RELIABILITY REPORT

FOR

MAX1614EUA

PLASTIC ENCAPSULATED DEVICES

June 20, 2003

MAXIM INTEGRATED PRODUCTS

120 SAN GABRIEL DR.

SUNNYVALE, CA 94086

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Conclusion

The MAX1614 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

A. General

The MAX1614 drives high-side, N-channel power MOSFETs to provide battery power-switching functions in portable equipment. N-channel power MOSFETs typically have one-third the on-resistance of P-channel MOSFETs of similar size and cost. An internal micropower regulator and charge pump generate the high-side drive output voltage, while requiring no external components.

The MAX1614 also features a 1.5%-accurate low-battery comparator that can be used to indicate a low-battery condition, provide an early power-fail warning to the system microprocessor, or disconnect the battery from the load, preventing deep discharge and battery damage. An internal latch allows for pushbutton on/off control with very low current consumption. Off-mode current consumption is only 6µA while normal operation requires less than 25µA. The MAX1614 is available in the space-saving µMAX package that occupies about 60% less space than a standard 8-pin SO.

B. Absolute Maximum Ratings

Item	Rating
BATT, SRC to GND	-0.3V to +30V
GATE to SRC	-0.3V to +12V
GATE to GND	-0.3V to +36V
GATE + SRC Sink Current, Continuous	2.7mA
LBI, LBO, ON, OFF to GND	-0.3V to +12V
LBO Current	5mA
Operating Temperature Range	-40°C to +85°C
Junction Temperature	+150°C
Storage Temperature Range	-65°C to +160°C
Lead Temperature (soldering, 10sec)	+300°C
Continuous Power Dissipation (TA = +70°C)	
8-Pin µMAX	330mW
Derates above +70°C	
8-Pin µMAX	4.1mW/°C

II. Manufacturing Information

    A. Description/Function: High-Side, N-Channel MOSFET Switch Driver

    B. Process: S3 (Standard 3 micron silicon gate CMOS)

    C. Number of Device Transistors: 264

    D. Fabrication Location: Oregon, USA

    E. Assembly Location: Philippines, Korea or Thailand

    F. Date of Initial Production: March, 1997

III. Packaging Information

    A. Package Type: **8-Pin µMAX**

    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: #05-1101-0005

    H. Flammability Rating: Class UL94-V0

    I. Classification of Moisture Sensitivity per JEDEC standard JESD22-112:   Level 1

IV. Die Information

    A. Dimensions: 58 x 84 mils

    B. Passivation: Si_3N_4/SiO_2 (Silicon nitride/ Silicon dioxide)

    C. Interconnect: Aluminum/Si (Si = 1%)

    D. Backside Metallization: None

    E. Minimum Metal Width: 3 microns (as drawn)

    F. Minimum Metal Spacing: 3 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 (Manager, Rel Operations)
                                                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:

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

Temperature Acceleration factor assuming an activation energy of 0.8eV

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

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

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. # 06-5229) 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 PX01 die type has been found to have all pins able to withstand a transient pulse of ±2000V per Mil-Std-883 Method 3015 (reference attached ESD Test Circuit). Latch-Up testing has shown that this device withstands a current of ±250mA.

Table 1
Reliability Evaluation Test Results

MAX1614EUA

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	uMAX	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 & functionality		77	0

Note 1: Life Test Data may represent plastic DIP qualification lots.
Note 2: Generic Package/Process data

