

RELIABILITY REPORT  
FOR  
MAX15038ETG+  
PLASTIC ENCAPSULATED DEVICES

May 4, 2009

**MAXIM INTEGRATED PRODUCTS**

120 SAN GABRIEL DR.  
SUNNYVALE, CA 94086

|                                   |
|-----------------------------------|
| <b>Approved by</b>                |
| Ken Wendel                        |
| Quality Assurance                 |
| Director, Reliability Engineering |

## Conclusion

The MAX15038ETG+ 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 MAX15038 high-efficiency switching regulator delivers up to 4A load current at output voltages from 0.6V to 90% of VIN. The IC operates from 2.9V to 5.5V, making it ideal for on-board point-of-load and postregulation applications. Total output error is less than  $\pm 1\%$  over load, line, and temperature ranges. The MAX15038 features fixed-frequency PWM mode operation with a switching frequency range of 500kHz to 2MHz set by an external resistor. The MAX15038 provides the option of operating in a pulse-skip mode to improve light-load efficiency. High-frequency operation allows for an all-ceramic capacitor design. The high operating frequency also allows for small-size external components. The low-resistance on-chip nMOS switches ensure high efficiency at heavy loads while minimizing critical inductances, making the layout a much simpler task with respect to discrete solutions. Following a simple layout and footprint ensures first-pass success in new designs. The MAX15038 comes with a high bandwidth (28MHz) voltage-error amplifier. The voltage-mode control architecture and the voltage-error amplifier permit a type III compensation scheme to be utilized to achieve maximum loop bandwidth, up to 20% of the switching frequency. High loop bandwidth provides fast transient response, resulting in less required output capacitance and allowing for all-ceramic-capacitor designs. The MAX15038 provides two three-state logic inputs to select one of nine preset output voltages. The preset output voltages allow customers to achieve  $\pm 1\%$  output-voltage accuracy without using expensive 0.1% resistors. In addition, the output voltage can be set to any customer value by either using two external resistors at the feedback with a 0.6V internal reference or applying an external reference voltage to the REFIN input. The MAX15038 offers programmable soft-start time using one capacitor to reduce input inrush current.

## II. Manufacturing Information

|                                  |   |
|----------------------------------|---|
| A. Description/Function:         | 4A, 2MHz Step-Down Regulator with Integrated Switches |
| B. Process:                      | S4  |
| C. Number of Device Transistors: | 5944  |
| D. Fabrication Location:         | California, Texas or Japan                            |
| E. Assembly Location:            | ASAT China, UTL Thailand, Unisem Malaysia             |
| F. Date of Initial Production:   | October 24, 2008                                      |

## III. Packaging Information

|  |                          |
|--|--------------------------|
| A. Package Type:   | 24-pin TQFN 4x4          |
| B. Lead Frame:   | Copper                   |
| C. Lead Finish:  | 100% matte Tin           |
| D. Die Attach:   | Conductive Epoxy         |
| E. Bondwire:   | Au (2.0 mil dia.)        |
| F. Mold Material:  | Epoxy with silica filler |
| G. Assembly Diagram:   | #                        |
| 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:  | 48°C/W                   |
| K. Single Layer Theta Jc:  | 2.7°C/W                  |
| L. Multi Layer Theta Ja:   | 36°C/W                   |
| M. Multi Layer Theta Jc:   | 2.7°C/W                  |

## IV. Die Information

|                            |   |
|----------------------------|---|
| A. Dimensions:             | 89 X 89 mils  |
| B. Passivation:            | Si <sub>3</sub> N <sub>4</sub> /SiO <sub>2</sub> (Silicon nitride/ Silicon dioxide) |
| C. Interconnect:           | Aluminum/0.5%Cu   |
| D. Backside Metallization: | None  |
| E. Minimum Metal Width:    | Metal1 = 0.5 / Metal2 = 0.6 / Metal3 = 0.6 microns (as drawn)                       |
| F. Minimum Metal Spacing:  | Metal1 = 0.45 / Metal2 = 0.5 / Metal3 = 0.6 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)<br>Bryan Preeshl (Managing Director of QA)       |
| B. Outgoing Inspection Level:     | 0.1% for all electrical parameters guaranteed by the Datasheet.<br>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:

$$\lambda = \frac{1}{\text{MTTF}} = \frac{1.83}{192 \times 4340 \times 48 \times 2} \quad (\text{Chi square value for MTTF upper limit})$$

(where 4340 = Temperature Acceleration factor assuming an activation energy of 0.8eV)

$$\lambda = 22.4 \times 10^{-9}$$

$$\lambda = 22.4 \text{ F.I.T. (60\% confidence level @ 25°C)}$$

The following failure rate represents data collected from Maxim's reliability monitor program. Maxim performs quarterly 1000 hour life test monitors on its processes. This data is published in the Product Reliability Report found at <http://www.maxim-ic.com/>. Current monitor data for the S4 Process results in a FIT Rate of 0.28 @ 25C and 4.85 @ 55C (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 NQ22 die type has been found to have all pins able to withstand a HBM transient pulse of 2500 per JEDEC JESD22-A114-D. Latch-Up testing has shown that this device withstands a current of 250.

**Table 1**  
Reliability Evaluation Test Results

**MAX15038ETG+**

| TEST ITEM   | TEST CONDITION                                     | FAILURE IDENTIFICATION        | SAMPLE SIZE | NUMBER OF FAILURES |
|---|--|-------------------------------|-------------|--------------------|
| <b>Static Life Test</b> (Note 1)                          | Ta = 135°C<br>Biased<br>Time = 192 hrs.            | DC Parameters & functionality | 48          | 0                  |
| <b>Moisture Testing</b> (Note 2)<br>85/85                 | Ta = 85°C<br>RH = 85%<br>Biased<br>Time = 1000hrs. | DC Parameters & functionality | 77          | 0                  |
| <b>Mechanical Stress</b> (Note 2)<br>Temperature<br>Cycle | -65°C/150°C<br>1000 Cycles<br>Method 1010          | DC Parameters & functionality | 77          | 0                  |

Note 1: Life Test Data may represent plastic DIP qualification lots.

Note 2: Generic Package/Process data