RELIABILITY REPORT

FOR

MAX221ExxE

PLASTIC ENCAPSULATED DEVICES

August 16, 2002

MAXIM INTEGRATED PRODUCTS

120 SAN GABRIEL DR.

SUNNYVALE, CA 94086

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Conclusion

The MAX221E 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 MAX221E is a +5V powered, single transmit/receive RS-232 and V.28 communications interface with automatic shutdown/wake-up features and high data rate capabilities.

The MAX221E features enhanced electrostatic discharge (ESD) protection. Both the transmitter output and receiver input are protected to ±15kV using the IEC 1000-4-2 Air-Gap Discharge Method, to ±8kV using the IEC 1000-4-2 Contact Discharge Method, and to ±15kV using the Human Body Model.

The MAX221E achieves a low 1µA supply current with Maxim's revolutionary AutoShutdown™ feature. AutoShutdown saves power without changes to the existing BIOS or operating system by entering low-power shutdown mode when the RS-232 cable is disconnected or when the transmitter of the connected peripheral is off. The MAX221E wakes up and drives the INVALID-bar pin high when an active RS-232 cable is connected, signaling the host that a peripheral is connected to the communications port.

The MAX221E is available in a 16-pin SSOP package as well as a 16-pin TSSOP that uses 50% less board space than a 16-pin SO.

B. Absolute Maximum Ratings

Item	Rating
VCC	-0.3V to +6V
V+	(VCC - 0.3V) to +14V
V-	-14V to +0.3V
Input Voltages	
TIN	-0.3V to (V+ + 0.3V)
RIN	±30V
FORCEON, FORCEOFF, EN	-0.3V to (VCC + 0.3V)
Output Voltages	
TOUT	(V- - 0.3V) to (V+ + 0.3V)
ROUT, INVALID	-0.3V to (VCC + 0.3V)
Short-Circuit Duration, TOUT	Continuous
Operating Temperature Range	
MAX221Ecxx	0°C to +70°C
MAX221Eexx	-40°C to +85°C
Maximum Junction Temperature	+150°C
Storage Temperature Range	-65°C to +150°C
Lead Temperature (soldering, 10sec)	+300°C
Continuous Power Dissipation (TA = +70°C)	
16-Pin SSOP	571mW
16-Pin TSSOP	533mW
Derates above +70°C	
16-Pin SSOP	6.7mW/°C
16-Pin TSSOP	7.1mW/°C

II. Manufacturing Information

A. Description/Function: ±15kV ESD-Protected, +5V, 1µA, Single RS-232Transceiver with AutoShutdown

B. Process: M5 (SMG) – 5 micron metal gate (CMOS)

C. Number of Device Transistors: 157

D. Fabrication Location: Oregon, USA

E. Assembly Location: Philippines or Thailand

F. Date of Initial Production: July, 1999

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:	# 05-1901-0234	# 05-1901-0235
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: 87 x 105 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: 5 microns (as drawn)

F. Minimum Metal Spacing: 5 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. # 06-5388) 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

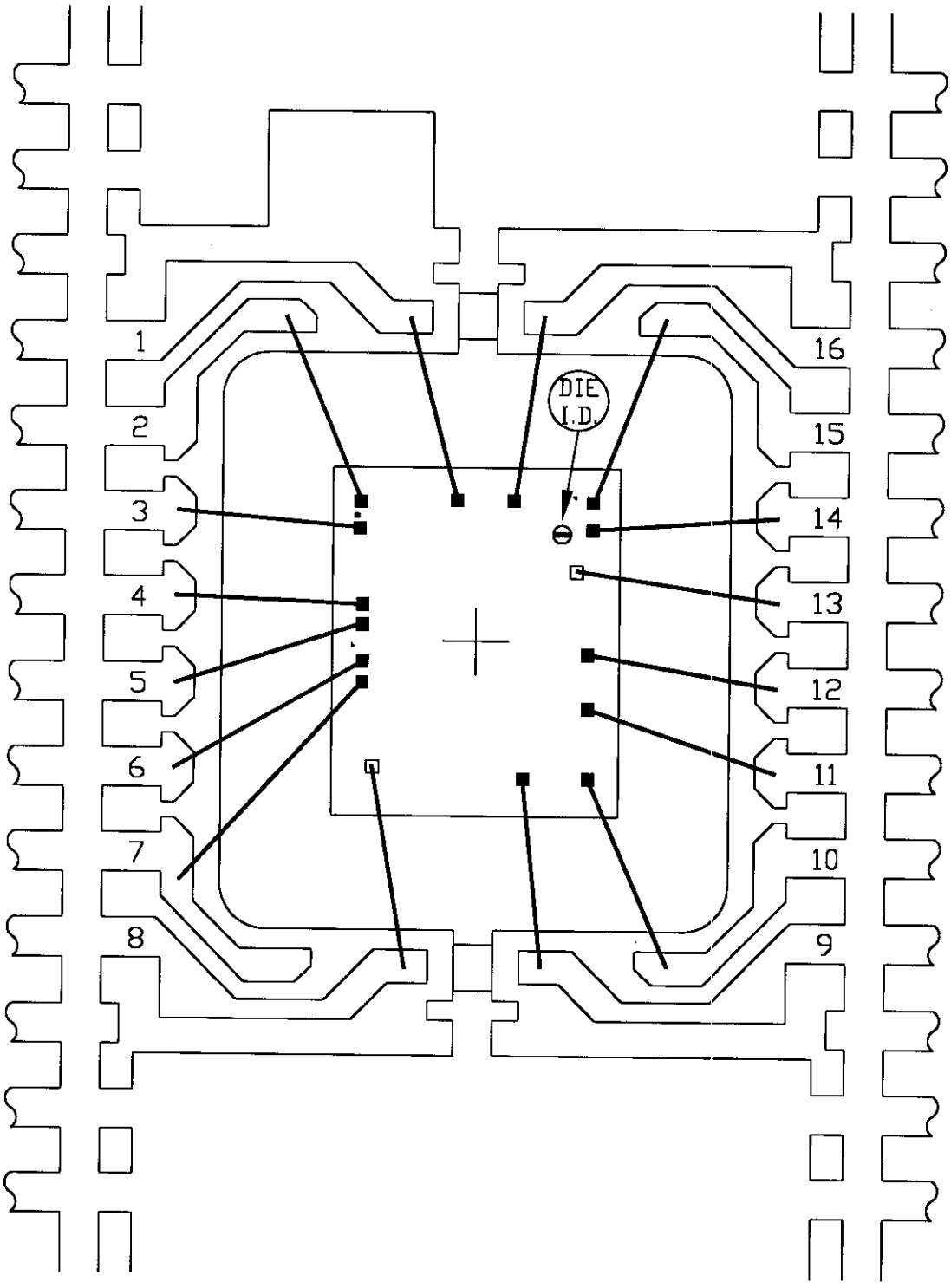
The RS72 die type has been found to have all pins able to withstand a transient pulse of ±1500V, per Mil-Std-883 Method 3015 (reference attached ESD Test Circuit). Additionally, the MAX221E has achieved ±15kV ESD protection using both methods 3015 and IEC 801-2 (air-gap discharge) on the I/O pins.
Latch-Up testing has shown that this device withstands a current of ±200mA.

