) |
| B. Outgoing Inspection Level: | 0.1% for all electrical parameters guaranteed by the Datasheet.<br>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:

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

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

$\lambda = 22.9 \times 10^{-9}$

$\lambda = 22.9$ 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 S4 Process results in a FIT Rate of 0.05 @ 25C and 0.83 @ 55C (0.8 eV, 60% UCL).

B. E.S.D. and Latch-Up Testing (lot TRBYCQ002O D/C 0934)

The OY29-1 die type has been found to have all pins able to withstand a transient pulse of:

| | |
|---|---|
| ESD-HBM: | +/- 2500V per JEDEC JESD22-A114 (lot TRBYCQ002O, D/C 0934) |
| ESD-CDM: | +/- 750V per JEDEC JESD22-C101 (lot TRBYCQ003F, D/C 1123) |

Latch-Up testing has shown that this device withstands a current of+/- 250mA and overvoltage per JEDEC JESD78.

**Table 1**
Reliability Evaluation Test Results

**MAX9934FART+**

| TEST ITEM | TEST CONDITION | FAILURE IDENTIFICATION | SAMPLE SIZE | NUMBER OF FAILURES | COMMENTS |
|---|---|---|---|---|---|
| **Static Life Test** (Note 1) | | | | | |
| | Ta = 135°C<br>Biased<br>Time = 192 hrs. | DC Parameters & functionality | 48 | 0 | TRBYCQ002O, D/C 0934 |

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