

RELIABILITY REPORT
FOR
MAX1228xxEP
PLASTIC ENCAPSULATED DEVICES

October 18th, 2004

MAXIM INTEGRATED PRODUCTS

120 SAN GABRIEL DR.

SUNNYVALE, CA 94086

Written by



Jim Pedicord
Quality Assurance
Reliability Lab Manager

Reviewed by



Bryan J. Preeshl
Quality Assurance
Executive Director

Conclusion

The MAX1228 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 MAX1228 is a serial 12-bit analog-to-digital converters (ADCs) with an internal reference and an internal temperature sensor. This device features on-chip FIFO, scan mode, internal clock mode, internal averaging, and AutoShutdown™. The maximum sampling rate is 300ksps using an external clock. The MAX1028 has 12 input channels. All input channels are configurable for single-ended or differential inputs in unipolar or bipolar mode. The device operates from a +5V supply and contain a 10MHz SPI™/QSPI™/MICROWIRE™-compatible serial port.

The MAX1228 is available in a QSOP package. The device is specified over the extended -40°C to +85°C temperature range.

B. Absolute Maximum Ratings

| <u>Item</u> | <u>Rating</u> |
|--|-----------------------|
| VDD to GND | -0.3V to +6V |
| CS, SCLK, DIN, EOC, DOUT to GND | -0.3V to (VDD + 0.3V) |
| AIN0–AIN13, REF-/AIN_, CNVST/AIN_, REF+ to GND | -0.3V to (VDD + 0.3V) |
| Maximum Current into Any Pin | 50mA |
| Operating Temperature Ranges | |
| MAX1028C__ | 0°C to +70°C |
| MAX1028E__ | -40°C to +85°C |
| Storage Temperature Range | -60°C to +150°C |
| Junction Temperature | +150°C |
| Lead Temperature (soldering, 10s) | +300°C |
| Continuous Power Dissipation (TA = +70°C) | |
| 20-Pin QSOP | 727mW |
| Derates above +70°C | |
| 20-Pin QSOP | 9.1mW/°C |

II. Manufacturing Information

- A. Description/Function: 12-Bit 300ksps ADC with FIFO, Temp Sensor, Internal Reference
- B. Process: S6 BiCMOS process
- C. Number of Device Transistors: 30,889
- D. Fabrication Location: California, USA
- E. Assembly Location: Malaysia, Philippines or Thailand
- F. Date of Initial Production: July, 2003

III. Packaging Information

- A. Package Type: **20-Lead QSOP**
- 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: Buildsheet # 05-9000-0240
- H. Flammability Rating: Class UL94-V0
- I. Classification of Moisture Sensitivity per JEDEC standard JESD22-A112: Level 1

IV. Die Information

- A. Dimensions: 86 x 120 mils
- B. Passivation: $\text{Si}_3\text{N}_4/\text{SiO}_2$ (Silicon nitride/ Silicon dioxide)
- C. Interconnect: TiW/ AlCu/ TiWN
- D. Backside Metallization: None
- E. Minimum Metal Width: .6 microns (as drawn)
- F. Minimum Metal Spacing: .6 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:

$$\lambda = \frac{1}{\text{MTTF}} = \frac{1.83}{192 \times 4389 \times 47 \times 2} \text{ (Chi square value for MTTF upper limit)}$$

△ Temperature Acceleration factor assuming an activation energy of 0.8eV

$$\lambda = 23.10 \times 10^{-9} \quad \lambda = 23.10 \text{ F.I.T. (60\% confidence level @ 25°C)}$$

This low failure rate represents data collected from Maxim's reliability qualification and monitor programs. Maxim also performs weekly Burn-In on samples from production to assure reliability of its processes. The reliability required for lots which receive a burn-in qualification 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 rejects from lots exceeding this level. The Burn-In Schematic (Spec.# 06-6080) shows the static circuit used for this test. Maxim also performs 1000 hour life test monitors quarterly for each process. This data is published in the Product Reliability Report (**RR-1M**) located on the Maxim website at <http://www.maxim-ic.com>.

B. Moisture Resistance Tests

Maxim evaluates pressure pot stress from every assembly process during qualification of each new design. Pressure Pot testing must pass a 20% LTPD for acceptance. Additionally, industry standard 85°C/85%RH or HAST tests are performed quarterly per device/package family.

C. E.S.D. and Latch-Up Testing

The AC19-2 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 $\pm 250\text{mA}$.

Table 1
Reliability Evaluation Test Results

MAX1228xxEP

| TEST ITEM | TEST CONDITION | FAILURE IDENTIFICATION | SAMPLE SIZE | NUMBER OF FAILURES |
|-----------------------------------|---|----------------------------------|--------------------|---------------------------|
| Static Life Test (Note 1) | | | | |
| | Ta = 135°C Biased Time = 192 hrs. | DC Parameters & functionality | 47 | 0 |
| Moisture Testing (Note 2) | | | | |
| Pressure Pot | Ta = 121°C P = 15 psi. RH= 100% Time = 168hrs. | DC Parameters & functionality | 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 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.

