

RELIABILITY REPORT
FOR
MAX5904ESA
PLASTIC ENCAPSULATED DEVICES

April 17, 2003

MAXIM INTEGRATED PRODUCTS

120 SAN GABRIEL DR.

SUNNYVALE, CA 94086

Written by

A handwritten signature in black ink, appearing to read "J Pedicord".

Jim Pedicord
Quality Assurance
Reliability Lab Manager

Reviewed by

A handwritten signature in black ink, appearing to read "Bryan J. Preeshl".

Bryan J. Preeshl
Quality Assurance
Executive Director

Conclusion

The MAX5904 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.

Table of Contents

| | |
|-----------------------------------|--------------------------------------|
| I.Device Description | V.Quality Assurance Information |
| II.Manufacturing Information | VI.Reliability Evaluation |
| III.Packaging Information | |
| IV.Die Information |Attachments |

I. Device Description

The MAX5904 +1V to +13.2V dual hot-swap controller provides complete protection for dual-supply systems. It allows the safe insertion and removal of circuit cards into live backplanes.

The discharged filter capacitors of the circuit card provide low impedance to the live backplane. High inrush currents from the backplane to the circuit card can burn up connectors and components, or momentarily collapse the backplane power supply leading to a system reset. The MAX5904 hot-swap controllers prevents such problems by gradually ramping up the output voltage and regulating the current to a preset limit when the board is plugged in, allowing the system to stabilize safely. After the startup cycle is completed, two on-chip comparators provide VariableSpeed/BiLevel™ protection against short-circuit and overcurrent faults, as well as immunity against system noise and load transients. In the event of a fault condition, the load is disconnected. The MAX5908 automatically restarts after a fault.

The MAX5904 offers a variety of options to reduce component count and design time. The device integrates an on-board charge pump to drive the gates of low-cost, external N-channel MOSFETs. The device offers integrated features like startup current regulation and current glitch protection to eliminate external timing resistors and capacitors.

The MAX5904 is available in space-saving 16-pin QSOP packages. The device is specified over the extended temperature range, -40°C to +85°C

B. Absolute Maximum Ratings

| <u>Item</u> | <u>Rating</u> |
|---|---|
| IN_ to GND | +14V |
| GATE_ to GND | +0.3V to (VIN_ + 6.2V) |
| ON, PGOOD, COMP+, COMPOUT, TIM to GND | -0.3V to the higher of (VIN1 + 0.3V) and (VIN2 + 0.3V) |
| SENSE_, MON_, LIM_ to GND | -0.3V to (VIN_ + 0.3V) |
| Current into Any Pin | ±50mA |
| Operating Temperature Range | -40°C to +85°C |
| Storage Temperature Range | -65°C to +150°C |
| Lead Temperature (soldering, 10s) | +300°C |
| Continuous Power Dissipation (TA = +70°C) | |
| 8-Pin NSO | 471mW |
| Derates above +70°C | |
| 8-Pin NSO | 5.9mW/°C |

II. Manufacturing Information

| | |
|----------------------------------|---|
| A. Description/Function: | Low-Voltage, Dual Hot-Swap Controllers/Power Sequencers |
| B. Process: | S8 |
| C. Number of Device Transistors: | 3230 |
| D. Fabrication Location: | California, USA |
| E. Assembly Location: | Malaysia, Philippines or Thailand |
| F. Date of Initial Production: | October, 2001 |

III. Packaging Information

| | |
|--|---------------------------|
| A. Package Type: | 8-Lead NSO |
| B. Lead Frame: | Copper |
| C. Lead Finish: | Solder Plate |
| D. Die Attach: | Silver-Filled Epoxy |
| E. Bondwire: | Gold (1.0 mil dia.) |
| F. Mold Material: | Epoxy with silica filler |
| G. Assembly Diagram: | Buildsheet # 05-1301-0028 |
| H. Flammability Rating: | Class UL94-V0 |
| I. Classification of Moisture Sensitivity per JEDEC standard JESD22-A112: | Level 1 |

IV. Die Information

| | |
|----------------------------|---|
| A. Dimensions: | 80 x 77 mils |
| B. Passivation: | Si ₃ N ₄ /SiO ₂ (Silicon nitride/ Silicon dioxide) |
| C. Interconnect: | Aluminum/Copper/Silicon |
| D. Backside Metallization: | None |
| E. Minimum Metal Width: | .8 microns (as drawn) |
| F. Minimum Metal Spacing: | .8 microns (as drawn) |
| G. Bondpad Dimensions: | 5 mil. Sq. |
| H. Isolation Dielectric: | SiO ₂ |
| I. Die Separation Method: | Wafer Saw |

