RELIABILITY REPORT

FOR

MAX5913EMH Rev H

PLASTIC ENCAPSULATED DEVICES

July 25, 2003

MAXIM INTEGRATED PRODUCTS

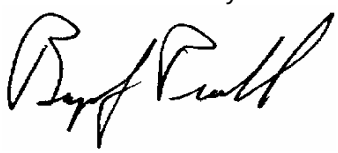
120 SAN GABRIEL DR.

SUNNYVALE, CA 94086

Written by

Jim Pedicord
Quality Assurance
Manager, Reliability Operations

Reviewed by



Bryan J. Preeshl
Quality Assurance
Executive Director of QA

Conclusion

The MAX5913 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 MAX5913 is a quadruple hot-swap controller. The MAX5913 independently control four external N-channel switches to hot-swap system loads from a single V_{CC} supply line. The device allows the safe insertion and removal of power devices from live network ports. Operating supply voltage range is between +35V and +72V. The device is intended for applications in Power-Over-Media-Dependent Interface (MDI), but is not limited to such usage.

The MAX5913 features an internal undervoltage lockout (UVLO) function that prevents the FET from turning on, if V_{CC} does not exceed the default value of +32V. The device also features a +12V relay driver with 100mA current drive capable of driving low-voltage +3.3V relays. The MAX5913 features an active-low relay driver that sinks current when the relay output is enabled. The MAX5913 uses an external sense resistor to enable all the internal current-sense functions.

The MAX5913 features a programmable analog current-limit circuit. If the switch remains in current limit for more than a programmable time, the N-channel FET latches off and the supply can be restarted either by autoretry or by an external command after the preset off-time has elapsed.

The MAX5913 is available in a 44-pin MQFP package and is specified for the extended -40°C to +85°C operating temperature range.

B. Absolute Maximum Ratings

Item	Rating
VCC to AGND or DGND	-0.6V to +76V
DRAIN_, OUT_ to AGND or DGND	-0.6V to VCC +0.3V
CSP_ to VCC	-0.3V to +0.3V
GATE_ to OUT_	-0.3V to +13V
VRLY to DGND	-0.3V to +18V
RLYD_ to DGND	-0.3V to (VRLY + 0.3V)
ON_, RLYON_, OCEN, RTRYEN, STATOUT, DC to DGND	-0.3V to +12V
FAULT to DGND	-0.3V to +12V
STAT_, RTIM to DGND	-0.3V to (VDD + 0.3V)
VDD to DGND	-0.3V to +7V
DGND to AGND	-5V to +5V
Current into RLYD_	-50mA to +150mA
Current into Any Other Pin	±50mA
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 (TA = +70C)	
44-PIN MQFP	1013mW
Derates above +70°C	
44-PIN MQFP	12.7mW/°C

II. Manufacturing Information

A. Description/Function:	+48V Quad Hot-Swap Controllers For Power-Over-LAN
B. Process:	BCD80
C. Number of Device Transistors:	14,622
D. Fabrication Location:	Oregon or California, USA
E. Assembly Location:	Philippines
F. Date of Initial Production:	October, 2001

III. Packaging Information

A. Package Type:	**44-Pin MQFP**
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:	# 05-1301-0037
H. Flammability Rating:	Class UL94-V0
I. Classification of Moisture Sensitivity per JEDEC standard JESD22-112:	Level 1

IV. Die Information

A. Dimensions:	190 X 198 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, Reliability Operations)
Bryan Preeshl (Executive Director of QA**)**
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:

$$\lambda = \frac{1}{MTTF} = \frac{1.83}{192 \times 4389 \times 232 \times 2}$$

(Chi square value for MTTF upper limit)

Temperature Acceleration factor assuming an activation energy of 0.8eV

$\lambda = 4.68 \times 10^{-9}$

$\lambda = 4.68$ 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. # 06-5762) 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 NP35 die type has been found to have all pins able to withstand a transient pulse of ±100V, 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

MAX5913EMH

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		232	0
Moisture Testing (Note 2)					
Pressure Pot	Ta = 121°C P = 15 psi. RH= 100% Time = 168hrs.	DC Parameters & functionality	MQFP	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