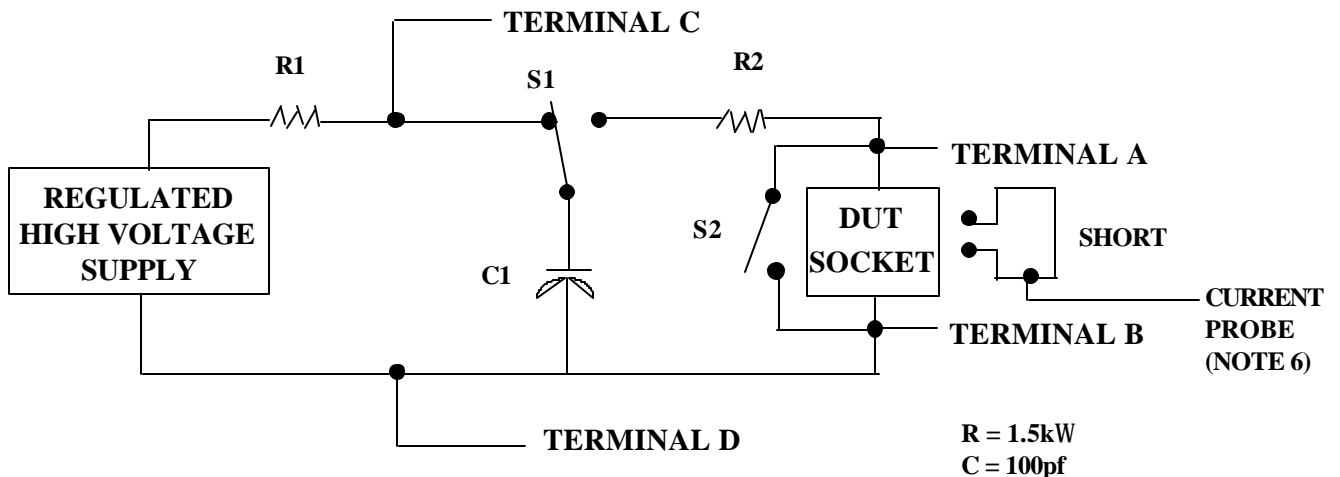
2/ No connects are not to be tested.

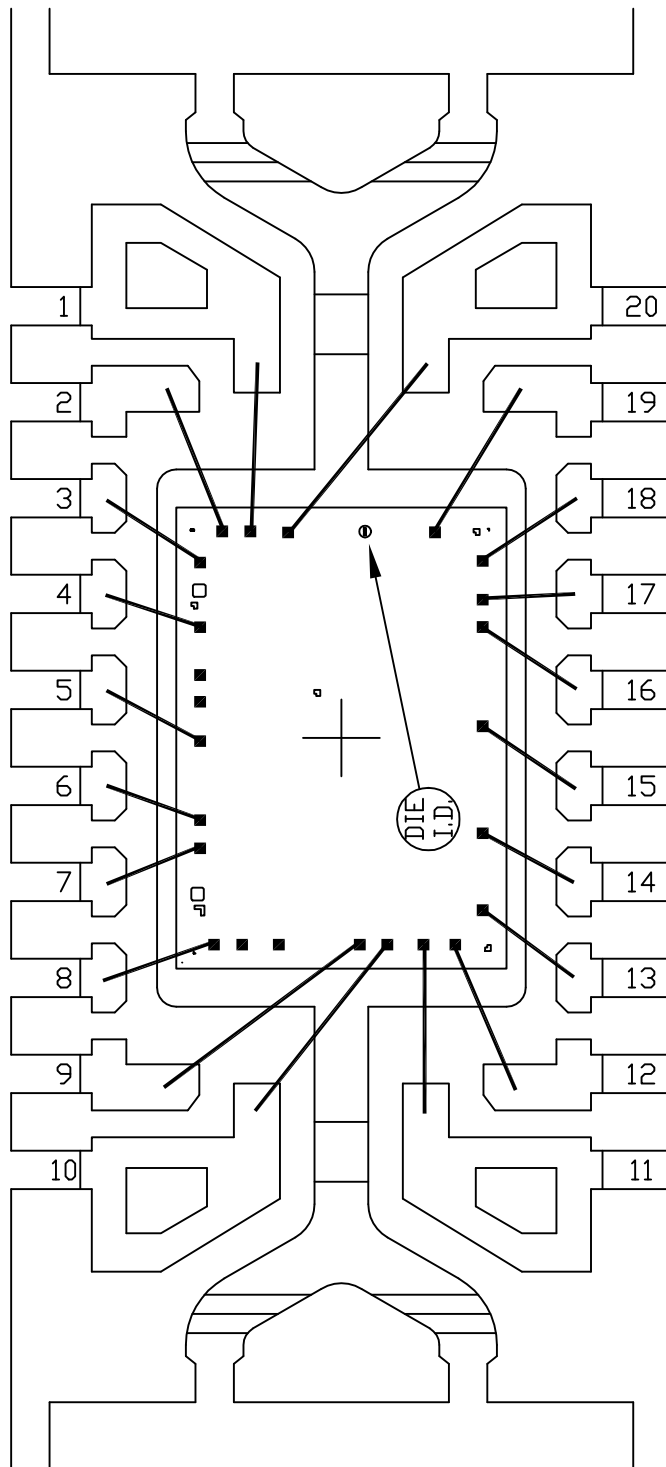
3/ Repeat pin combination I for each named Power supply and for ground

