

RELIABILITY REPORT  
FOR  
MAX1538ETI+  
PLASTIC ENCAPSULATED DEVICES

January 30, 2015

**MAXIM INTEGRATED**

160 RIO ROBLES  
SAN JOSE, CA 95134

|                      |
|----------------------|
| <b>Approved by</b>   |
| Sokhom Chum          |
| Quality Assurance    |
| Reliability Engineer |

## Conclusion

The MAX1538ETI+ successfully meets the quality and reliability standards required of all Maxim Integrated products. In addition, Maxim Integrated's continuous reliability monitoring program ensures that all outgoing product will continue to meet Maxim Integrated's quality and reliability standards.

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### I. Device Description

#### A. General

The MAX1538 selector provides power-source control for dual-battery systems. The device selects between an AC adapter and dual batteries based on the presence of the three power sources and the state of charge of each battery. The MAX1538 includes analog comparators to detect AC/airline-adapter presence and determine battery undervoltage. Fast analog circuitry allows the device to switch between power sources to implement a break-before-make time, which allows hot swapping of battery packs. The MAX1538 independently performs power-source monitoring and selection, freeing the system power-management  $\mu$ P for other tasks. This simplifies the development of  $\mu$ P power-management firmware and allows the  $\mu$ P to enter standby, reducing system power consumption. The MAX1538 supports "relearn mode," which allows the system to measure and fully utilize battery capacity. In this state, the part allows the selected battery to be discharged even when an AC adapter is present. The MAX1538 can also be used to power the system in an aircraft. On detecting an airline adapter, the MAX1538 automatically disables charging or discharging of battery packs and only allows the system to be powered from the adapter. The MAX1538 is available in a space-saving 28-pin thin QFN package with a maximum footprint of 5mm x 5mm.

## II. Manufacturing Information

|                                  |  |
|----------------------------------|--|
| A. Description/Function:         | Power-Source Selector for Dual-Battery Systems |
| B. Process:                      | B8   |
| C. Number of Device Transistors: |  |
| D. Fabrication Location:         | California or Texas                            |
| E. Assembly Location:            | China, Thailand                                |
| F. Date of Initial Production:   | January 24, 2004                               |

## III. Packaging Information

|  |                          |
|--|--------------------------|
| A. Package Type:   | 28-pin TQFN 5x5          |
| B. Lead Frame:   | Copper                   |
| C. Lead Finish:  | 100% matte Tin           |
| D. Die Attach:   | Conductive               |
| E. Bondwire:   | Au (1 mil dia.)          |
| F. Mold Material:  | Epoxy with silica filler |
| G. Assembly Diagram:   | #05-9000-0464            |
| 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:   | 35°C/W                   |
| M. Multi Layer Theta Jc:   | 2.7°C/W                  |

## IV. Die Information

|                            |   |
|----------------------------|---|
| A. Dimensions:             | 103X85 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:    | 0.8 microns (as drawn)  |
| F. Minimum Metal Spacing:  | 0.8 microns (as drawn)  |
| G. Bondpad Dimensions:     |   |
| H. Isolation Dielectric:   | SiO <sub>2</sub>  |
| I. Die Separation Method:  | Wafer Saw   |

## V. Quality Assurance Information

- A. Quality Assurance Contacts: Don Lipps (Manager, Reliability Engineering)  
Bryan Preeshl (Vice President 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 135C biased (static) life test are shown in Table 1. Using these results, the Failure Rate ( $\lambda$ ) is calculated as follows:

$$\lambda = \frac{1}{\text{MTTF}} = \frac{1.83}{192 \times 4340 \times 94 \times 2} \quad (\text{Chi square value for MTTF upper limit})$$

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

$$\lambda = 11.7 \times 10^{-9}$$

$$\lambda = 11.7 \text{ F.I.T. (60\% confidence level @ 25°C)}$$

The following failure rate represents data collected from Maxim Integrated's reliability monitor program. Maxim Integrated performs quarterly life test monitors on its processes. This data is published in the Reliability Report found at <http://www.maximintegrated.com/qa/reliability/monitor>. Cumulative monitor data for the B8 Process results in a FIT Rate of 0.01 @ 25C and 0.26 @ 55C (0.8 eV, 60% UCL)

### B. E.S.D. and Latch-Up Testing (ESD lot JDX0DA005J D/C 1334, Latch-Up lot SDX0BQ001B D/C 0343)

The PD33 die type has been found to have all pins able to withstand a HBM transient pulse of +/-1000V per JEDEC JESD22-A114. Latch-Up testing has shown that this device withstands a current of +/-250mA.

**Table 1**  
Reliability Evaluation Test Results

**MAX1538ETI+**

| TEST ITEM                        | TEST CONDITION  | FAILURE IDENTIFICATION | SAMPLE SIZE | NUMBER OF FAILURES | COMMENTS             |
|----------------------------------|-----------------|------------------------|-------------|--------------------|----------------------|
| <b>Static Life Test</b> (Note 1) | Ta = 135°C      | DC Parameters          | 48          | 0                  | DDX0CQ001A, D/C 0643 |
|                                  | Biased          | & functionality        | 46          | 0                  | SDX0BQ001B, D/C 0343 |
|                                  | Time = 192 hrs. |                        |             |                    |                      |

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