

RELIABILITY REPORT
FOR
MAX16936xATEx/V+T / MAX16936xAUEx/V+T
PLASTIC ENCAPSULATED DEVICES

December 11, 2012

MAXIM INTEGRATED

160 RIO ROBLES
SAN JOSE, CA 95134

| Approved by |
|----------------------------------|
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Conclusion

The MAX16936xATEx/V+T / MAX16936xAUEx/V+T 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 MAX16936 is a 2.5A current-mode step-down converter with integrated high-side and low-side MOSFETs designed to operate with an external Schottky diode for better efficiency. The low-side MOSFET enables fixed-frequency forced-PWM (FPWM) operation under light-load applications. The device operates with input voltages from 3.5V to 36V, while using only 25 μ A quiescent current at no load. The switching frequency is resistor programmable from 220kHz to 2.2MHz and can be synchronized to an external clock. The MAX16936's output voltage is available as 5V/3.3V fixed or adjustable from 1V to 10V. The wide input voltage range along with its ability to operate at 98% duty cycle during undervoltage transients make the MAX16936 ideal for automotive and industrial applications. The MAX16936 maintains maximum dropout of 650mV (typ) under the full load of 2.5A. Under light-load applications, the FSYNC logic input allows the MAX16936 to either operate in skip mode for reduced current consumption or fixed-frequency FWM mode to eliminate frequency variation to minimize EMI. Fixed-frequency FPWM mode is extremely useful for power supplies designed for RF transceivers where tight emission control is necessary. Protection features include cycle-by-cycle current limit and thermal shutdown with automatic recovery. Additional features include a powergood monitor to ease power-supply sequencing and a 180° out-of-phase clock output relative to the internal oscillator at SYNCOUT to create cascaded power supplies with multiple MAX16836s. The MAX16936 operates over the -40°C to +125°C automotive temperature range and is available in 16-pin TSSOP-EP and 5mm x 5mm, 16-pin TQFN-EP packages.

II. Manufacturing Information

| | | |
|----------------------------------|---|--------------------------|
| A. Description/Function: | 36V, 220kHz to 2.2MHz Step-Down Converter with 28iA Quiescent Current | |
| B. Process: | S18 | |
| C. Number of Device Transistors: | | |
| D. Fabrication Location: | USA | |
| E. Assembly Location: | China and Taiwan | Philippines and Thailand |
| F. Date of Initial Production: | June 25, 2012 | |

III. Packaging Information

| | | |
|--|--------------------------|--------------------------|
| A. Package Type: | 16-pin TQFN 5x5 | 16-pin TSSOP |
| B. Lead Frame: | Copper | Copper |
| C. Lead Finish: | 100% matte Tin | 100% matte Tin |
| D. Die Attach: | Conductive | Conductive |
| E. Bondwire: | Au (1.3 mil dia.) | Au (1.3 mil dia.) |
| F. Mold Material: | Epoxy with silica filler | Epoxy with silica filler |
| G. Assembly Diagram: | #05-9000-4752 | #05-9000-4761 |
| H. Flammability Rating: | Class UL94-V0 | Class UL94-V0 |
| I. Classification of Moisture Sensitivity per JEDEC standard J-STD-020-C | Level 1 | Level 1 |
| J. Single Layer Theta Ja: | 48°C/W | 47°C/W |
| K. Single Layer Theta Jc: | 2.7°C/W | 3°C/W |
| L. Multi Layer Theta Ja: | 35°C/W | 38.3°C/W |
| M. Multi Layer Theta Jc: | 2.7°C/W | 3°C/W |

IV. Die Information

| | |
|----------------------------|---|
| A. Dimensions: | mils |
| B. Passivation: | Si ₃ N ₄ /SiO ₂ (Silicon nitride/ Silicon dioxide) |
| C. Interconnect: | Al/0.5%Cu with Ti/TiN Barrier |
| D. Backside Metallization: | None |
| E. Minimum Metal Width: | Metal1 = 0.23 / Metal2-3 = 0.28 / Metal 4 = 2.6 microns (as drawn) |
| F. Minimum Metal Spacing: | Metal1 = 0.23 / Metal2-3 = 0.28 / Metal 4 = 3.0 microns (as drawn) |
| G. Bondpad Dimensions: | |
| H. Isolation Dielectric: | SiO ₂ |
| I. Die Separation Method: | Wafer Saw |

V. Quality Assurance Information

| | |
|-----------------------------------|--|
| A. Quality Assurance Contacts: | Richard Aburano (Manager, Reliability Engineering) 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 (λ) is calculated as follows:

$$\lambda = \frac{1}{\text{MTTF}} = \frac{1.83}{240 \times 4340 \times 78 \times 2} \quad (\text{Chi square value for MTTF upper limit})$$

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

$$\lambda = 11.3 \times 10^{-9}$$

$$\lambda = 11.3 \text{ F.I.T. (60\% confidence level @ 25°C)}$$

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 S18 Process results in a FIT Rate of 0.06 @ 25C and 1.05 @ 55C (0.8 eV, 60% UCL)

B. E.S.D. and Latch-Up Testing (lot SAEN9Q001D, D/C 1219)

The AP33-0 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 +/- 100mA and overvoltage per JEDEC JESD78.

Table 1
Reliability Evaluation Test Results

MAX16936xAEx/V+T / MAX16936xAUEx/V+T

| TEST ITEM | TEST CONDITION | FAILURE IDENTIFICATION | SAMPLE SIZE | NUMBER OF FAILURES | COMMENTS |
|----------------------------------|--|----------------------------------|-------------|--------------------|----------------------|
| Static Life Test (Note 1) | Ta = 135C Biased Time = 240 hrs. | DC Parameters & functionality | 78 | 0 | SAEN9Q001D, D/C 1219 |

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