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

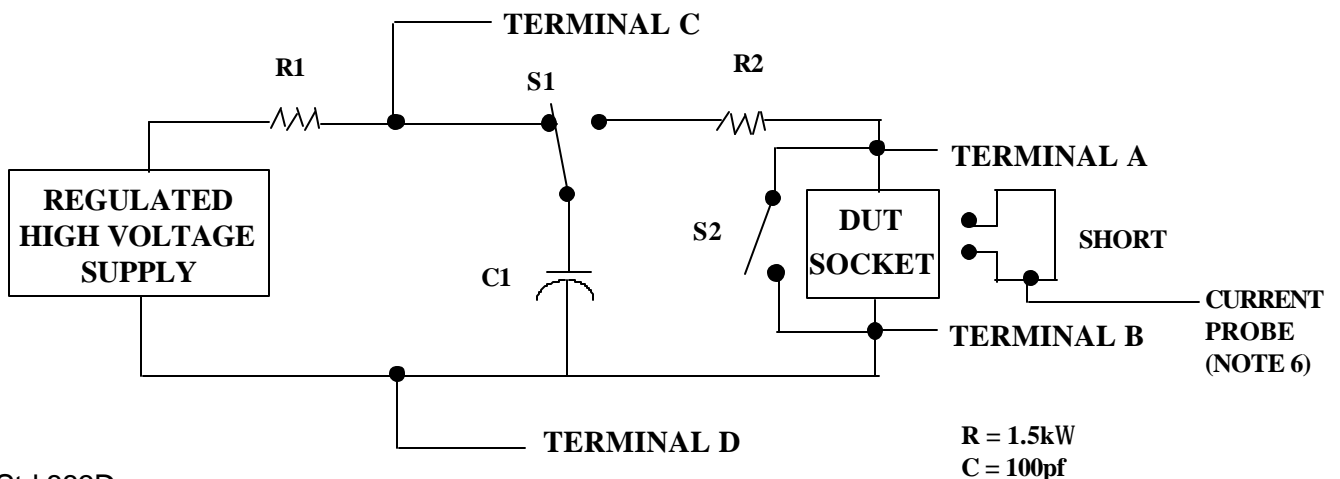1/ Table II is restated in narrative form in 3.4 below.
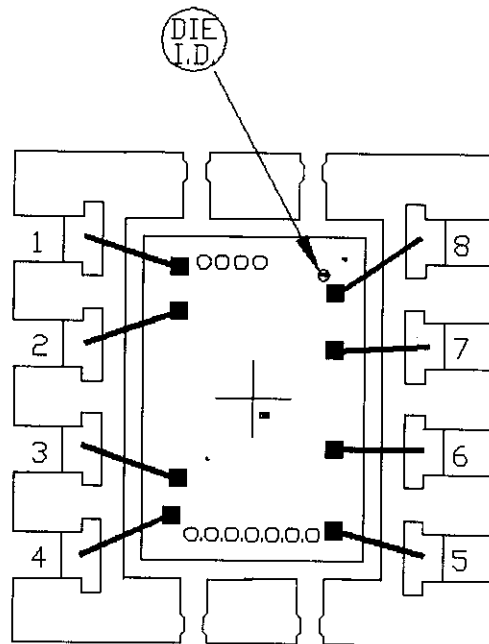2/ No connects are not to be tested.
3/ Repeat pin combination I for each named Power supply and for ground

