Conclusion

The MAX766ESA+ 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 MAX764/MAX765/MAX766 inverting switching regulators are highly efficient over a wide range of load currents, delivering up to 1.5W. A unique, current-limited, pulse-frequency-modulated (PFM) control scheme combines the benefits of traditional PFM converters with the benefits of pulse-width-modulated (PWM) converters. Like PWM converters, the MAX764/MAX765/MAX766 are highly efficient at heavy loads. Yet because they are PFM devices, they use less than 120µA of supply current (vs. 2mA to 10mA for a PWM device). The input voltage range is 3V to 16V. The output voltage is preset at -5V (MAX764), -12V (MAX765), or -15V (MAX766); it can also be adjusted from -1V to -16V using two external resistors (Dual Mode(tm)). The maximum operating $V_{\text{IN}} - V_{\text{OUT}}$ differential is 20V. These devices use miniature external components; their high switching frequencies (up to 300kHz) allow for less than 5mm diameter surface-mount magnetics. A standard 47µH inductor is ideal for most applications, so no magnetics design is necessary. An internal power MOSFET makes the MAX764/MAX765/MAX766 ideal for minimum component count, low- and medium-power applications. For increased output drive capability or higher output voltages, use the MAX774/MAX775/MAX776 or MAX1774, which drive an external power P-channel MOSFET for loads up to 5W.
II. Manufacturing Information

A. Description/Function: -5V/-12V/-15V or Adjustable, High-Efficiency, Low-I<sub>Q</sub> DC-DC Inverters
B. Process: SG5
C. Number of Device Transistors:
D. Fabrication Location: Oregon
E. Assembly Location: Philippines, Thailand
F. Date of Initial Production: Pre 1997

III. Packaging Information

A. Package Type: 8-pin SOIC (N)
B. Lead Frame: Copper
C. Lead Finish: 100% matte Tin
D. Die Attach: Conductive Epoxy
E. Bondwire: Gold (1.3 mil dia.)
F. Mold Material: Epoxy with silica filler
G. Assembly Diagram: #05-1701-0130
H. Flammability Rating: Class UL94-V0
I. Classification of Moisture Sensitivity per JEDEC standard J-STD-020-C Level 1
J. Single Layer Theta Ja: 170°C/W
K. Single Layer Theta Jc: 40°C/W
L. Multi Layer Theta Ja: 128.4°C/W
M. Multi Layer Theta Jc: 36°C/W

IV. Die Information

A. Dimensions: 80 X 145 mils
B. Passivation: Si<sub>3</sub>N<sub>4</sub>/SiO<sub>2</sub> (Silicon nitride/ Silicon dioxide)
C. Interconnect: Al/0.5%Cu with Ti/TiN Barrier
D. Backside Metallization: None
E. Minimum Metal Width: 5.0 microns (as drawn)
F. Minimum Metal Spacing: 5.0 microns (as drawn)
G. Bondpad Dimensions: 5 mil. Sq.
H. Isolation Dielectric: SiO<sub>2</sub>
I. Die Separation Method: Wafer Saw
V.  Quality Assurance Information

A.  Quality Assurance Contacts:  
    Ken Wendel (Director, Reliability Engineering)  
    Bryan Preeshl (Managing Director of QA)  

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:

\[
\chi = \frac{1}{MTTF} = \frac{1.83}{192 \times 4340 \times 80 \times 2} \text{(Chi square value for MTTF upper limit)}
\]

\[
= 6.7 \times 10^{-9}
\]

\[
\chi = 6.7 \text{ F.I.T. (60% confidence level @ 25°C)}
\]

The following failure rate represents data collected from Maxim’s reliability monitor program. Maxim performs quarterly life test monitors on its processes. This data is published in the Reliability Report found at http://www.maxim-ic.com/qa/reliability/monitor. Cumulative monitor data for the SG5 Process results in a FIT Rate of 0.12 @ 25°C and 2.04 @ 55°C (0.8 eV, 60% UCL)

B.  Moisture Resistance Tests

The industry standard 85°C/85%RH or HAST testing is monitored per device process once a quarter.

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

The PW10-2 die type has been found to have all pins able to withstand a HBM transient pulse of +/-1500 V per Mil-Std 883 Method 3015.7. Latch-Up testing has shown that this device withstands a current of +/-250 mA.
### Table 1
Reliability Evaluation Test Results

**MAX766ESA+**

<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></td>
<td>(Note 1)</td>
<td>Ta = 135°C Biased</td>
<td>80</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Time = 192 hrs.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Moisture Testing</strong></td>
<td><strong>HAST</strong> Ta = 130°C RH = 85% Biased</td>
<td>77</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Time = 96hrs.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Mechanical Stress</strong></td>
<td>(Note 2)</td>
<td>Temperature Cycle</td>
<td>77</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>-65°C/150°C</td>
<td>1000 Cycles 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