MAX4000EUA
Rev. A

# RELIABILITY REPORT

FOR

**MAX4000EUA**

PLASTIC ENCAPSULATED DEVICES

February 10, 2003

**MAXIM INTEGRATED PRODUCTS**

120 SAN GABRIEL DR.

SUNNYVALE, CA 94086


Written by

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## Conclusion

The MAX4000 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

### A. General

The MAX4000 low-cost, low-power logarithmic amplifier is designed to control RF power amplifiers (PA) operating in the 0.1GHz to 2.5GHz frequency range. A typical dynamic range of 45dB makes this family of log amps useful in a variety of wireless applications including cellular handset PA control, transmitter power measurement, and RSSI for terminal devices. Logarithmic amplifiers provide much wider measurement range and superior accuracy to controllers based on diode detectors. Excellent temperature stability is achieved over the full operating range of -40°C to +85°C.

The logarithmic amplifier is a voltage-measuring device with a typical signal range of -58dBV to -13dBV for the MAX4000.

The input signal for the MAX4000 is internally AC-coupled using an on-chip 5pF capacitor in series with a 2kΩ input resistance. This highpass coupling, with a corner at 16MHz, sets the lowest operating frequency and allows the input signal source to be DC grounded.

The MAX4000 family is available in an 8-pin µMAX package and an 8-bump chip-scale package (UCSP™). The device consumes 5.9mA with a 5.5V supply, and when powered down the typical shutdown current is 13µA.

### B. Absolute Maximum Ratings

| Item | Rating |
|---|---|
| (Voltages Referenced to GND) | |
| VCC | -0.3V to +6V |
| OUT, SET, SHDN , CLPF | -0.3V to (VCC + 0.3V) |
| RFIN | +6dBm |
| Equivalent Voltage | 0.45VRMS |
| OUT Short Circuit to GND | Continuous |
| Operating Temperature Range | -40°C to +85°C |
| Storage Temperature Range | -65°C to +150°C |
| Lead Temperature (soldering , 10s) | +300°C |
| Continuous Power Dissipation (TA = +70°C) | |
| 8-Pin µMAX | 362mW |
| Derates above +70°C | |
| 8-Pin µMAX | 4.5mW/°C |

## II. Manufacturing Information

| | |
|---|---|
| A. Description: | 2.5GHz 45dB RF-Detecting Controllers |
| B. Process: | CB30 |
| C. Number of Device Transistors: | 358 |
| D. Fabrication Location: | Oregon, USA |
| E. Assembly Location: | Malaysia, Philippines or Thailand |
| F. Date of Initial Production: | January, 2002 |

## III. Packaging Information

| | |
|---|---|
| A. Package Type: | **8-Pin µMAX** |
| B. Lead Frame: | Copper |
| C. Lead Finish: | Solder Plate |
| D. Die Attach: | Silver-filled Epoxy |
| E. Bondwire: | Gold (1.0 mil dia.) |
| F. Mold Material: | Epoxy with silica filler |
| G. Assembly Diagram: | Buildsheet # 05-2501-0199 |
| H. Flammability Rating: | Class UL94-V0 |
| I. Classification of Moisture Sensitivity per JEDEC standard JESD22-A112: | Level 1 |

## IV. Die Information

| | |
|---|---|
| A. Dimensions: | 49 x 48 mils |
| B. Passivation: | $Si_3N_4/SiO_2$ (Silicon nitride/ Silicon dioxide) |
| C. Interconnect: | Gold |
| D. Backside Metallization: | None |
| E. Minimum Metal Width: | Metal 1: 1.4 microns Metal 2: 1.4 microns Metal 3: 3 microns (as drawn) |
| F. Minimum Metal Spacing: | Metal 1: 1.6 microns Metal 2: 1.6 microns Metal 3: 3 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 of QA)
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 ($\lambda$) is calculated as follows:

$$\lambda = \frac{1}{MTTF} = \frac{1.83}{192 \times 4389 \times 45 \times 2}$$ (Chi square value for MTTF upper limit)

Temperature Acceleration factor assuming an activation energy of 0.8eV

$\lambda = 24.13 \times 10^{-9}$ $\lambda = 24.13$ F.I.T. (60% confidence level @ 25°C)

This low failure rate represents data collected from Maxim's reliability qualification and monitor programs. Maxim also performs weekly Burn-In on samples from production to assure reliability of its processes. The reliability required for lots which receive a burn-in qualification 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 rejects from lots exceeding this level. The attached Burn-In Schematic (Spec. # 06-5904) shows the static circuit used for this test. Maxim also performs 1000 hour life test monitors quarterly for each process. This data is published in the Product Reliability Report (**RR-1M**).

