

RELIABILITY REPORT
FOR
MAX6167xESA+
PLASTIC ENCAPSULATED DEVICES

March 25, 2003

MAXIM INTEGRATED PRODUCTS

120 SAN GABRIEL DR.

SUNNYVALE, CA 94086

Written by



Jim Pedicord
Quality Assurance
Reliability Lab Manager

Reviewed by



Bryan J. Preeshl
Quality Assurance
Executive Director

Conclusion

The MAX6167 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 MAX6167 is a precision, low-dropout, micropower voltage references. This three-terminal devices operates with an input voltage range from ($V_{OUT} + 200\text{mV}$) to 12.6V and are is with output voltage options of 1.25V, 2.048V, 2.5V, 3V, 4.096V, 4.5V, and 5V. It features a proprietary curvature-correction circuit and laser-trimmed thin-film resistors that results in a very low temperature coefficient of 5ppm/°C (max) and an initial accuracy of $\pm 2\text{mV}$ (max). Specifications apply to the extended temperature range (-40°C to +85°C).

The MAX6167 typically draws only 90 μA of supply current and can source 5mA or sink 2mA of load current. Unlike conventional shunt-mode (two-terminal) references that waste supply current and require an external resistor, this device offers a supply current that is virtually independent of the supply voltage (8 $\mu\text{A/V}$ variation) and does not require an external resistor. Additionally, this internally compensated device does not require an external compensation capacitor and is stable with up to 1 μF of load capacitance. Eliminating the external compensation capacitor saves valuable board area in space-critical applications. Low dropout voltage and supply independent, ultra-low supply current make this device ideal for battery-operated, high-performance, low-voltage systems.

The MAX6167 is available in 8-pin SO packages.

B. Absolute Maximum Ratings

<u>Item</u>	<u>Rating</u>
Voltages Referenced to GND	
IN	-0.3 to +13.5V
OUT	-0.3V to ($V_{IN} + 0.3\text{V}$)
Output Short-Circuit Duration to GND or IN ($V_{IN} = 0\text{V}$)	Continuous
Output Short-Circuit Duration to GND or IN ($V_{IN} > 6\text{V}$)	60s
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 ($T_A = +70^\circ\text{C}$)	
8-Pin SO	471mW
Derates above +70°C	
8-Pin SO	5.88mW/°C

II. Manufacturing Information

- A. Description/Function: Precision, Micropower, Low-Dropout, High-Output-Current, SO-8 Voltage Reference
- B. Process: S12 (Standard 1.2 micron silicon gate CMOS)
- C. Number of Device Transistors: 117
- D. Fabrication Location: Oregon or California, USA
- E. Assembly Location: Philippines, Thailand or Malaysia
- F. Date of Initial Production: March, 2002

III. Packaging Information

- A. Package Type: **8-Pin SO**
- B. Lead Frame: Copper
- C. Lead Finish: Solder Plate
- D. Die Attach: Silver-filled Epoxy
- E. Bondwire: Gold (1 mil dia.)
- F. Mold Material: Epoxy with silica filler
- G. Assembly Diagram: # 05-0901-0158
- H. Flammability Rating: Class UL94-V0
- I. Classification of Moisture Sensitivity per JEDEC standard JESD22-112: Level 1

IV. Die Information

- A. Dimensions: 44 x 31 mils
- B. Passivation: $\text{Si}_3\text{N}_4/\text{SiO}_2$ (Silicon nitride/ Silicon dioxide)
- C. Interconnect: Aluminum/Si (Si = 1%)
- D. Backside Metallization: None
- E. Minimum Metal Width: 1.2 microns (as drawn)
- F. Minimum Metal Spacing: 1.2 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)
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:

$$\lambda = \frac{1}{\text{MTTF}} = \frac{1.83}{192 \times 4389 \times 160 \times 2} \quad (\text{Chi square value for MTTF upper limit})$$

 Temperature Acceleration factor assuming an activation energy of 0.8eV

$$\lambda = 6.79 \times 10^{-9}$$

$$\lambda = 6.79 \text{ F.I.T. (60\% confidence level @ 25°C)}$$

This low failure rate represents data collected from Maxim's reliability monitor program. In addition to routine production Burn-In, Maxim pulls a sample from every fabrication process three times per week and subjects it to an extended Burn-In prior to shipment to ensure its reliability. The reliability control level for each lot to be shipped as standard product 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 any lot that exceeds this reliability control level. Attached Burn-In Schematic (Spec. # 06-5631) shows the static Burn-In circuit. Maxim also performs quarterly 1000 hour life test monitors. This data is published in the Product Reliability Report (**RR-1M**).

B. Moisture Resistance Tests

Maxim pulls pressure pot samples from every assembly process three times per week. Each lot sample must meet an LTPD = 20 or less before shipment as standard product. Additionally, the industry standard 85°C/85%RH testing is done per generic device/package family once a quarter.