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

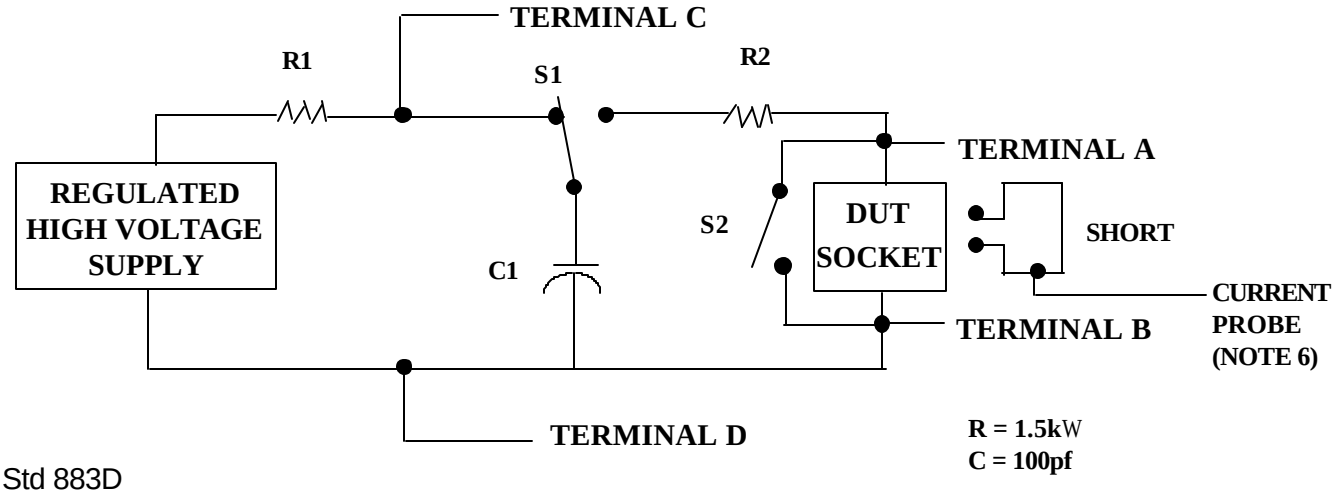
(e.g., where V_{PS1} is V_{DD}, V_{CC}, V_{SS}, V_{BB}, GND, $+V_S$, $-V_S$, V_{REF}, etc).

3.4 Pin combinations to be tested.

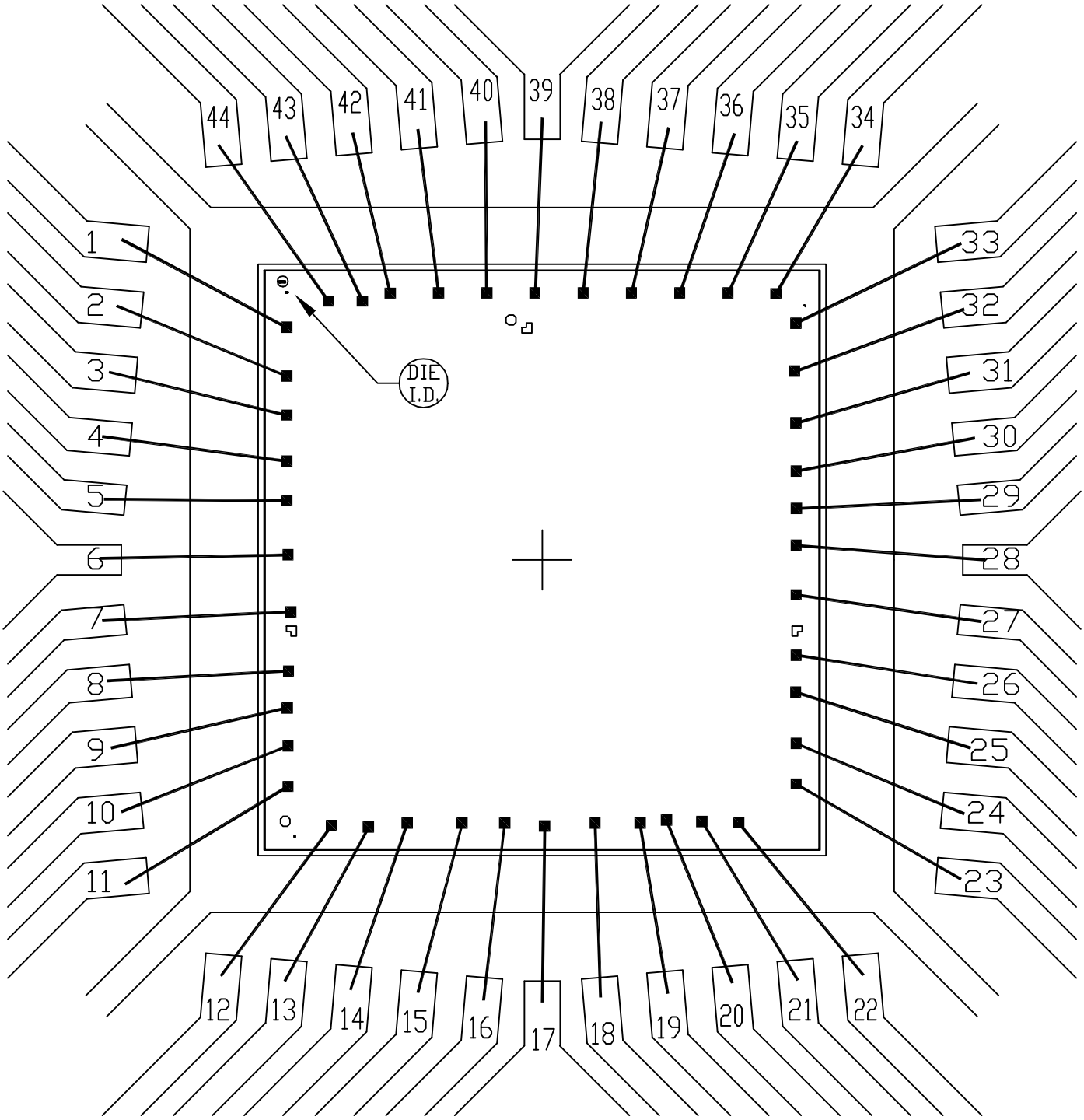
a. Each pin individually connected to terminal A with respect to the device ground pin(s) connected to terminal B. All pins except the one being tested and the ground pin(s) shall be open.