V. Quality Assurance Information

A. Quality Assurance Contacts:

| | |
|-----------------|----------------------------|
| Jim Pedicord | (Reliability Lab Manager) |
| Bryan Preeshl | (Executive Director of QA) |
| Kenneth Huening | (Vice President) |

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 (λ) is calculated as follows:

$$\lambda = \frac{1}{\text{MTTF}} = \frac{1.83}{192 \times 4389 \times 80 \times 2} \quad (\text{Chi square value for MTTF upper limit})$$

└ Thermal acceleration factor assuming a 0.8eV activation energy

$$\lambda = 13.57 \times 10^{-9} \quad \lambda = 13.57 \text{ F.I.T. (60\% confidence level @ 25°C)}$$

This low failure rate represents data collected from Maxim's reliability qualification and monitor programs. Maxim also performs weekly Burn-In on samples from production to assure the reliability of its processes. The reliability required for lots which receive a burn-in qualification is 59 F.I.T. at a 60% confidence level, which equates to 3 failures in an 80 piece sample. Maxim performs failure analysis on lots exceeding this level. The following Burn-In Schematic (Spec. #06-5742) shows the static circuit used for this test. Maxim also performs 1000 hour life test monitors quarterly for each process. This data is published in the Product Reliability Report (**RR-1M**).

B. Moisture Resistance Tests

Maxim evaluates pressure pot stress from every assembly process during qualification of each new design. Pressure Pot testing must pass a 20% LTPD for acceptance. Additionally, industry standard 85°C/85%RH or HAST tests are performed quarterly per device/package family.

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

The NP30 die type has been found to have all pins able to withstand a transient pulse of 1000V, per Mil-Std-883 Method 3015 (reference attached ESD Test Circuit). Latch-Up testing has shown that this device withstands a current of $\pm 250\text{mA}$.

Table 1
Reliability Evaluation Test Results

MAX5904ESA

| TEST ITEM | TEST CONDITION | FAILURE IDENTIFICATION | SAMPLE SIZE | NUMBER OF FAILURES |
|-----------------------------------|---|----------------------------------|-------------|--------------------|
| Static Life Test (Note 1) | | | | |
| | Ta = 135°C Biased Time = 192 hrs. | DC Parameters & functionality | 80 | 0 |
| Moisture Testing (Note 2) | | | | |
| Pressure Pot | Ta = 121°C P = 15 psi. RH= 100% Time = 168hrs. | DC Parameters & functionality | 77 | 0 |
| 85/85 | Ta = 85°C RH = 85% Biased Time = 1000hrs. | DC Parameters & functionality | 77 | 0 |
| Mechanical Stress (Note 2) | | | | |
| Temperature Cycle | -65°C/150°C 1000 Cycles Method 1010 | DC Parameters | 77 | 0 |

Note 1: Life Test Data may represent plastic D.I.P. qualification lots.

Note 2: Generic package/process data

Attachment #1

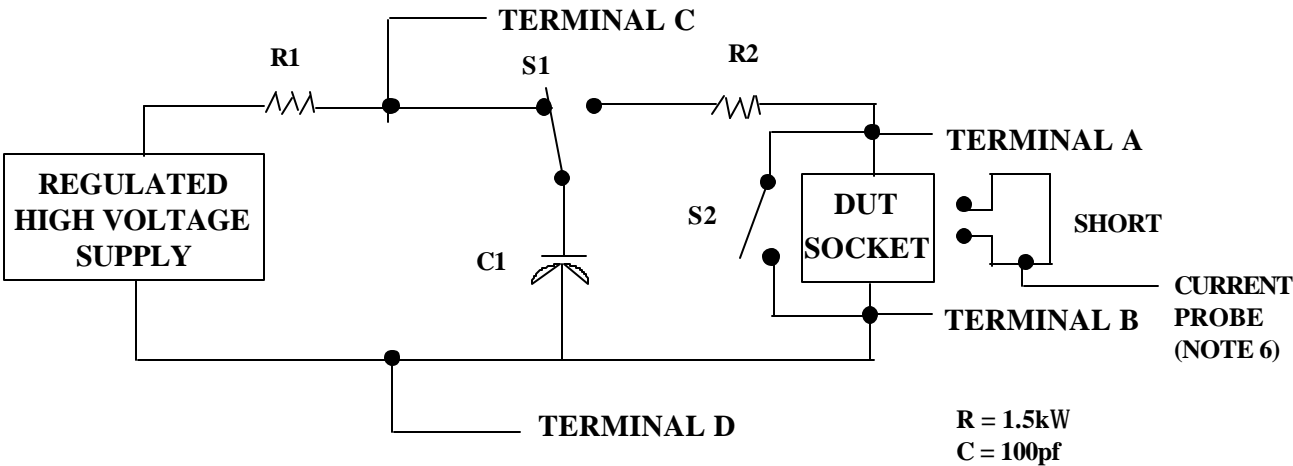
TABLE II. Pin combination to be tested. 1/ 2/