B. Moisture Resistance Tests

Maxim evaluates pressure pot stress from every assembly process during qualification of each new design. Pressure Pot testing must pass a 20% LTPD for acceptance. Additionally, industry standard 85°C/85%RH or HAST tests are performed quarterly per device/package family.

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

The OX83 die type has been found to have all pins able to withstand a transient pulse of ±2500V, per Mil-Std-883 Method 3015 (reference attached ESD Test Circuit). Latch-Up testing has shown that this device withstands a current of ±250mA.

**Table 1**
Reliability Evaluation Test Results

**MAX4000EUA**

| TEST ITEM | TEST CONDITION | FAILURE IDENTIFICATION | PACKAGE | SAMPLE SIZE | NUMBER OF FAILURES |
|---|---|---|---|---|---|
| **Static Life Test** (Note 1) | | | | | |
| | Ta = 135°C<br>Biased<br>Time = 192 hrs. | DC Parameters<br>& functionality | | 45 | 0 |
| **Moisture Testing** (Note 2) | | | | | |
| Pressure Pot | Ta = 121°C<br>P = 15 psi.<br>RH= 100%<br>Time = 168hrs. | DC Parameters<br>& functionality | uMAX | 77 | 0 |
| 85/85 | Ta = 85°C<br>RH = 85%<br>Biased<br>Time = 1000hrs. | DC Parameters<br>& functionality | | 77 | 0 |
| **Mechanical Stress** (Note 2) | | | | | |
| Temperature Cycle | -65°C/150°C<br>1000 Cycles<br>Method 1010 | DC Parameters | | 77 | 0 |

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

Attachment #1

TABLE II. Pin combination to be tested. 1/ 2/

| | Terminal A (Each pin individually connected to terminal A with the other floating) | Terminal B (The common combination of all like-named pins connected to terminal B) |
|---|---|---|
| 1. | All pins except $V_{PS1}$ 3/ | All $V_{PS1}$ pins |
| 2. | All input and output pins | All other input-output pins |

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

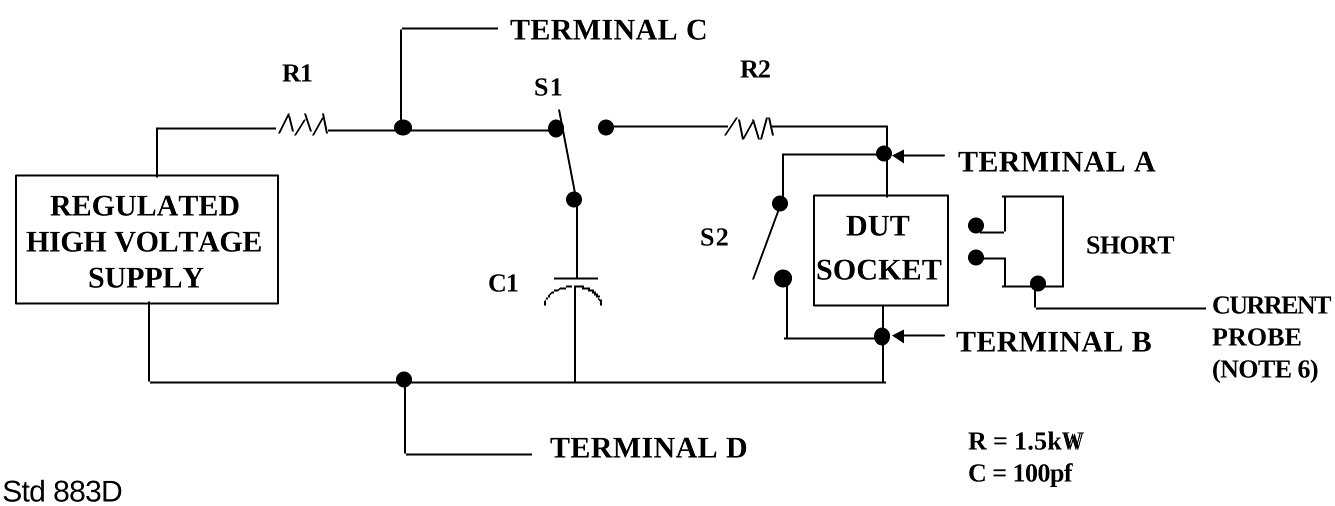
(e.g., where $V_{PS1}$ is $V_{DD}$, $V_{CC}$, $V_{SS}$, $V_{BB}$, GND, $+V_{S,}$ $-V_S$, $V_{REF}$, etc).