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

The RF24-2 die type has been found to have all pins able to withstand a transient pulse of $\pm 1500\text{V}$, 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

MAX6167xESA+

TEST ITEM	TEST CONDITION	FAILURE IDENTIFICATION	PACKAGE	SAMPLE SIZE	NUMBER OF FAILURES
Static Life Test (Note 1)					
	Ta = 135°C Biased Time = 192 hrs.	DC Parameters & functionality		160	0
Moisture Testing (Note 2)					
Pressure Pot	Ta = 121°C P = 15 psi. RH= 100% Time = 168hrs.	DC Parameters & functionality	SO	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 DIP 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.

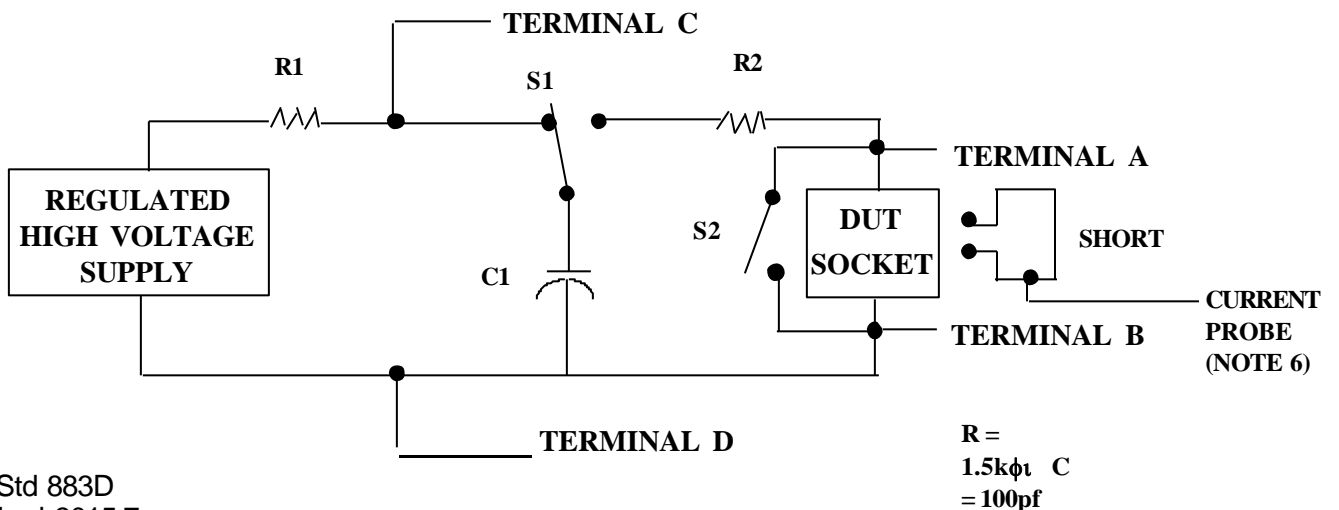
2/ No connects are not to be tested.

3/ Repeat pin combination I for each named Power supply and for ground

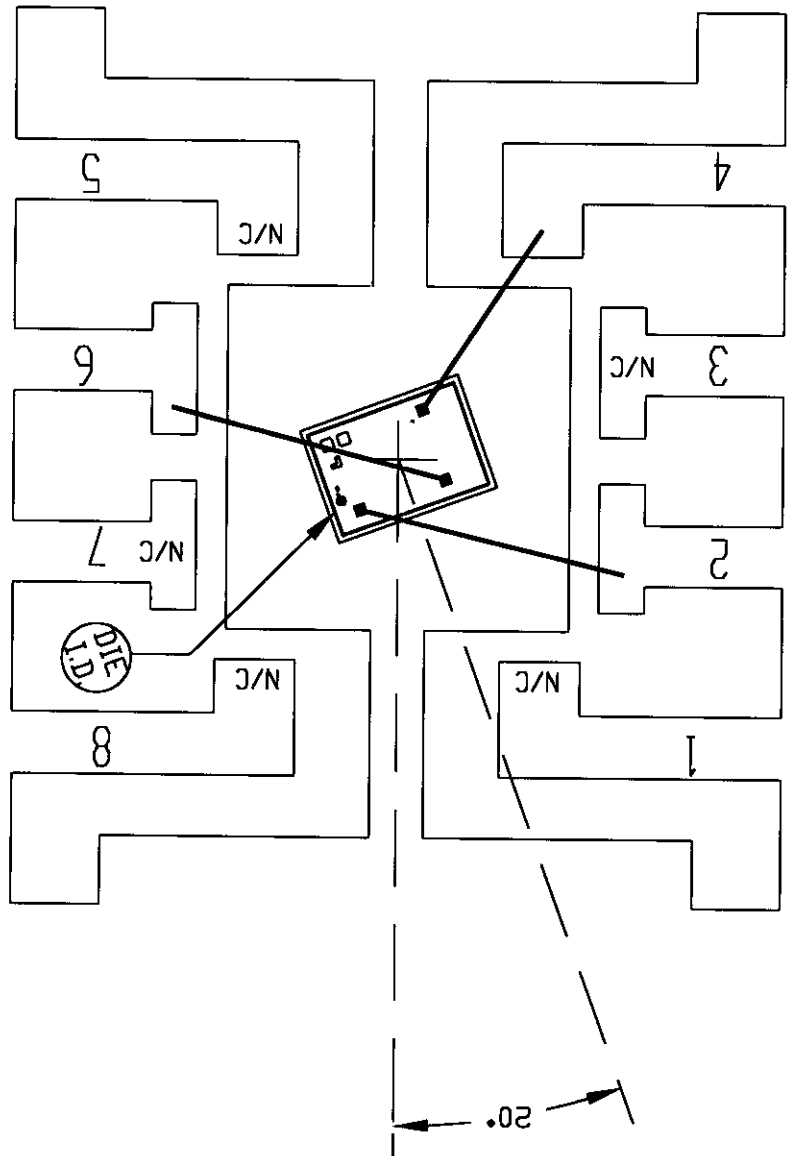
(e.g., where V_{PS1} is V_{DD} , V_{CC} , V_{SS} , V_{BB} , GND, $+V_S$, $-V_S$, V_{REF} , etc).