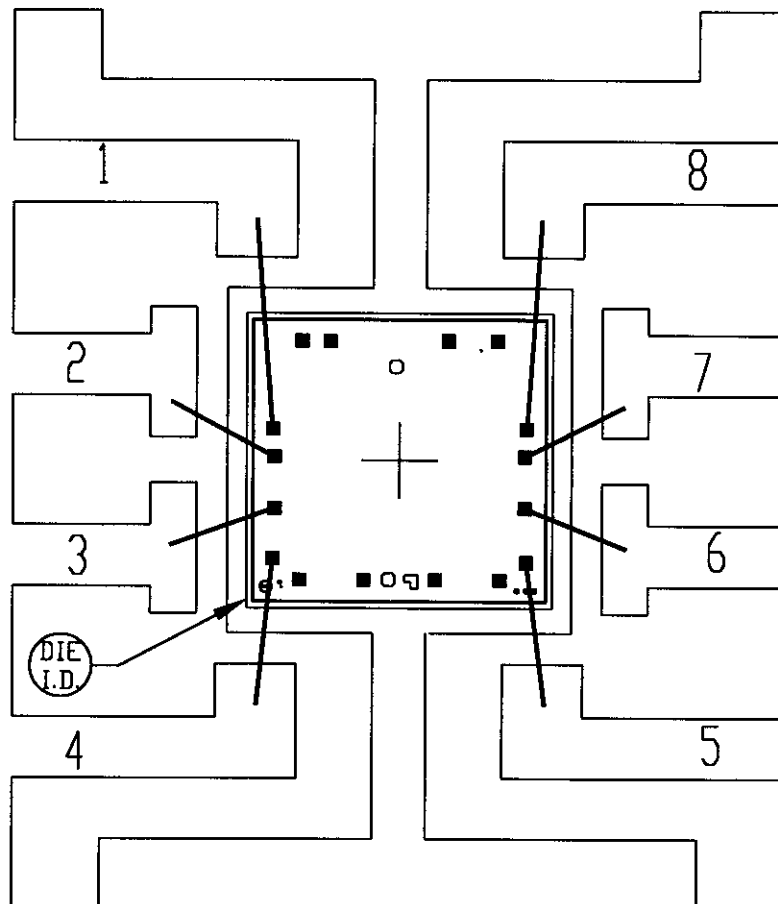
| | Terminal A (Each pin individually connected to terminal A with the other floating) | Terminal B (The common combination of all like-named pins connected to terminal B) |
|----|---|---|
| 1. | All pins except V_{PS1} 3/ | All V_{PS1} pins |
| 2. | All input and output pins | All other input-output pins |


- 1/ Table II is restated in narrative form in 3.4 below.
2/ No connects are not to be tested.
3/ Repeat pin combination I for each named Power supply and for ground
(e.g., where V_{PS1} is V_{DD} , V_{CC} , V_{SS} , V_{BB} , GND , $+V_S$, $-V_S$, V_{REF} , etc).

3.4 Pin combinations to be tested.

- a. Each pin individually connected to terminal A with respect to the device ground pin(s) connected to terminal B. All pins except the one being tested and the ground pin(s) shall be open.
- b. Each pin individually connected to terminal A with respect to each different set of a combination of all named power supply pins (e.g., V_{SS1} , or V_{SS2} or V_{SS3} or V_{CC1} , or V_{CC2}) connected to terminal B. All pins except the one being tested and the power supply pin or set of pins shall be open.
- c. Each input and each output individually connected to terminal A with respect to a combination of all the other input and output pins connected to terminal B. All pins except the input or output pin being tested and the combination of all the other input and output pins shall be open.

