



RELIABILITY REPORT  
FOR  
MAX15051EWE+T  
PLASTIC ENCAPSULATED DEVICES

September 24, 2010

**MAXIM INTEGRATED PRODUCTS**

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## Conclusion

The MAX15051EWE+T 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 MAX15050/MAX15051 high-efficiency switching regulators deliver up to 4A load current at output voltages from 0.6V to  $(0.9 \times V_{IN})$ . The devices operate from 2.9V to 5.5V, making them ideal for on-board point-of-load and postregulation applications. Total output-voltage accuracy is within  $\pm 1\%$  over load, line, and temperature.

The MAX15050/MAX15051 feature 1MHz fixed-frequency PWM operation. The MAX15050 features pulse-skip mode to improve light-load efficiency. The MAX15050 soft-starts in a monotonic mode and then operates in the forced PWM mode or pulse-skip mode depending on the output load current condition. The MAX15051 soft-starts in the monotonic mode and operates in the forced PWM mode. The high operating frequency allows for small-size external components.

The low-resistance on-chip nMOS switches ensure high efficiency at heavy loads while minimizing critical parasitic 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 MAX15050/MAX15051 incorporate a high-bandwidth ( $> 26\text{MHz}$ ) voltage-error amplifier. The voltage-mode control architecture and the voltage-error amplifier permit a type III compensation scheme to achieve maximum loop bandwidth, up to 200kHz. High loop bandwidth provides fast transient response, resulting in less required output capacitance and allowing for all-ceramic capacitor designs.

The MAX15050/MAX15051 feature an output overload hiccup protection and peak current limit on both high-side and low-side MOSFETs. These features provide for ultra-safe operation in the cases of short-circuit conditions, severe overloads, or in converters with bulk electrolytic capacitors.

The MAX15050/MAX15051 feature an adjustable output voltage. The output voltage is adjustable by using two external resistors at the feedback or by applying an external reference voltage to the REFIN/SS input. The MAX15050/MAX15051 offer programmable soft-start time using one capacitor to reduce input inrush current. A built-in thermal shutdown protection assures safe operation under all conditions. The MAX15050/MAX15051 are available in a 2mm x 2mm, 16-bump (4 x 4 array), 0.5mm pitch WLP package.

**II. Manufacturing Information**

A. Description/Function:	High-Efficiency, 4A, 1MHz Step-down Regulators with Integrated Switches in 2mm x 2mm package.
B. Process:	S45
C. Number of Device Transistors:	10089
D. Fabrication Location:	California, Texas or Japan
E. Assembly Location:	Japan
F. Date of Initial Production:	September 23, 2009

**III. Packaging Information**

A. Package Type:	16-bump WLP 4x4 array
B. Lead Frame:	N/A
C. Lead Finish:	N/A
D. Die Attach:	None
E. Bondwire:	N/A (N/A mil dia.)
F. Mold Material:	N/A
G. Assembly Diagram:	#05-9000-3785
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:	°C/W
K. Single Layer Theta Jc:	°C/W
L. Multi Layer Theta Ja:	49°C/W
M. Multi Layer Theta Jc:	9°C/W

**IV. Die Information**

A. Dimensions:	89 X 80 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:	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:	Richard Aburano (Manager, Reliability Operations) 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:

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

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

$$\lambda = 22.9 \times 10^{-9}$$

$$\lambda = 22.9 \text{ F.I.T. (60\% confidence level @ 25°C)}$$

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 S45 Process results in a FIT Rate of 0.49 @ 25C and 8.49 @ 55C (0.8 eV, 60% UCL)

### B. E.S.D. and Latch-Up Testing (lot TYCZCQ001A, D/C 0937)

The NQ45-1 die type has been found to have all pins able to withstand a transient pulse of

ESD-HBM:	+/- 2500V per JEDEC JESD22-A114
ESD-CDM:	+/- 750V per JEDEC JESD22-C101

Latch-Up testing has shown that this device withstands a current of 250mA and overvoltage to JEDEC JESD78.

**Table 1**  
Reliability Evaluation Test Results

**MAX15051EWE+T**

TEST ITEM	TEST CONDITION	FAILURE IDENTIFICATION	SAMPLE SIZE	NUMBER OF FAILURES	COMMENTS
<b>Static Life Test</b> (Note 1)	Ta = 135°C Biased Time = 192 hrs.	DC Parameters & functionality	48	0	TYCZCQ001A, D/C 0937

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