RELIABILITY REPORT
FOR
MAX1737EEI
PLASTIC ENCAPSULATED DEVICES

July 4, 2003

MAXIM INTEGRATED PRODUCTS
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Conclusion

The MAX1737 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 MAX1737 is a switch-mode lithium-ion (Li+) battery charger that charges one to four cells. It provides a regulated charging current and a regulated voltage with only a ±0.8% total voltage error at the battery terminals. The external N-channel switch and synchronous rectifier provide high efficiency over a wide input voltage range. A built-in safety timer automatically terminates charging once the adjustable time limit has been reached.

The MAX1737 regulates the voltage set point and charging current using two loops that work together to transition smoothly between voltage and current regulation. An additional control loop monitors the total current drawn from the input source to prevent overload of the input supply, allowing the use of a low-cost wall adapter.

The per-cell battery voltage regulation limit is set between 4.0V and 4.4V and the number of cells can be set from one to four by pin strapping. Battery temperature is monitored by an external thermistor to prevent charging if the battery temperature is outside the acceptable range.

The MAX1737 is available in a space-saving 28-pin QSOP package. Use the evaluation kit (MAX1737EVKIT) to help reduce design time.

B. Absolute Maximum Ratings (Note 1)

<table>
<thead>
<tr>
<th>Item</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSSP, CSSN, DCIN to GND</td>
<td>-0.3V to +30V</td>
</tr>
<tr>
<td>BST, DHI to GND</td>
<td>-0.3V to +36V</td>
</tr>
<tr>
<td>BST to LX</td>
<td>-0.3V to +6V</td>
</tr>
<tr>
<td>DHI to LX</td>
<td>-0.3V to ((BST - LX) + 0.3V)</td>
</tr>
<tr>
<td>LX to GND</td>
<td>-0.3V to (CSSN + 0.3V)</td>
</tr>
<tr>
<td>FULLCHG, FASTCHG, FAULT to GND</td>
<td>-0.3V to +30V</td>
</tr>
<tr>
<td>VL, VLO, SHDN, CELL, TIMER1, TIMER2, CCI, CCS</td>
<td>-0.3V to +6V</td>
</tr>
<tr>
<td>CCV, REF, ISETIN, ISETOUT, VADJ, THM to GND</td>
<td>-0.3V to (VLO + 0.3V)</td>
</tr>
<tr>
<td>DLO to GND</td>
<td>-0.3V to +20V</td>
</tr>
<tr>
<td>BATT, CS to GND</td>
<td>-0.3V to +20V</td>
</tr>
<tr>
<td>PGND to GND, CSSP to CSSN</td>
<td>-0.3V to +0.3V</td>
</tr>
<tr>
<td>VL to VLO</td>
<td>-0.3V to +0.3V</td>
</tr>
<tr>
<td>VL Source Current</td>
<td>50mA</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°C</td>
</tr>
<tr>
<td>Continuous Power Dissipation (TA = +70°C)</td>
<td>860mW</td>
</tr>
<tr>
<td>28-Pin QSOP</td>
<td>10.8W/°C</td>
</tr>
<tr>
<td>Derates above +70°C</td>
<td></td>
</tr>
<tr>
<td>28-Pin QSOP</td>
<td></td>
</tr>
</tbody>
</table>
II. Manufacturing Information

A. Description/Function: Stand-Alone Switch-Mode Lithium-Ion Battery-Charger Controller

B. Process: S12 (Standard 1.2 micron silicon gate CMOS)

C. Number of Device Transistors: 5978

D. Fabrication Location: Oregon or California, USA

E. Assembly Location: Malaysia, Thailand or Philippines

F. Date of Initial Production: April, 2000

III. Packaging Information

A. Package Type: 28-Pin QSOP

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: # 05-1101-0136

H. Flammability Rating: Class UL94-V0

I. Classification of Moisture Sensitivity per JEDEC standard JESD22-112: Level 1

IV. Die Information

A. Dimensions: 86 x 160 mils

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

C. Interconnect: Aluminum/Si (Si = 1%)

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 (Manager, Rel Operations)
   Bryan Preeshl (Executive Director)
   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 $135^\circ\text{C}$ biased (static) life test are shown in Table 1. Using these results, the Failure Rate ($\lambda$) is calculated as follows:

   $\lambda = \frac{1}{\text{MTTF}} = \frac{4.04}{192 \times 4389 \times 159 \times 2}$
   
   (Chi square value for MTTF upper limit)

   Temperature Acceleration factor assuming an activation energy of $0.8\text{eV}$

   $\lambda = 15.08 \times 10^{-9}$

   $\lambda = 15.08 \text{ F.I.T. (60\% confidence level @ 25}^\circ\text{C)}$

   This low failure rate represents data collected from Maxim’s reliability monitor program. In addition to routine production Burn-In, Maxim pulls a sample from every fabrication process three times per week and subjects it to an extended Burn-In prior to shipment to ensure its reliability. The reliability control level for each lot to be shipped as standard product 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 any lot that exceeds this reliability control level. Attached Burn-In Schematic (Spec. # 06-5501) shows the static Burn-In circuit. Maxim also performs quarterly 1000 hour life test monitors. This data is published in the Product Reliability Report (RR-1M).

B. Moisture Resistance Tests

   Maxim pulls pressure pot samples from every assembly process three times per week. Each lot sample must meet an LTPD = 20 or less before shipment as standard product. Additionally, the industry standard $85^\circ\text{C}/85\%\text{RH}$ testing is done per generic device/package family once a quarter.

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

   The PX59 die type has been found to have all pins able to withstand a transient pulse of $\pm200\text{V}$, per Mil-Std-883 Method 3015 (reference attached ESD Test Circuit). Latch-Up testing has shown that this device withstands a current of $\pm250\text{mA}$.
## Table 1
Reliability Evaluation Test Results

**MAX1737EEI**

<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 &amp; functionality</td>
<td>159</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Biased</td>
<td></td>
<td>Time = 192 hrs.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Moisture Testing</strong> (Note 2)</td>
<td>Pressure Pot</td>
<td>Ta = 121°C</td>
<td>DC Parameters &amp; functionality</td>
<td>QSOP</td>
<td>77</td>
</tr>
<tr>
<td></td>
<td>P = 15 psi.</td>
<td></td>
<td>Time = 168hrs.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>RH = 100%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>85/85</td>
<td>Ta = 85°C</td>
<td>DC Parameters &amp; functionality</td>
<td>77</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>RH = 85%</td>
<td></td>
<td>Biased</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 Cycle</td>
<td>-65°C/150°C</td>
<td>DC Parameters &amp; functionality</td>
<td>77</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>1000 Cycles</td>
<td></td>
<td>Method 1010</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note 1: Life Test Data may represent plastic DIP qualification lots.
Note 2: Generic Package/Process data
TABLE II. Pin combination to be tested. 1/ 2/

<table>
<thead>
<tr>
<th></th>
<th>Terminal A</th>
<th>Terminal B</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<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.</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 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