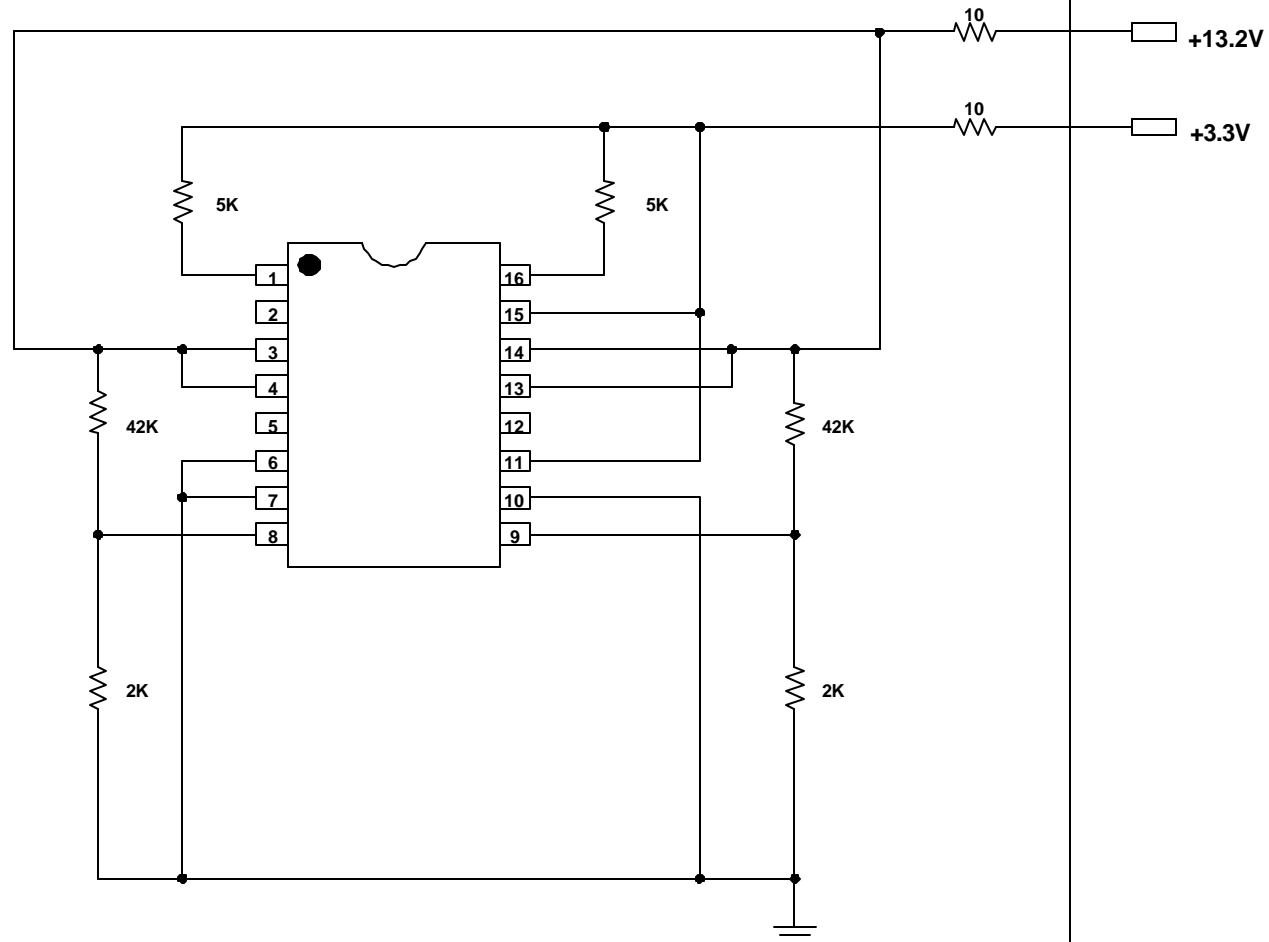




| | | | | | |
|------------------------|-------------|------------|------|---|-----------|
| PKG. CODE: S8-2 | | SIGNATURES | DATE |  CONFIDENTIAL & PROPRIETARY | |
| CAV./PAD SIZE: 90 X 90 | PKG. DESIGN | | | BOND DIAGRAM #: 05-1301-0028 | REV: A |

ONCE PER SOCKET

ONCE PER BOARD



DEVICES: MAX5906/5907/5908/5909/5918/5919
 PACKAGE: 16-QSOP
 MAX. EXPECTED CURRENT = +3.3V (1.5mA), +13.2V (3mA)

DRAWN BY: HAK TAN
 NOTES: