RELIABILITY REPORT

FOR

MAX726xCK

PLASTIC ENCAPSULATED DEVICES

June 20, 2003

MAXIM INTEGRATED PRODUCTS

120 SAN GABRIEL DR.

SUNNYVALE, CA 94086

Written by
Jim Pedicord
Quality Assurance
Reliability Lab Manager

Reviewed by
Bryan J. Preeshl
Quality Assurance
Executive Director
Conclusion

The MAX726 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                                V. Quality Assurance Information
II. Manufacturing Information                      VI. Reliability Evaluation
III. Packaging Information                         VII. Attachments
IV. Die Information

I. Device Description

A. General

The MAX726 is a monolithic, bipolar, pulse-width modulation (PWM), switch-mode DC-DC regulator optimized for step-down applications. The MAX726 is rated at 2A. Few external components are needed for standard operation because the power switch, oscillator, and control circuitry are all on-chip. Employing a classic buck topology, this regulator performs high-current step-down functions, but can also be configured as an inverter, a negative boost converter, or a flyback converter.

This regulator has excellent dynamic and transient response characteristics, while featuring cycle-by-cycle current limiting to protect against overcurrent faults and short-circuit output faults. The MAX726 also has a wide 8V to 40V input range in the buck step-down configuration. In inverting and boost configurations, the input can be as low as 5V. This device has a preset 100kHz oscillator frequency and a preset current limit of 2.6A.

B. Absolute Maximum Ratings

<table>
<thead>
<tr>
<th>Item</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input Voltage</td>
<td>45V</td>
</tr>
<tr>
<td>Switch Voltage with Respect to Input Voltage</td>
<td>50V</td>
</tr>
<tr>
<td>Switch Voltage with Respect to Ground Pin (V_{SW} Negative) (Note 1)</td>
<td>35V</td>
</tr>
<tr>
<td>Feedback Pin Voltage</td>
<td>-0.3V, +10V</td>
</tr>
<tr>
<td>Storage Temp.</td>
<td>-65°C to +160°C</td>
</tr>
<tr>
<td>Lead Temp. (10 sec.)</td>
<td>+300°C</td>
</tr>
<tr>
<td>Continuous Power Dissipation (TA = +70°C0)</td>
<td>1111mW</td>
</tr>
<tr>
<td>5-Pin TO-220</td>
<td></td>
</tr>
<tr>
<td>Derates above +70°C</td>
<td>13.9mW/^°C</td>
</tr>
<tr>
<td>5-Pin TO-220</td>
<td></td>
</tr>
</tbody>
</table>

Note 1: Do not exceed switch-to-input voltage limitation.
II. Manufacturing Information

A. Description/Function: 5A Step-Down, PWM, Switch-Mode DC-DC Regulator
B. Process: 6BC50 ((BIP) - Standard 5 micron Bipolar Power Process)
C. Number of Device Transistors: 148
D. Fabrication Location: California, USA
E. Assembly Location: Malaysia
F. Date of Initial Production: June, 1996

III. Packaging Information

A. Package Type: 5 Lead TO-220
B. Lead Frame: Copper
C. Lead Finish: Solder Plate
D. Die Attach: Silver-filled Epoxy
E. Bondwire: Gold (2.0 mil dia.)
F. Mold Material: Epoxy with silica filler
G. Assembly Diagram: # 05-1701-0221
H. Flammability Rating: Class UL94-V0
I. Classification of Moisture Sensitivity per JEDEC standard JESD22-A112: Level 1

IV. Die Information

A. Dimensions: 116 x 121 mils
B. Passivation: Si₃N₄/SiO₂ (Silicon nitride/ Silicon dioxide)
C. Interconnect: Aluminum/Si (Si = 1%)
D. Backside Metallization: None
E. Minimum Metal Width: 5 microns (as drawn)
F. Minimum Metal Spacing: 5 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, Reliability Operations)
   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:

   $$\lambda = \frac{1}{\text{MTTF}} = \frac{1.83}{192 \times 4389 \times 480 \times 2}$$

   (Chi square value for MTTF upper limit)

   Thermal acceleration factor assuming a 0.8eV activation energy

   $$\lambda = 2.26 \times 10^{-9}$$

   $\lambda = 2.26$ 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 the 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 lots exceeding this level. The following Burn-In Schematic (Spec. # 06-0079) 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 PW15 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

**MAX726xCK**

<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 Biased</td>
<td>DC Parameters &amp; functionality</td>
<td>480</td>
<td>0</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>Pressure Pot</td>
<td>Ta = 121°C P = 15 psi. RH = 100% Time = 168 hrs.</td>
<td>DC Parameters &amp; functionality</td>
<td>77</td>
</tr>
<tr>
<td></td>
<td>85/85</td>
<td>Ta = 85°C RH = 85% Biased Time = 1000hrs.</td>
<td>DC Parameters &amp; functionality</td>
<td>77</td>
</tr>
<tr>
<td><strong>Mechanical Stress</strong> (Note 2)</td>
<td>Temperature Cycle</td>
<td>-65°C/150°C 1000 Cycles Method 1010</td>
<td>DC Parameters &amp; functionality</td>
<td>77</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<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. 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.

---

Mil Std 883D
Method 3015.7
Notice 8
NOTES:
1. TEMPERATURE: 125°C OR EQUIVALENT
2. TIME: 1680 HOURS MIN. OR EQUIVALENT
3. ALL COMPONENTS AND MATERIAL MUST STAND
   1500% CONTINUOUS
4. APPROVED FOR EXI COMMERCIAL
   EX 1N/883

SPEC. NO. 06-0079 REV. B
DATE: 8/19/93
DRAWN BY: C. JONES

MAXIM BURN-IN SCHEMATIC

DEVICE TYPE: MAX724/728
             MAX727/728/729
             MAX767/788/789
             LT1074/1075