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.

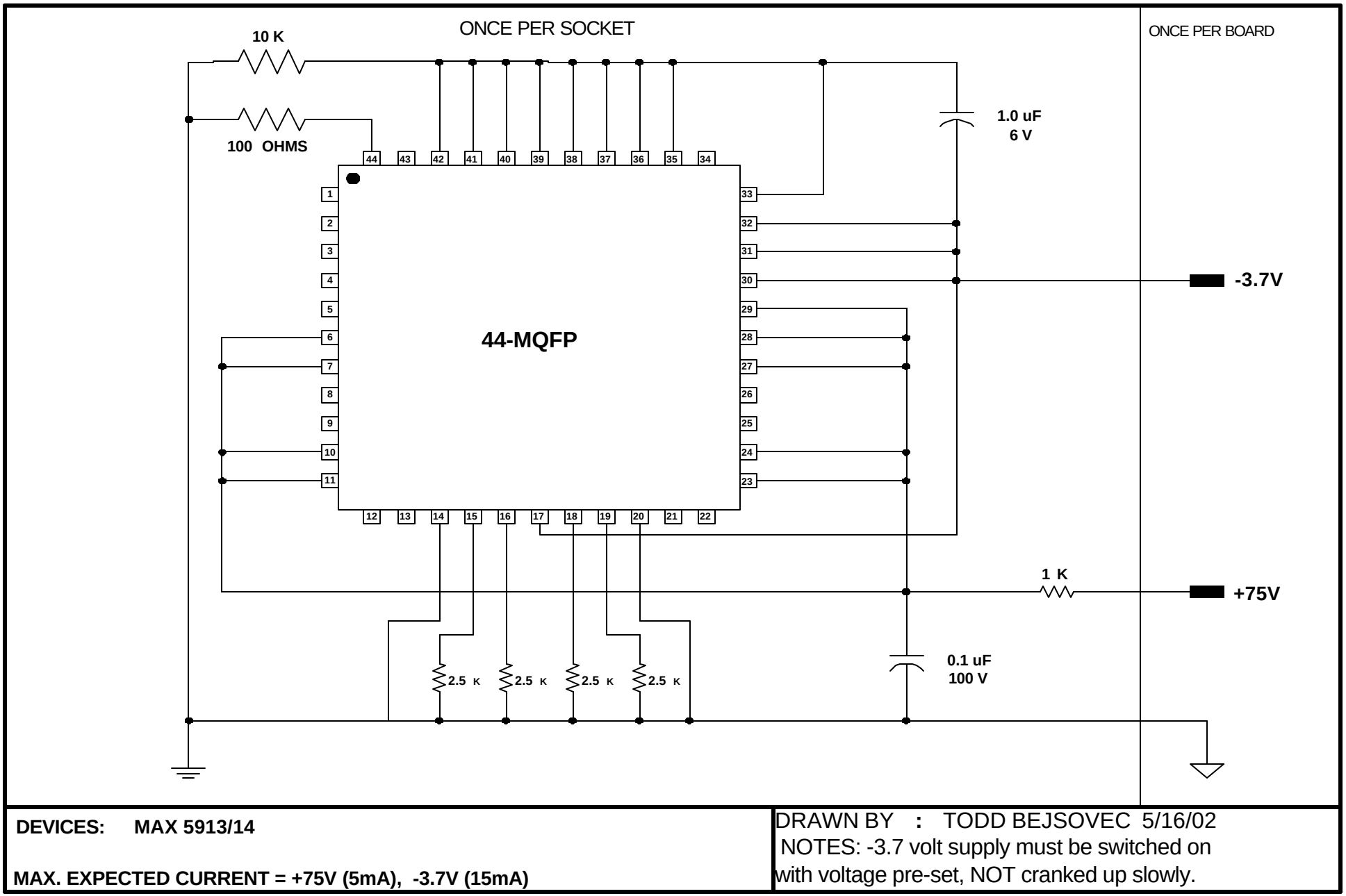
c. Each input and each output individually connected to terminal A with respect to a combination of all the other input and output pins connected to terminal B. All pins except the input or output pin being tested and the combination of all the other input and output pins shall be open.



Mil Std 883D
Method 3015.7
Notice 8



PKG. CODE: M44-3		SIGNATURES	DATE	MAXIM CONFIDENTIAL & PROPRIETARY	
CAV./PAD SIZE: 236X236	PKG.		3/27/01	BOND DIAGRAM #: 05-1301-0037	REV: A
	DESIGN		3/28/01		



DEVICES: MAX 5913/14

MAX. EXPECTED CURRENT = +75V (5mA), -3.7V (15mA)

DRAWN BY : TODD BEJSOVEC 5/16/02

NOTES: -3.7 volt supply must be switched on with voltage pre-set, NOT cranked up slowly.