

RELIABILITY REPORT
FOR
MAX712xxE
PLASTIC ENCAPSULATED DEVICES

May 20, 2002

MAXIM INTEGRATED PRODUCTS

120 SAN GABRIEL DR.

SUNNYVALE, CA 94086

Written by



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Conclusion

The MAX712 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 MAX712 fast charges 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 determines charge completion. The MAX712 is powered by the DC source via an on-board +5V shunt regulator. It draws a maximum of 5mA 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 MAX712 terminates fast charge by detecting zero voltage slope. An external power PNP transistor, blocking diode, three resistors, and three capacitors are the only required external components. For high-power charging requirements, the MAX712 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	-Power
Not Applied	±20V
With Power Applied	The higher of ±20V or
±2V 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
Continuous Power Dissipation (TA = +70°C)	
Plastic DIP	842mW
Narrow SO	696mW
Derates above +70°C	
Plastic DIP	10.53mW/°C
Narrow SO	8.70mW/°C
Operating Temperature Ranges	
MAX712C_E	0°C to +70°C
MAX712E_E	-40°C to +85°C
Storage Temperature Range	-65°C to +150°C
Lead Temperature (soldering, 10s)	+300°C

II. Manufacturing Information

- A. Description/Function: NiCd/NiMH Battery Fast-Charge Controllers.
- B. Process: SG3 (Standard 3 micron silicon gate CMOS)
- C. Number of Device Transistors: 2193
- D. Fabrication Location: California or Oregon, USA
- E. Assembly Location: Philippines, Malaysia or Thailand
- F. Date of Initial Production: November, 1992

III. Packaging Information

- | A. Package Type: | 16-Pin SO | 16-Pin DIP |
|--|--------------------------|--------------------------|
| 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: | # 05-1701-0053 | # 05-1701-0052 |
| H. Flammability Rating: | Class UL94-V0 | Class UL94-V0 |
| I. Classification of Moisture Sensitivity per JEDEC standard JESD22-112: | Level 1 | Level 1 |

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: 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:

$$\lambda = \frac{1}{\text{MTTF}} = \frac{1.83}{192 \times 4389 \times 640 \times 2} \quad (\text{Chi square value for MTTF upper limit})$$

▲
Temperature Acceleration factor assuming an activation energy of 0.8eV

$$\lambda = 1.70 \times 10^{-9}$$

$$\lambda = 1.70 \text{ F.I.T. (60\% confidence level @ 25°C)}$$

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-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 PW04 die type has been found to have all pins able to withstand a transient pulse of $\pm 2000\text{V}$, per Mil-Std-883 Method 3015 (reference attached ESD Test Circuit). Latch-Up testing has shown that this device withstands a current of $\pm 100\text{mA}$ and/or $\pm 20\text{V}$.

Table 1
Reliability Evaluation Test Results

MAX712xxE

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		640	0
Moisture Testing (Note 2)					
Pressure Pot	Ta = 121°C P = 15 psi. RH= 100% Time = 168hrs.	DC Parameters & functionality	SO	77	0
			DIP	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.

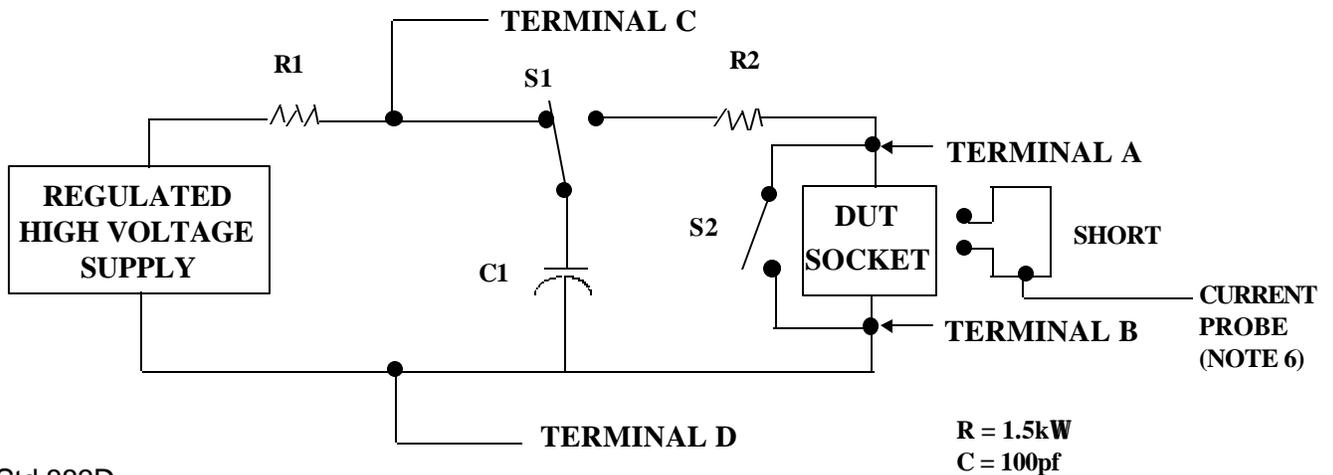
2/ No connects are not to be tested.

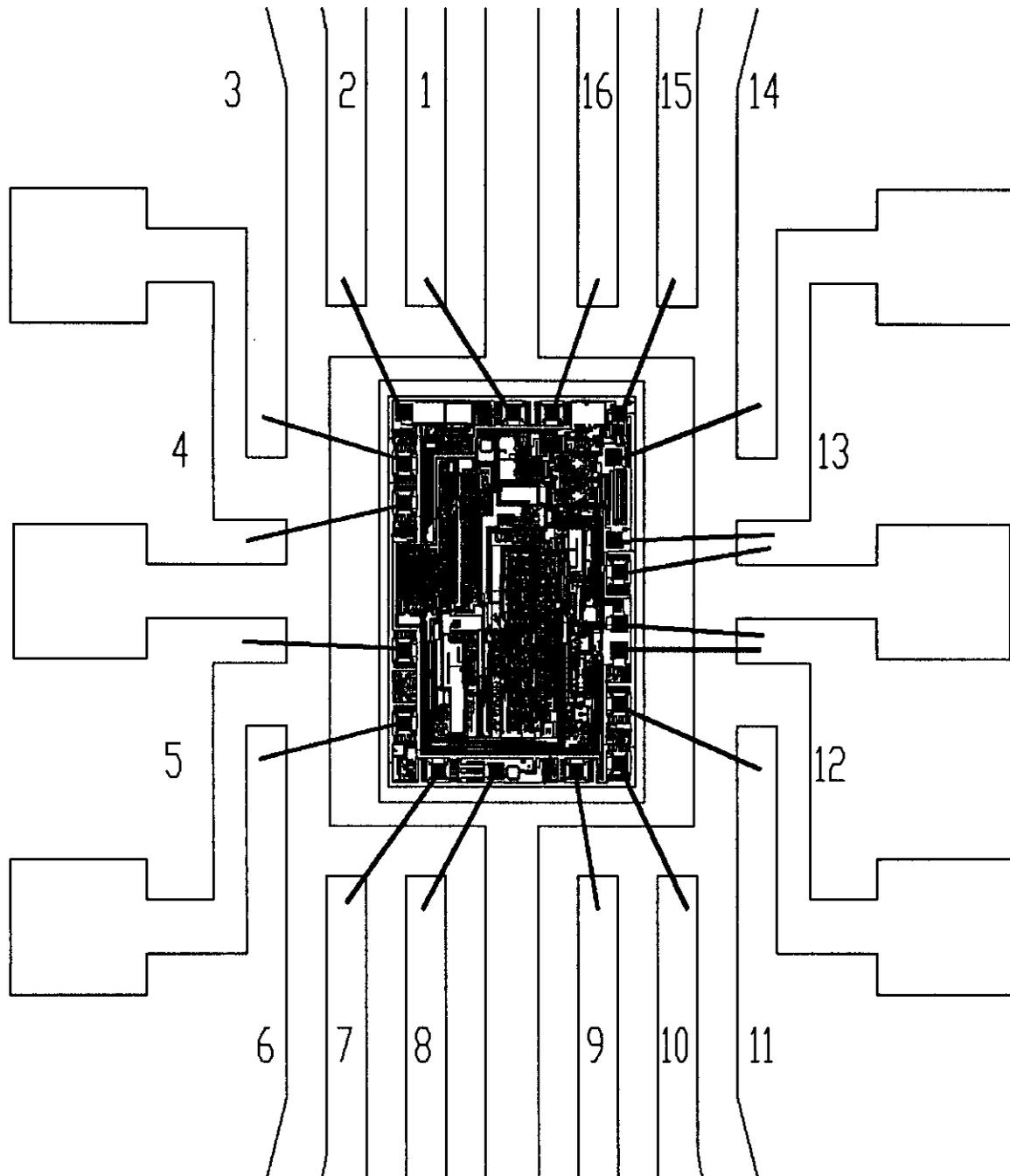
3/ Repeat pin combination I for each named Power supply and for ground

(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.





PKG.CODE: P16-1

CAV./PAD SIZE:
110 X 140

APPROVALS

PKG.
DESIGN

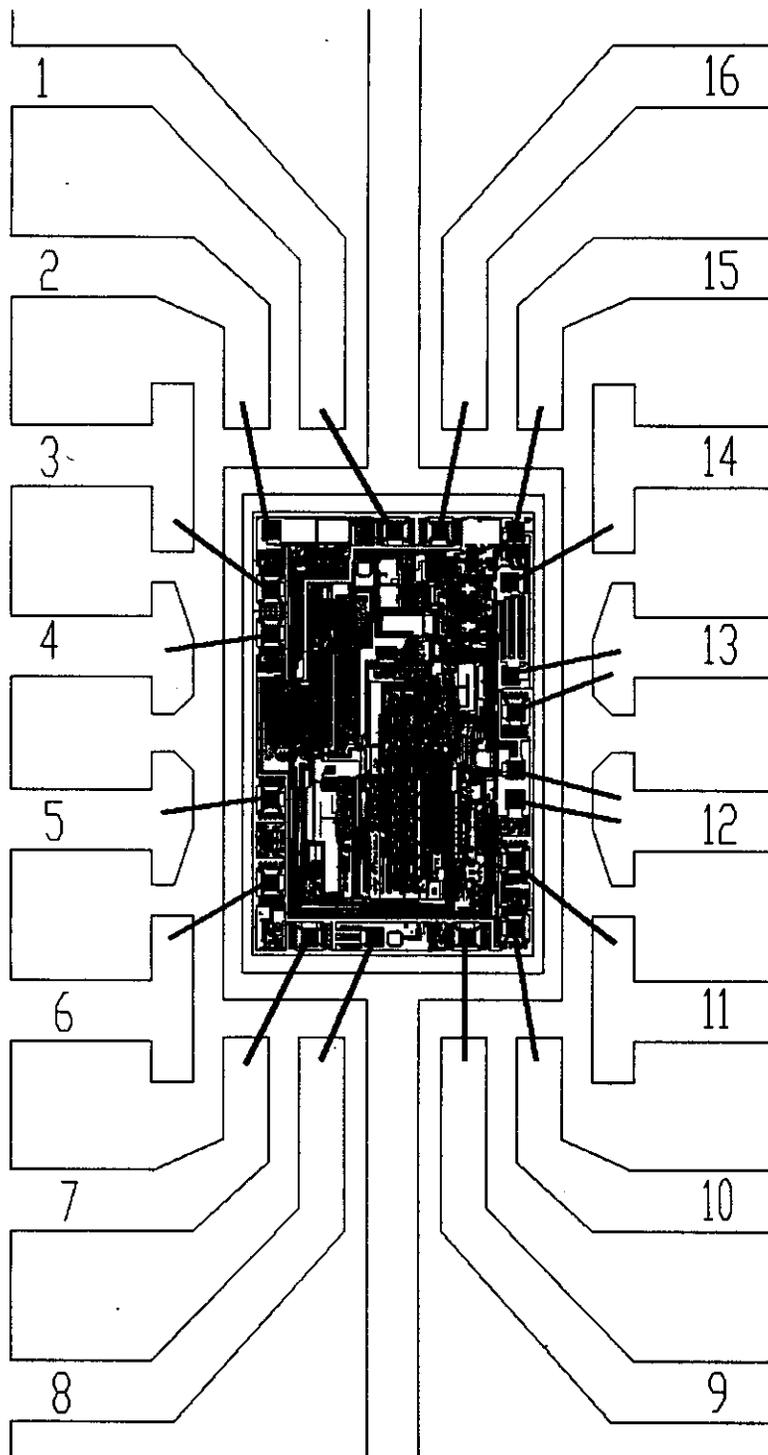
DATE

3/10/92
3/12/92

MAXIM

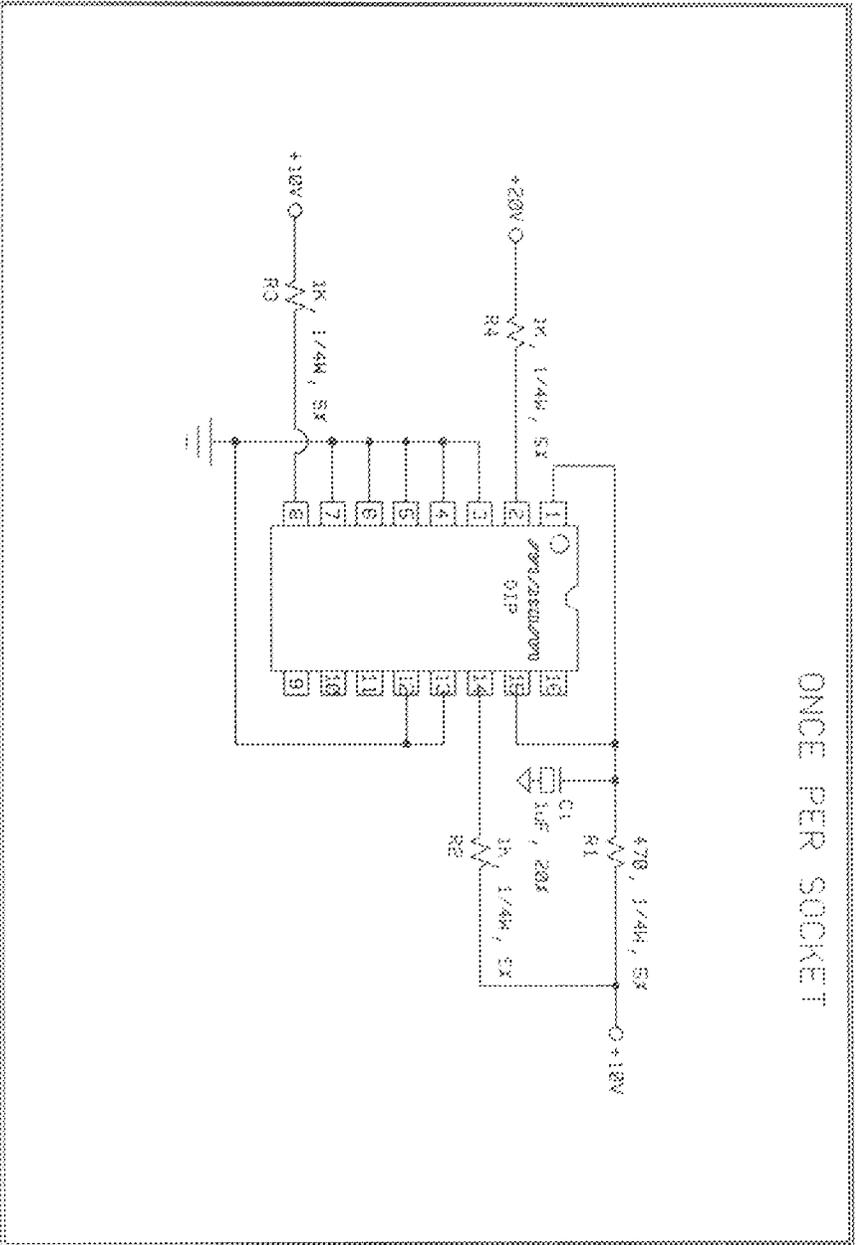
BUILDSHEET NUMBER:
05-1701-0052

REV.:
A



PKG.CODE: S16-1		APPROVALS	DATE	MAXIM	
CAV./PAD SIZE: 90 X 140	PKG.	[REDACTED]	7/20/92	BUILDSHEET NUMBER:	REV:
	DESIGN		7/27/92	05-1701-0053	B

ONCE PER SOCKET

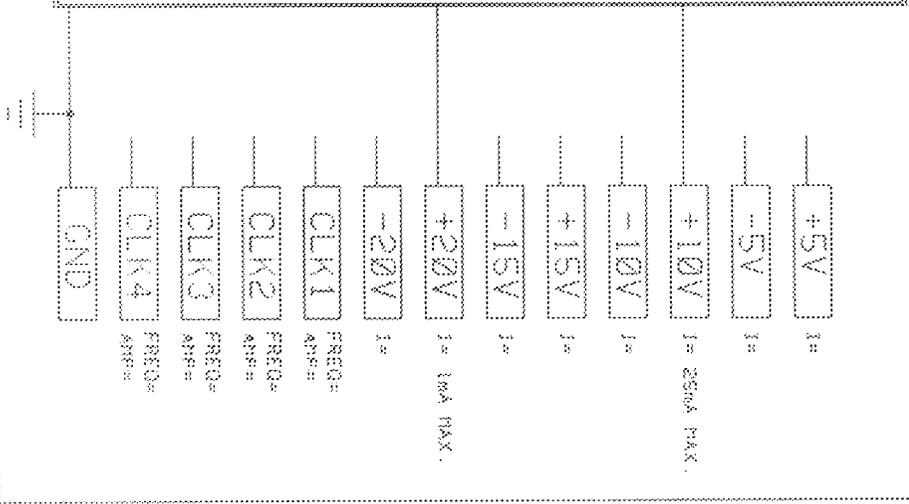


...STEADY STATE LIFE TEST IS PER MIL-STD-883 METHOD 1885.
 ...BURN-IN IS PER MIL-STD-883 METHOD 1815. COND. 3

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

ONCE PER BOARD



SPEC. NO. 06-0030 REV. A

DATE: 5/5/92

DRAWN BY: N.K. NGUYEN

MAXIM BURNT-IN SCHEMATIC

DEVICE TYPE:
 PART 12/3