(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.
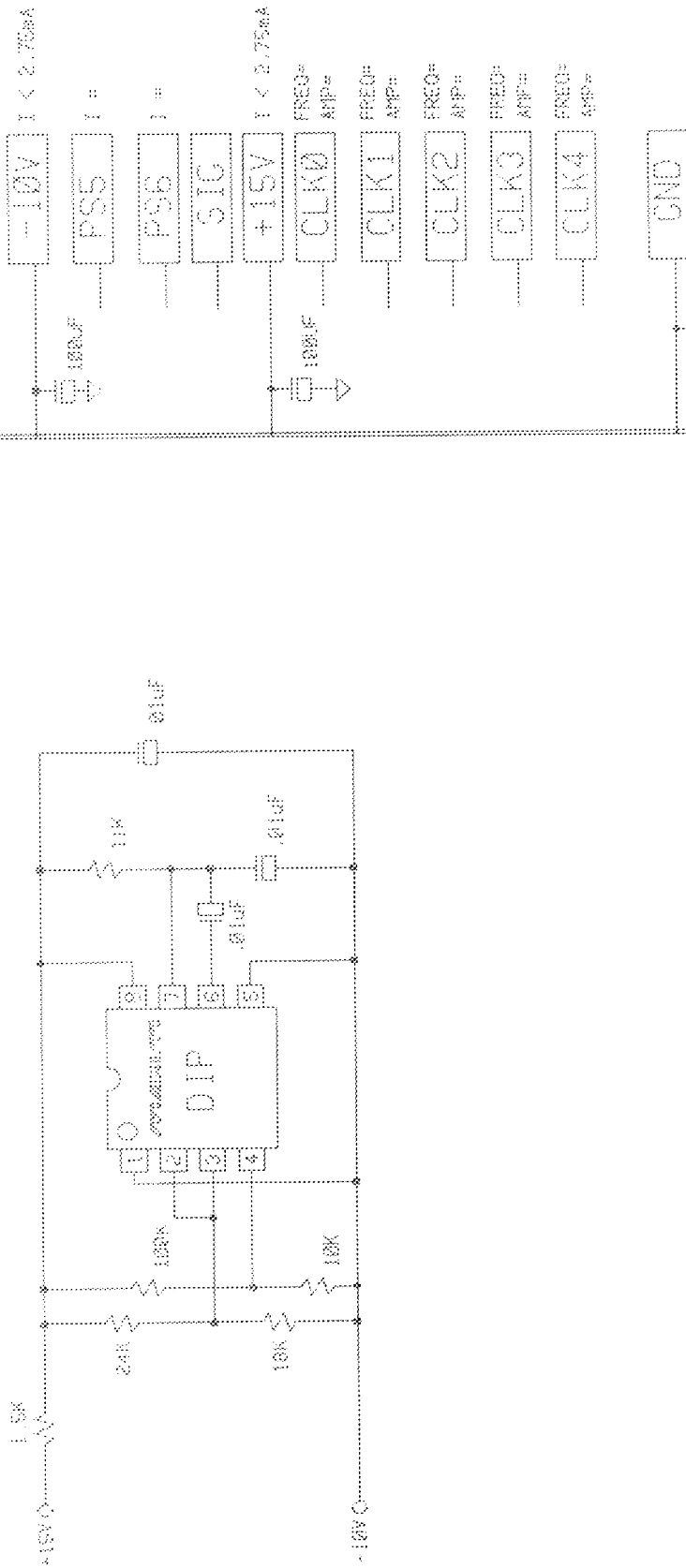
TERMINAL C

R1   S1   R2

REGULATED HIGH VOLTAGE SUPPLY

S2

DUT SOCKET

TERMINAL A

SHORT

C1

TERMINAL B

CURRENT PROBE (NOTE 6)

TERMINAL D

R = 1.5kW
C = 100pf

Mil Std 883D
Method 3015.7
Notice 8

DIE I.D

1
2
3
4
8
7
6
5

ONCE PER BOARD

ONCE PER DEVICE

+5V   I =
PS2   I =
PS3   I =
-10V   I < 2.75mA
PS5   I =
PS6   I =
SIG   I =
+15V   I < 2.75mA
CLK0   FREQ=   AMP=
CLK1   FREQ=   AMP=
CLK2   FREQ=   AMP=
CLK3   FREQ=   AMP=
CLK4   FREQ=   AMP=
GND

100uF

100uF

0.1uF

1.1k

0.1uF

0.1uF

DIP

+15V

10K

1.5K

2.4K

10K

-10V

NOTES:
1. TEMPERATURE: 125C OR EQUIVALENT
2. TIME: 160 HOURS MIN. OR EQUIVALENT
3. ALL COMPONENTS AND MATERIAL MUST STAND
   150C CONTINUOUS
4. APPROVED FOR (X) COMMERCIAL
                (X) MIL/883

-STEADY STATE LIFE TEST IS PER MIL-STD-883 METHOD 1005.
-BURN-IN IS PER MIL-STD-883 METHOD 1015, COND. B