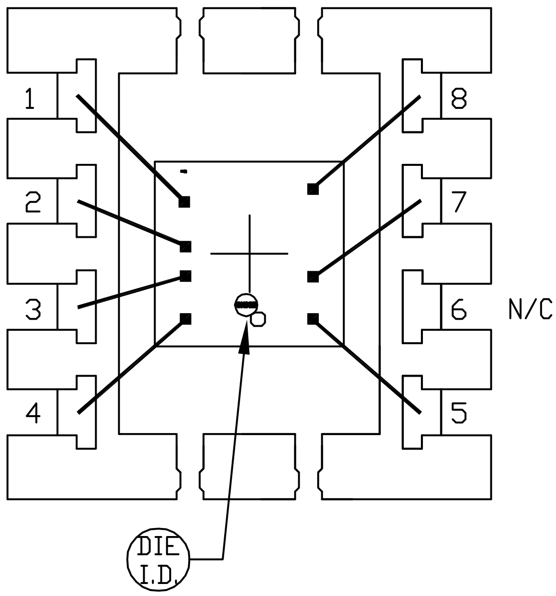
3.4 Pin combinations to be tested.

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., $V_{SS1}$, or $V_{SS2}$ or $V_{SS3}$ or $V_{CC1}$, or $V_{CC2}$) 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.

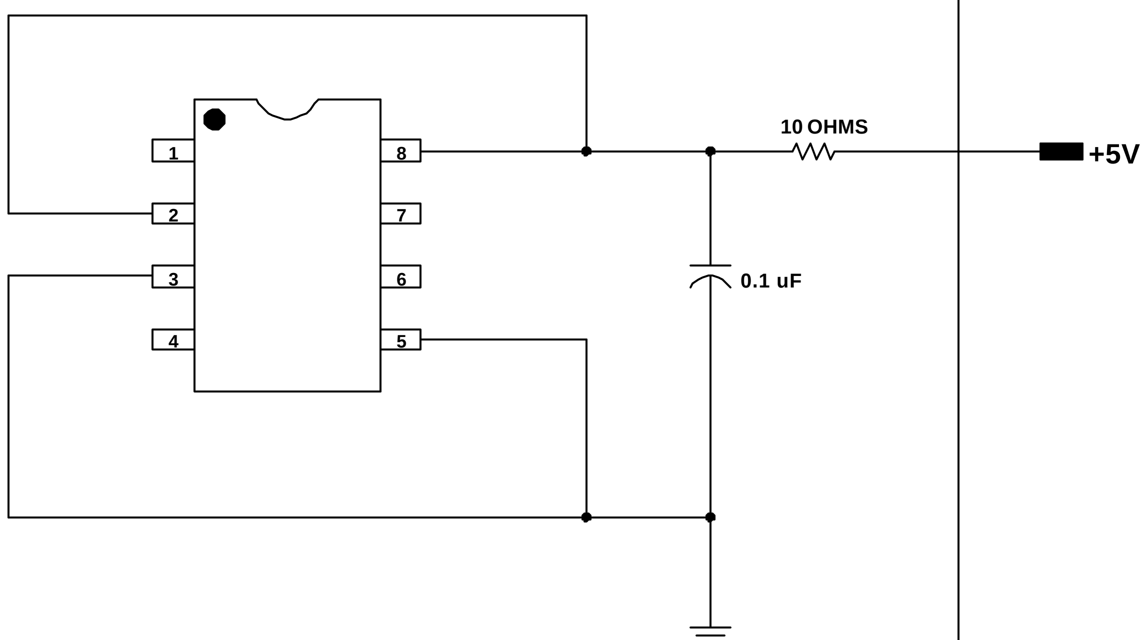





| | | | | | |
|---|---|---|---|---|---|
| PKG. CODE: U8-1 | | SIGNATURES | DATE | MAXIM CONFIDENTIAL & PROPRIETARY | |
| CAV./PAD SIZE: 68x94 | PKG. | | | BOND DIAGRAM #: 05-2501-0199 | REV: A |
| | DESIGN | | | | |

ONCE PER SOCKET

ONCE PER BOARD




**DEVICES: MAX 4000/4001/4002/4003**
**PACKAGE: 8-uMAX**
**MAX. EXPECTED CURRENT = 8mA**

**DRAWN BY: TEK TAN**
**NOTES:**