RELIABILITY REPORT

FOR

MAX1856EUB

PLASTIC ENCAPSULATED DEVICES

March 25, 2002

MAXIM INTEGRATED PRODUCTS

120 SAN GABRIEL DR.

SUNNYVALE, CA 94086

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Executive Director
Conclusion

The MAX1856 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 MAX1856 offers a low-cost solution for generating a SLIC (ringer and off-hook) power supply. Using standard off-the-shelf transformers from multiple vendors, the MAX1856 generates various output voltages: -24V and -72V (dual output) for both ringer and off-hook supplies for voice-enabled broadband consumer premises equipment (CPE), -48V for IP phones and routers, -5V and -15V (single or dual output) for DSL CO line drivers, or negative voltages as high as -185V for MEMS bias supplies. The output voltages are adjusted with an external voltage divider.

Due to its wide operating voltage range, the MAX1856 operates from a low-cost, unregulated DC power supply for cost-sensitive applications like xDSL, cable modems, set-top boxes, LMDS, MMDS, WLL, and FTTH CPE. The MAX1856 provides low audio-band noise for talk battery and a sturdy output capable of handling the ring trip conditions for ring battery.

The operating frequency can be set between 100kHz and 500kHz with an external resistor in free-running mode. For noise-sensitive applications, the MAX1856’s operating frequency can be synchronized to an external clock over its operating frequency range.

The flyback topology allows operation close to 50% duty cycle, offering high transformer utilization, low ripple current, and less stress on input and output capacitors. Internal soft-start minimizes startup stress on the input capacitor, without any external components.

The MAX1856’s current-mode control scheme does not require external loop compensation. The low-side current-sense resistor provides accurate current-mode control and overcurrent protection.

B. Absolute Maximum Ratings

<table>
<thead>
<tr>
<th>Item</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_{CC}$, SYNC/SHDN to GND</td>
<td>-0.3V to +30V</td>
</tr>
<tr>
<td>PGND to GND</td>
<td>-0.3V to +0.3V</td>
</tr>
<tr>
<td>LDO, FREQ, FB, CS to GND</td>
<td>-0.3V to +6.0V</td>
</tr>
<tr>
<td>EXT, REF to GND</td>
<td>-0.3V to (VLDO + 0.3V)</td>
</tr>
<tr>
<td>LDO Output Current</td>
<td>-1mA to +20mA</td>
</tr>
<tr>
<td>REF Short Circuit to GND</td>
<td>Continuous</td>
</tr>
<tr>
<td>Storage Temp.</td>
<td>-65°C to +150°C</td>
</tr>
<tr>
<td>Operating Temperature Range</td>
<td>-40°C to +85°C</td>
</tr>
<tr>
<td>Lead Temp. (10 sec.)</td>
<td>+300°C</td>
</tr>
<tr>
<td>Continuous Power Dissipation ($TA = +70°C$)</td>
<td>444mW</td>
</tr>
<tr>
<td>10-Pin uMAX</td>
<td></td>
</tr>
<tr>
<td>Derates above +70°C</td>
<td>5.6mW/°C</td>
</tr>
</tbody>
</table>

444mW
II. Manufacturing Information

A. Description/Function: Wide Input Range, Synchronizable, PWM SLIC Power Supply

B. Process: S12 – Silicon Gate 1.2 micron CMOS

C. Number of Device Transistors: 1538

D. Fabrication Location: Oregon, USA

E. Assembly Location: Malaysia or Philippines

F. Date of Initial Production: March, 2001

III. Packaging Information

A. Package Type: 10-Lead uMAX

B. Lead Frame: Copper

C. Lead Finish: Solder Plate

D. Die Attach: Silver-filled epoxy

E. Bondwire: Gold (1.3 mil dia.)

F. Mold Material: Epoxy with silica filler

G. Bonding Diagram 05-2301-0088

H. Flammability Rating: Class UL94-V0

I. Classification of Moisture Sensitivity per JEDEC standard JESD22-A112: Level 1

IV. Die Information

A. Dimensions: 58 x 81 mils

B. Passivation: Si₃N₄/SiO₂ (Silicon nitride/ Silicon dioxide)

C. Interconnect: Aluminum

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: SiO₂

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:

   $\lambda = \frac{1}{\text{MTTF}} = \frac{1.83}{192 \times 4389 \times 80 \times 2}$  
   (Chi square value for MTTF upper limit)

   $\lambda = 13.58 \times 10^{-9}$  
   $\lambda = 13.58$  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. # 06-5679) 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 PY98 die type has been found to have all pins able to withstand a transient pulse of ±2000V, per 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

#### MAX1856EUB

<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</td>
<td>80</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Biased</td>
<td>&amp; functionality</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Time = 192 hrs.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Moisture Testing</strong> (Note 2)</td>
<td>Ta = 121°C</td>
<td>DC Parameters</td>
<td>uMAX</td>
<td>419</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>P = 15 psi.</td>
<td>&amp; functionality</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>RH= 100%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Time = 168hrs.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>85/85</strong></td>
<td>Ta = 85°C</td>
<td>DC Parameters</td>
<td>77</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>RH = 85%</td>
<td>&amp; functionality</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Biased</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Time = 1000hrs.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Mechanical Stress</strong> (Note 2)</td>
<td>Temperature</td>
<td>DC Parameters</td>
<td>77</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>-65°C/150°C</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cycle</td>
<td>1000 Cycles</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Method 1010</td>
<td>Method</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note 1: Life Test Data may represent plastic D.I.P. qualification lots.
Note 2: Generic package/process data
TABLE II. Pin combination to be tested. 1/ 2/

<table>
<thead>
<tr>
<th>Terminal A</th>
<th>Terminal B</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Each pin individually connected to terminal A with the other floating)</td>
<td>(The common combination of all like-named pins connected to terminal B)</td>
</tr>
<tr>
<td>1. All pins except $V_{PS1}$ 3/</td>
<td>All $V_{PS1}$ pins</td>
</tr>
<tr>
<td>2. 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 $V_{PS1}$ 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.

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**Mil Std 883D**

**Method 3015.7**

**Notice 8**
DEVICES: MAX 1856

MAX. EXPECTED CURRENT = 350uA

DRAWN BY: HAK TAN

NOTES:

ONCE PER SOCKET

ONCE PER BOARD

10-uMAX

250 K

1uF

4.69 K

0.22uF

330 OHMS

100uF

+20V

350uA