

RELIABILITY REPORT  
FOR  
**MAX713xxE**  
PLASTIC ENCAPSULATED DEVICES

July 21, 2001

**MAXIM INTEGRATED PRODUCTS**

120 SAN GABRIEL DR.

SUNNYVALE, CA 94086

Written by



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## Conclusion

The MAX713 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 MAX713 fast charge Nickel Metal Hydride (NiMH) and Nickel Cadmium (NiCd) batteries from a DC source at least 1.5V higher than the maximum battery voltage. 1 to 16 series cells can be charged at rates up to 4C. A voltage-slope detecting analog-to-digital converter, timer, and temperature window comparator determine charge completion. The MAX713 is powered by the DC source via an on-board +5V shunt regulator. It draws a maximum of 5 $\mu$ A from the battery when not charging. A low-side current-sense resistor allows the battery charge current to be regulated while still supplying power to the battery's load.

The MAX713 uses a negative voltage-slope detection scheme. An external power PNP transistor, blocking diode, three resistors, and three capacitors are the only required external components.

For high-power charging requirements, the MAX713 can be configured as a switch-mode battery charger that minimizes power dissipation.

### B. Absolute Maximum Ratings

<u>Item</u>	<u>Rating</u>
V+ to BATT-	-0.3V, +7V
BATT- to GND	$\pm 1$ V
BATT+ to BATT-	
Power Not Applied	$\pm 20$
With Power Applied	The higher of $\pm 20$ V or $\pm 2$ V x (programmed cells)
DRV to GND	-0.3V, +20V
/FASTCHG to BATT-	-0.3V, +12V
All Other Pins to GND	-0.3V, (V= + 0.3V)
V+ Current	100mA
DRV Current	100mA
REF Current	10mA
Storage Temp.	-65°C to +150°C
Lead Temp. (10 sec.)	+300°C
Power Dissipation	
Plastic DIP	842mW
Narrow SO	696mW
Derates above +70°C	
Plastic DIP	10.53mW/°C
Narrow SO	8.70mW/°C

## II. Manufacturing Information

- A. Description/Function: NiCd/NiMH Battery Fast-Charge Controller
- B. Process: S3 (Standard 3 micron silicon gate CMOS)
- C. Number of Device Transistors: 2193
- D. Fabrication Location: California or Oregon, USA
- E. Assembly Location: Philippines, Malaysia, Thailand
- F. Date of Initial Production: November, 1992

## III. Packaging Information

A. Package Type:	16 Lead PDIP	16 Lead NSO
B. Lead Frame:	Copper	Copper
C. Lead Finish:	Solder Plate	Solder Plate
D. Die Attach:	Silver-filled Epoxy	Silver-Filled Epoxy
E. Bondwire:	Gold (1.3 mil dia.)	Gold (1.3 mil dia.)
F. Mold Material:	Epoxy with silica filler	Epoxy with silica filler
G. Assembly Diagram Buildsheat:	# 05-1701-0049	#05-1701-0051
H. Flammability Rating:	Class UL94-V0	Class UL94-V0

## IV. Die Information

- A. Dimensions: 80 x 126 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: 3 microns (as drawn)
- F. Minimum Metal Spacing: 3 microns (as drawn)
- G. Bondpad Dimensions: 5 mil. Sq.
- H. Isolation Dielectric:  $\text{SiO}_2$
- 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: < 100 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 ( $\lambda$ ) is calculated as follows:

$$\lambda = \frac{1}{\text{MTTF}} = \frac{1.83}{192 \times 4389 \times 320 \times 2} \quad (\text{Chi square value for MTTF upper limit})$$

└ Temperature Acceleration factor assuming an activation energy of 0.8eV

$$\lambda = 3.39 \times 10^{-9}$$

$$\lambda = 3.39 \text{ F.I.T. (60\% confidence level @ 25°C)}$$

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. # 06-0030) 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-1L**).

### 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 PW04 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  $\pm 50\text{mA}$  and/or  $\pm 20\text{V}$ .

**Table 1**  
Reliability Evaluation Test Results  
**MAX713xxE**

TEST ITEM	TEST CONDITION	FAILURE IDENTIFICATION	SAMPLE SIZE	NUMBER OF FAILURES
<b>Static Life Test</b> (Note 1)				
	Ta = 135°C Biased Time = 192 hrs.	DC Parameters & functionality	320	0
<b>Moisture Testing</b> (Note 2)				
Pressure Pot	Ta = 121°C P = 15 psi. RH= 100% Time = 96hrs.	DC Parameters & functionality	PDIP 260	0
			NSO 720	2
85/85	Ta = 85°C RH = 85% Biased Time = 1000hrs.	DC Parameters & functionality	77	0
<b>Mechanical Stress</b> (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 for the Small Outline package.

Note 2: Generic process/package 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 $V_{PS1}$ <u>3/</u>	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.

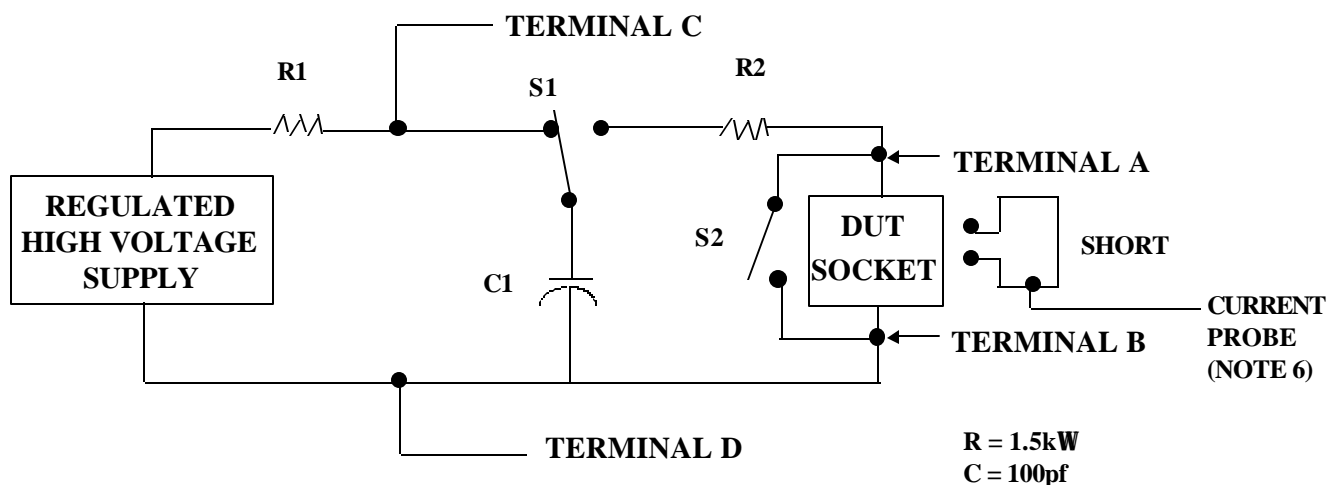
2/ No connects are not to be tested.

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).

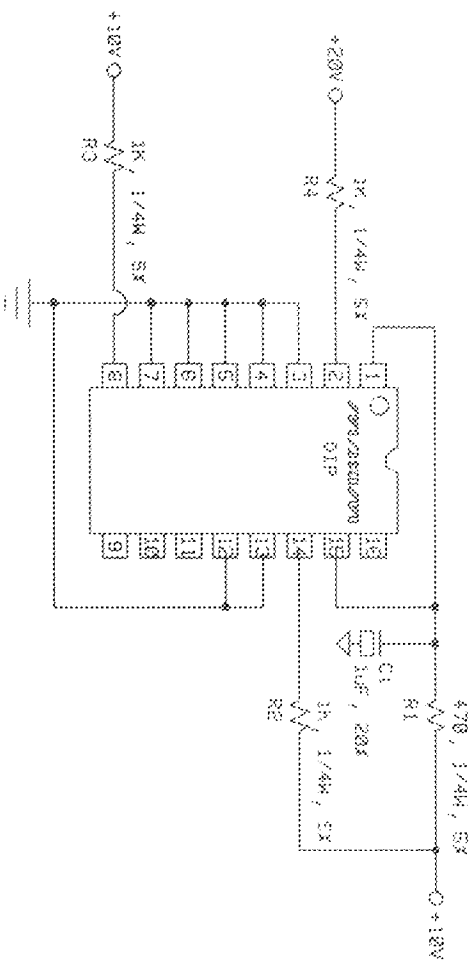
## 3.4 Pin combinations to be tested.

- 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.
- 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.
- 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.



ONCE PER SOCKET

ONCE PER BOARD



... STEADY STATE LIFE TEST IS PER MIL-STD-883 METHOD 1885.  
... BURN-IN IS PER MIL-STD-883 METHOD 1815. COND. B

# NOTES:

1. TEMPERATURE: 125C OR EQUIVALENT
2. TIME: 168 HOURS MIN, OR EQUIVALENT
3. ALL COMPONENTS AND MATERIAL MUST STAND 125C CONTINUOUS
4. APPROVED FOR EX) COMMERCIAL EX) HR/883

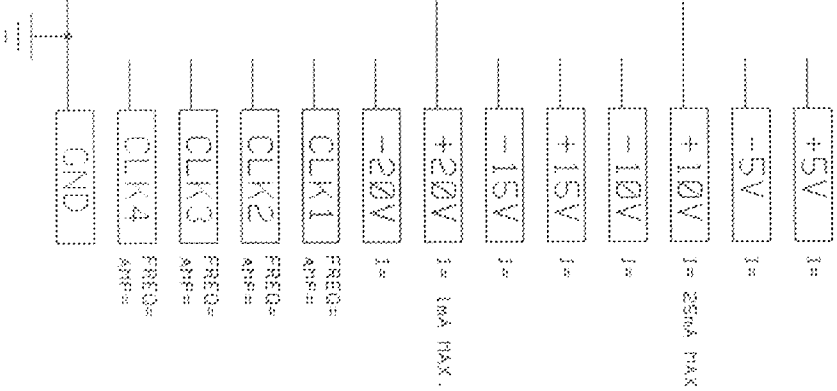
SPEC. NO. 06-0030 REV. A

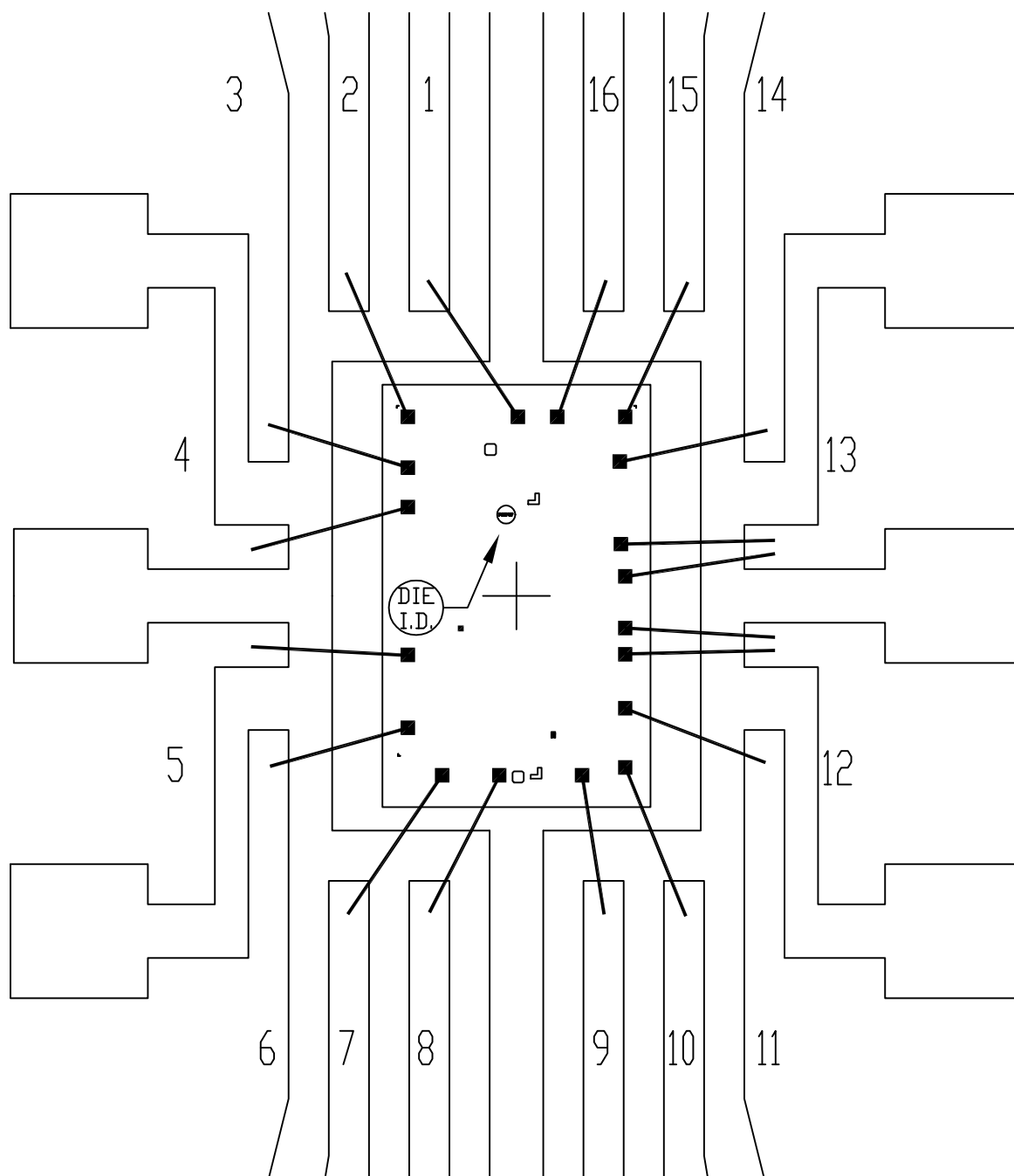
DATE: 5/5/92

DRAWN BY: N.K. NGUYEN

MAXIM BURN-IN SCHEMATIC

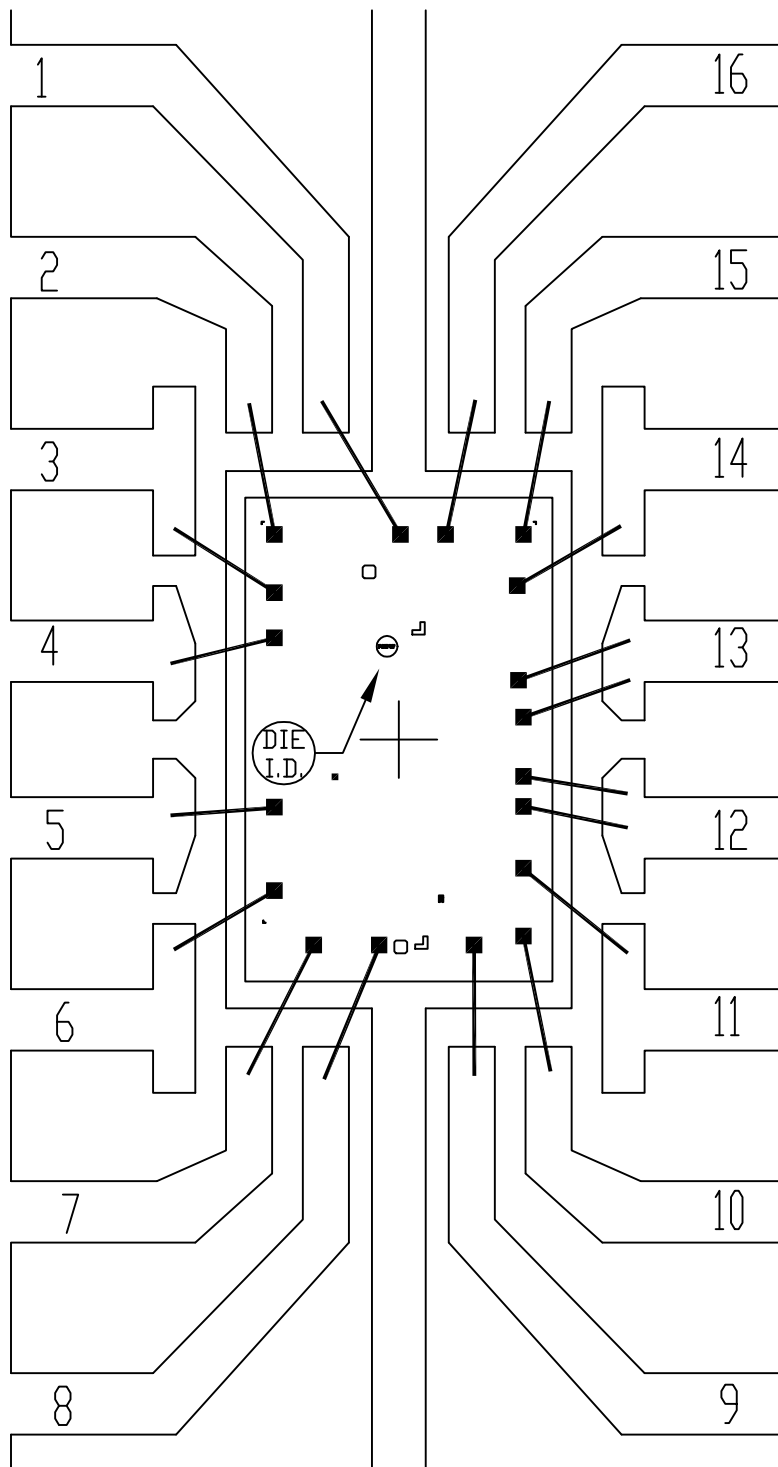
DEVICE TYPE:  
MAX712/3





PKG. CODE: P16-1		SIGNATURES	DATE	 CONFIDENTIAL & PROPRIETARY	
CAV./PAD SIZE: 110x140	PKG. DESIGN			BOND DIAGRAM #: 05-1701-0049	REV: B





PKG. CODE: S16-1		SIGNATURES	DATE	 CONFIDENTIAL & PROPRIETARY	
CAV./PAD SIZE: 90 X 140	PKG. DESIGN			BOND DIAGRAM #: 05-1701-0051	REV: B