RELIABILITY REPORT

FOR

MAX1570ETE

PLASTIC ENCAPSULATED DEVICES

January 21, 2003

MAXIM INTEGRATED PRODUCTS

120 SAN GABRIEL DR.

SUNNYVALE, CA 94086

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Quality Assurance
Executive Director
Conclusion

The MAX1570 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 MAX1570 fractional charge pump drives up to five white LEDs with regulated constant current for uniform intensity. The MAX1570 maintains the highest possible efficiency over the full 1-cell lithium-ion (Li+) battery input voltage range by utilizing a 1x/1.5x fractional charge pump and very-low-dropout current regulators. The MAX1570 operates with 1MHz fixed-frequency switching, allowing for tiny external components. The regulation scheme is optimized to ensure low EMI and low input ripple.

An external resistor sets the full-scale LED current, while two digital inputs control on/off and select between three levels of brightness. A pulse-width modulation (PWM) signal can also be used to modulate LED brightness.

The MAX1570 is available in 16-pin 4mm x 4mm Thin QFN packaging (0.8mm max height).

B. Absolute Maximum Ratings

<table>
<thead>
<tr>
<th>Item</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>IN, OUT, EN1, EN2 to GND</td>
<td>-0.3V to +6V</td>
</tr>
<tr>
<td>SET, LED1, LED2, LED3, LED4, LED5 to GND</td>
<td>-0.3V to (VIN + 0.3V)</td>
</tr>
<tr>
<td>PGND to GND</td>
<td>-0.3 to +0.3V</td>
</tr>
<tr>
<td>C1N, C2N to GND</td>
<td>-0.3 to (VIN + 1V)</td>
</tr>
<tr>
<td>C1P, C2P to GND</td>
<td>-0.3V to the greater</td>
</tr>
<tr>
<td>(VOUT + 1V) or (VIN + 1V) OUT Short Circuit to GND</td>
<td>Indefinite</td>
</tr>
<tr>
<td>Operating Temperature Range</td>
<td>-40°C to +85°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°</td>
</tr>
<tr>
<td>Continuous Power Dissipation (TA = +70°C)</td>
<td>1349mW</td>
</tr>
<tr>
<td>16-Pin QFN</td>
<td>16.9mW/°C</td>
</tr>
<tr>
<td>Derates above +70°C</td>
<td></td>
</tr>
<tr>
<td>16-Pin QFN</td>
<td></td>
</tr>
</tbody>
</table>
II. Manufacturing Information
A. Description/Function: White LED Current Regulator with 1x/1.5x High-Efficiency Charge Pump
B. Process: S8 - Standard 8 micron silicon gate CMOS
C. Number of Device Transistors: 3187
D. Fabrication Location: California, USA
E. Assembly Location: Thailand
F. Date of Initial Production: July, 2002

III. Packaging Information
A. Package Type: 16-Lead QFN (4x4)
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. Assembly Diagram: Buildsheet # 05-9000-0081
H. Flammability Rating: Class UL94-V0
I. Classification of Moisture Sensitivity per JEDEC standard JESD22-A112: Level 1

IV. Die Information
A. Dimensions: 81 X 81 mils
B. Passivation: Si₃N₄/SiO₂ (Silicon nitride/ Silicon dioxide)
C. Interconnect: TiW/ AlCu/ TiWN
D. Backside Metallization: None
E. Minimum Metal Width: .8 microns (as drawn)
F. Minimum Metal Spacing: .8 microns (as drawn)
G. Bondpad Dimensions: 2.7 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:

   $$\lambda = \frac{1}{\text{MTTF}} = \frac{1.83}{192 \times 4389 \times 45 \times 2}$$
   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 Burn-In Schematic (Spec.# 06-6032) 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) located on the Maxim website at http://www.maxim-ic.com.

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 PM62 die type has been found to have all pins able to withstand a transient pulse of ±400V, 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

**MAX1570ETE**

<table>
<thead>
<tr>
<th>TEST ITEM</th>
<th>TEST CONDITION</th>
<th>FAILURE IDENTIFICATION</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>45</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Biased</td>
<td>&amp; functionality</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Time = 192 hrs.</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>77</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Pressure Pot</td>
<td>&amp; functionality</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>P = 15 psi.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>RH = 100%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Time = 168 hrs.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>85/85</td>
<td>DC Parameters</td>
<td>77</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Ta = 85°C</td>
<td>&amp; functionality</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>RH = 85%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Biased</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Time = 1000hrs.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Mechanical Stress</strong> (Note 2)</td>
<td>-65°C/150°C</td>
<td>DC Parameters</td>
<td>77</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>1000 Cycles</td>
<td>&amp; functionality</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Method 1010</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Notes:**

- **Note 1:** Life Test Data may represent plastic D.I.P. qualification lots.
- **Note 2:** Generic process/package data
Attachment #1

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_{PS1} 3/</td>
<td>All V_{PS1} 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 1 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.

Mil Std 883D
Method 3015.7
Notice 8
DEVICES: MAX 1570
PACKAGE: 16-QFN (4x4)
MAX. EXPECTED CURRENT = 20mA (100mW).

ONCE PER SOCKET

ONCE PER BOARD

+5V

1000 OHMS

1000 OHMS

1000 OHMS

1000 OHMS

1000 OHMS

1000 OHMS

40000 OHMS

1000 OHMS

10 OHMS

1 uF

1 uF

1 uF

1 uF

DRAWN BY: TEK TAN
NOTES:

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