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

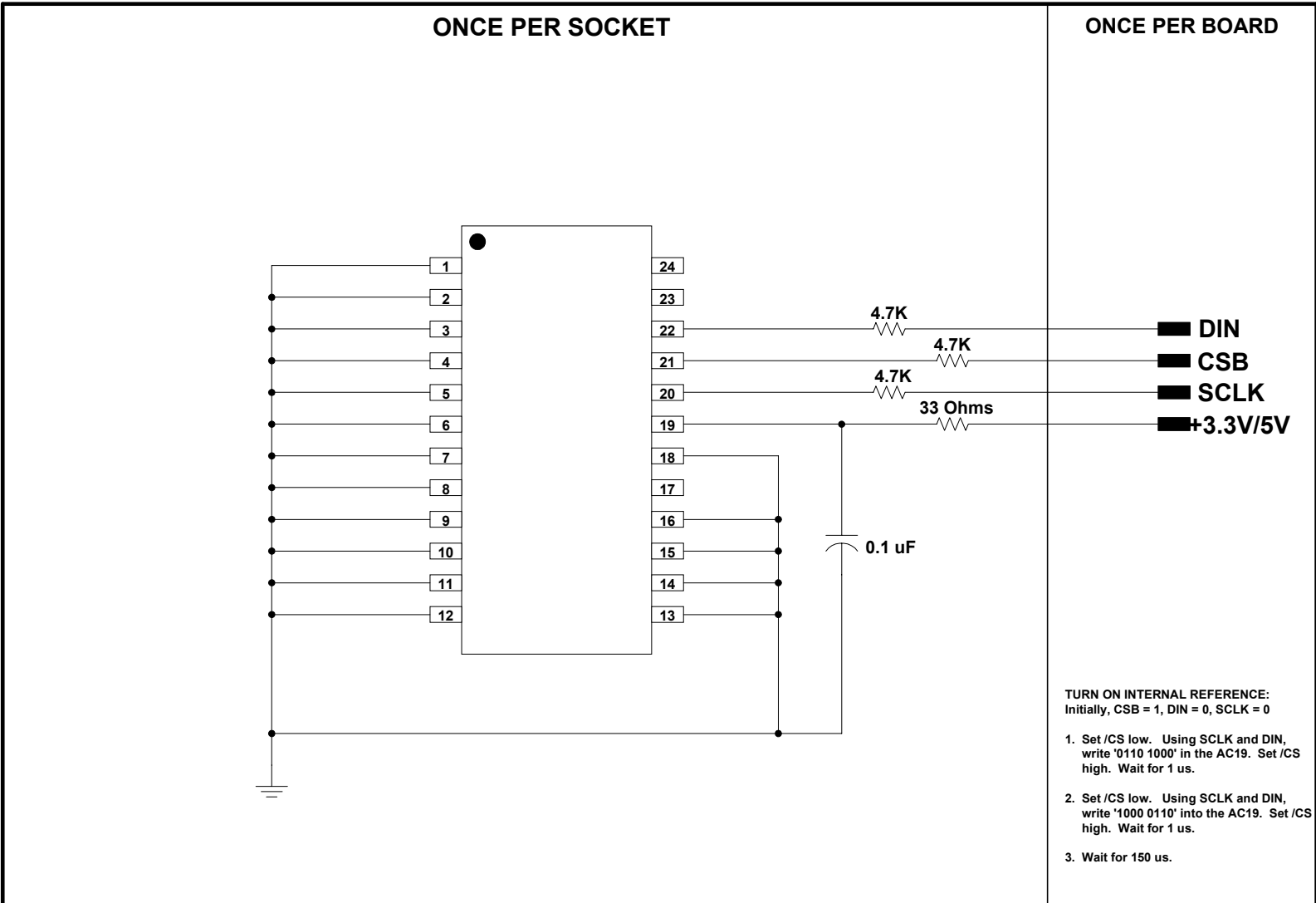
3.4 Pin combinations to be tested.

- 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.





| | | | | | |
|--------------------------|----------------|------------|------|---|-----------|
| PKG. CODE: E20-1 | | SIGNATURES | DATE |  CONFIDENTIAL & PROPRIETARY | |
| CAV./PAD SIZE: 96X140 | PKG. DESIGN | | | BOND DIAGRAM #: 05-9000-0240 | REV: A |



DEVICES: MAX 1230/1231
PACKAGE: 24-QSOP
MAX. EXPECTED CURRENT = 1.5mA (+3V) OR (+5V)

DRAWN BY: TEK TAN
NOTES: +3.3V FOR MAX1031/1231.
+5V FOR MAX1030/1230.

SPI Input Timing

Applies to MAX1230,1231,1030, and 1031

Vih= VDD

Vil= 0V

SCLK Frequency= 200 Khz