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.

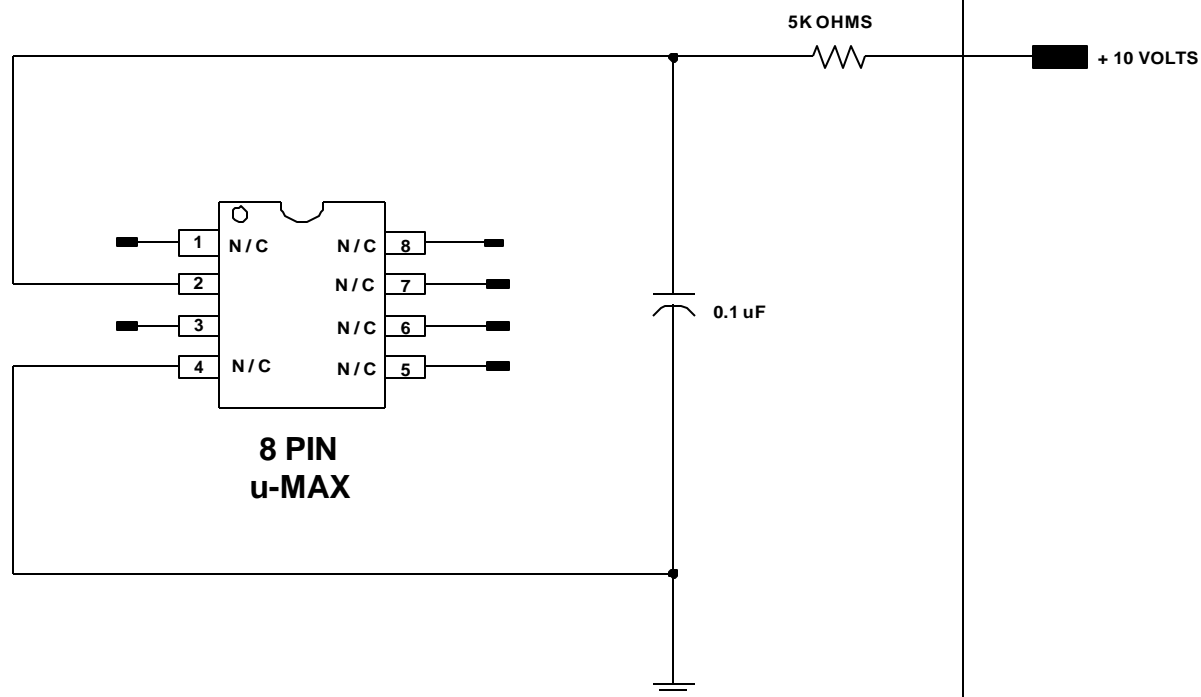


CAV/PAD SIZE: 90 X 90	DESIGN
PKG.	
PKG.CODE: S8-2	APPROVALS
	DATE
BUILD SHEET NUMBER: 05-0901-0158	REVISION: A



ONCE PER SOCKET

ONCE PER BOARD



pedicord_j
2004-01-30 09:58:40

- DRAWN BY: CHRIS
JAMBARO NOTES:

DEVICES: MAX6161-6168 (RF24Z)
MAX6190-6195 (RF23Z) MAX CURRENT= 35uA for
RF23Z and 125uA for RF24Z.

DRAWN BY: CHRIS JAMBARO
NOTES: