RELIABILITY REPORT

FOR

**MAX3221xxE**

PLASTIC ENCAPSULATED DEVICES

April 13, 2003

# MAXIM INTEGRATED PRODUCTS

120 SAN GABRIEL DR.

SUNNYVALE, CA 94086

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**Conclusion**

The MAX3221 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 MAX3221 achieves 1µA supply current with Maxim's revolutionary AutoShutdown™ feature. When the MAX3221 does not sense a valid signal level on its receiver inputs, the on-board power supply and drivers shut down. This occurs if the RS-232 cable is disconnected or if the transmitters of the connected peripheral are turned off. The system turns on again when a valid level is applied to any RS-232 receiver input. As a result, the system saves power without changes to the existing BIOS or operating system.

The MAX3221 transceiver is a 3V-powered EIA/TIA-232 and V.28/V.24 communications interface intended for notebook computer applications. A proprietary, high-efficiency, dual charge-pump power supply and a low-dropout transmitter combine to deliver true RS-232 performance from a single +3.0V to +5.5V supply. A guaranteed data rate of 120kbps provides compatibility with popular software for communicating with personal computers.

The MAX3221 requires only 0.1µF capacitors in 3.3V operation, and can operate from input voltages ranging from +3.0V to +5.5V. It is ideal for 3.3V-only systems, mixed 3.3V and 5.0V systems, or 5.0V-only systems that require true RS-232 performance.

The MAX3221 is a 1-driver/1-receiver 16-pin SSOP version of the 20-pin MAX3223 (2-driver/2-receiver).

B. Absolute Maximum Ratings

| Item | Rating |
|---|---|
| $V_{CC}$ to GND | -0.3V to +6V |
| V+ to GND (Note 1) | -0.3V to +7V |
| V- to GND (Note 1) | +0.3V to -7V |
| V+ + \|V-\| (Note 1) | +13V |
| Input Voltages | |
| T_IN, /EN, FORCEON, /FORCEOFF to GND | -0.3V to +6V |
| R_IN to GND | ±25V |
| Output Voltages | |
| T_OUT to GND | ±13.2V |
| R_OUT, R2OUTB, /INVALID to GND | -0.3V to ($V_{CC}$ + 0.3V) |
| Short-Circuit Duration | |
| T_OUT to GND | Continuous |
| Storage Temp. | -65°C to +160°C |
| Lead Temp. (10 sec.) | +300°C |
| Continuous Power Dissipation (TA = +70°C) | |
| 16-Pin SSOP | 571mW |
| Derates above +70°C | |
| 16-Pin SSOP | 7.14mW/°C |

**Note 1:** V+ and V- can have maximum magnitudes of 7V, but their absolute difference cannot exceed 13V.

## II. Manufacturing Information

A. Description/Function: 1µA, 3.0V to 5.5V, 250kbps, RS-232 Transceiver with AutoShutdown

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

C. Number of Device Transistors: 269

D. Fabrication Location: Oregon, USA

E. Assembly Location: Philippines or Thailand

F. Date of Initial Production: January, 1998

## III. Packaging Information

| | | |
|---|---|---|
| A. Package Type: | **16-Pin SSOP** | **16-Pin TSSOP** |
| B. Lead Frame: | Copper | Copper |
| C. Lead Finish: | Solder Plate | Solder Plate |
| D. Die Attach: | Silver-filled Epoxy | Silver-filled Epoxy |
| E. Bondwire: | Gold (1.0 mil dia.) | Gold (1.0 mil dia.) |
| F. Mold Material: | Epoxy with silica filler | Epoxy with silica filler |
| G. Assembly Diagram: | # 05-2601-0027 | # 05-2601-0028 |
| H. Flammability Rating: | Class UL94-V0 | Class UL94-V0 |
| I. Classification of Moisture Sensitivity per JEDEC standard JESD22-A112: | Level 1 | Level 1 |

## IV. Die Information

A. Dimensions: 86 x 120 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 (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:

$$\lambda = \frac{1}{MTTF} = \frac{1.83}{192 \times 4389 \times 80 \times 2}$$

(Chi square value for MTTF upper limit)

Temperature Acceleration factor assuming an activation energy of 0.8eV

$\lambda = 13.57 \times 10^{-9}$

$\lambda = 13.57$ 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. # 06-5402) 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 RT11-1 die type has been found to have all pins able to withstand a transient pulse of ±3000V, 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

**MAX3221xxE**

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

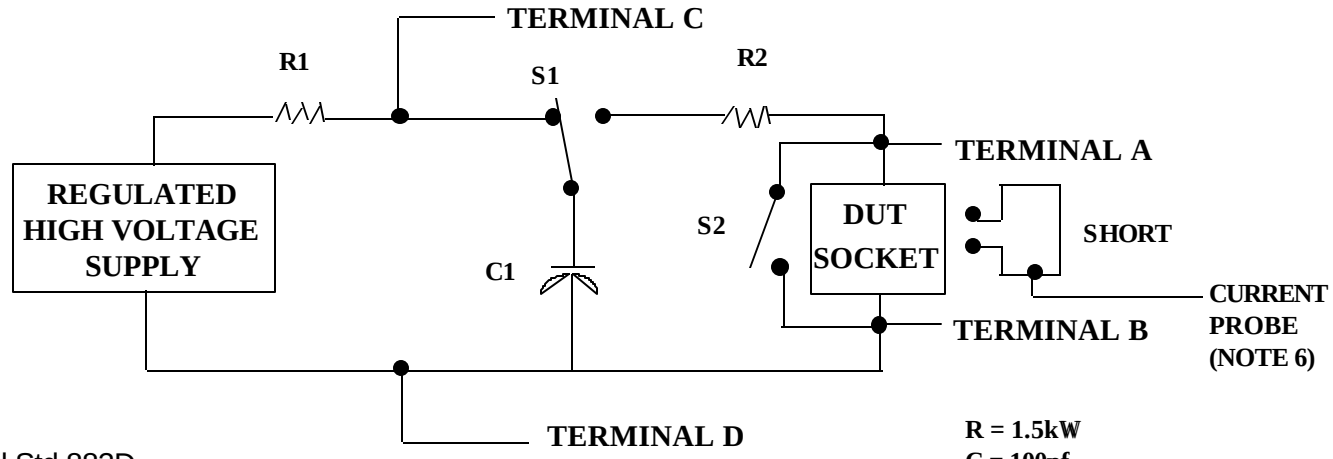
(e.g., where $V_{PS1}$ is $V_{DD}$, $V_{CC}$, $V_{SS}$, $V_{BB}$, GND, $+V_S$, $-V_S$, $V_{REF}$, etc).

3.4 Pin combinations to be tested.

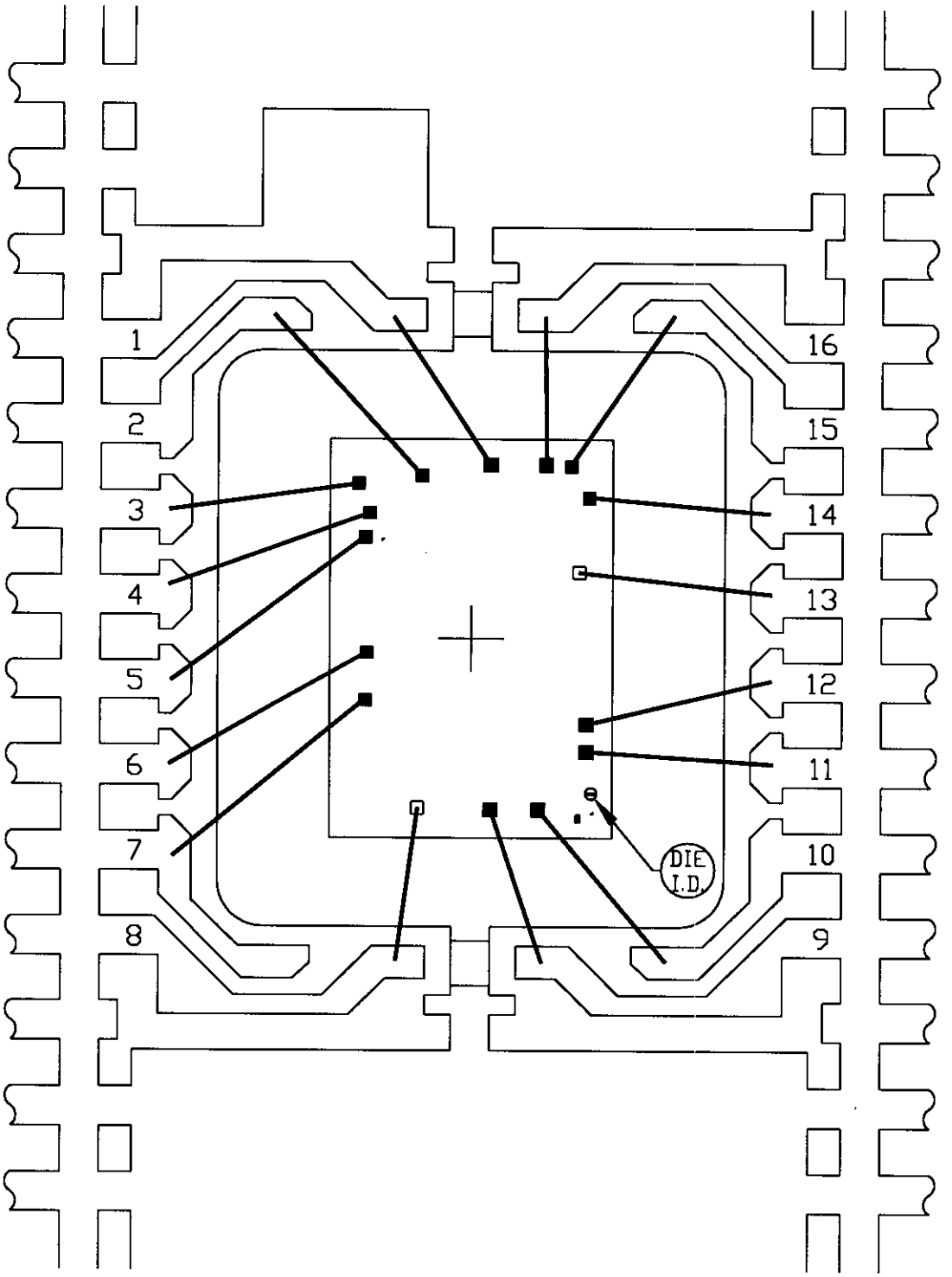
a. Each pin individually connected to terminal A with respect to the device ground pin(s) connected to terminal B. All pins except the one being tested and the ground pin(s) shall be open.

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.

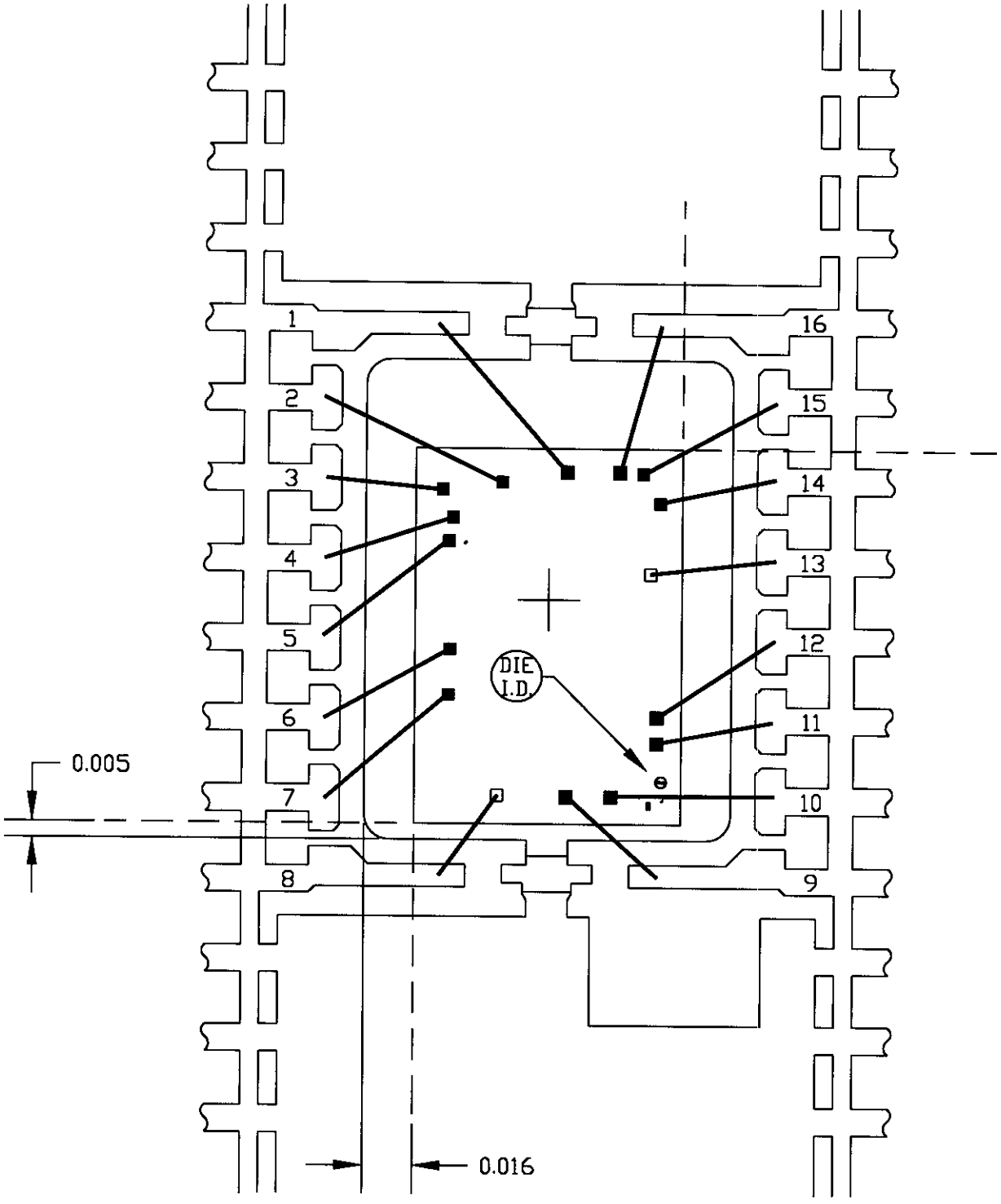
c. Each input and each output individually connected to terminal A with respect to a combination of all the other input and output pins connected to terminal B. All pins except the input or output pin being tested and the combination of all the other input and output pins shall be open.



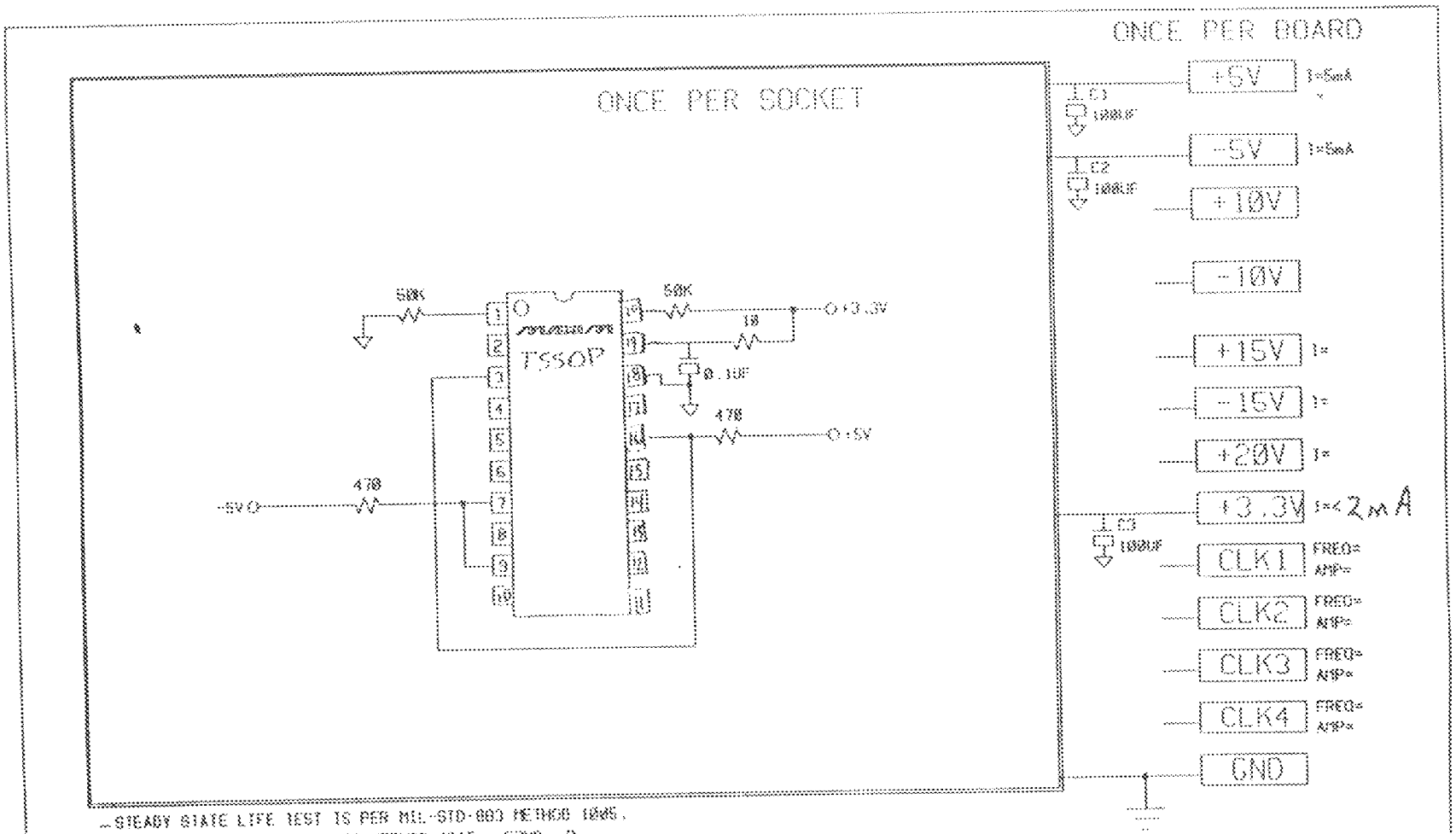

Mil Std 883D
Method 3015.7
Notice 8




| PKG. CODE: A16-2 | | SIGNATURES | DATE | MAXIM CONFIDENTIAL & PROPRIETARY | |
|---|---|---|---|---|---|
| CAV./PAD SIZE: 154X173 | PKG. DESIGN | | | BOND DIAGRAM #: 05-2601-0027 | REV: A |




| | | | | |
|---|---|---|---|---|
| PKG. CODE: U16-1 | | SIGNATURES | DATE | MAXIM CONFIDENTIAL & PROPRIETARY |
| CAV./PAD SIZE: 118X154 | PKG. DESIGN | | | BOND DIAGRAM #: 05-2601-0028 / REV: A |




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

NOTES:

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

SPEC. NO. 06-5402 REV B

DATE: 1/19/00

DRAWN BY:

MAXIM BURN-IN SCHEMATIC

DEVICE TYPE:

MAX3222
MAX3317