Table 1
Reliability Evaluation Test Results

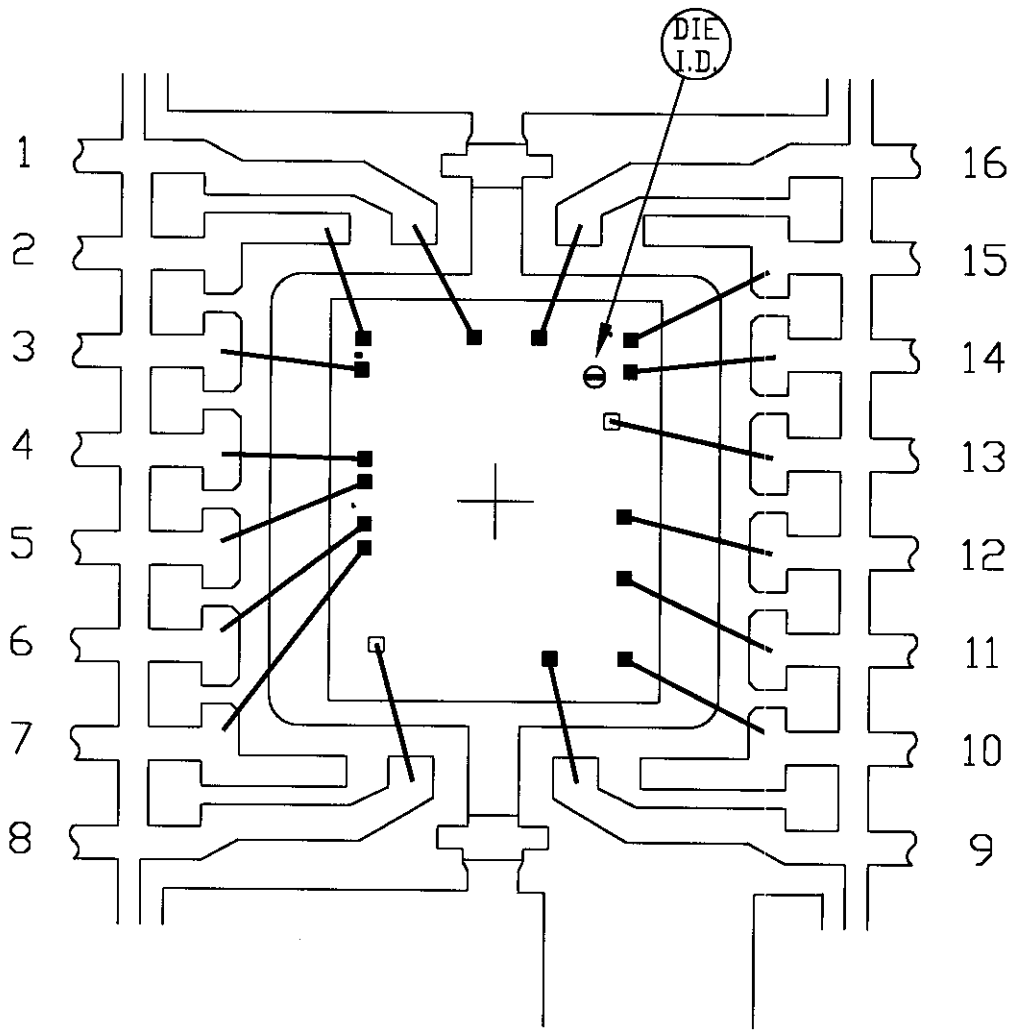
MAX221ExxE

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		80	0
Moisture Testing (Note 2)					
Pressure Pot	Ta = 121°C P = 15 psi. RH= 100% Time = 168hrs.	DC Parameters & functionality	SSOP TSSOP	77 77	0 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



PKG.CODE: A16-2		APPROVALS	DATE	MAXIM
CAV./PAD SIZE: 154X173	PKG. DESIGN			BUILDSHEET NUMBER: 05-1901-0234 / REV.: A



PKG.CODE: U16-2		APPROVALS	DATE	MAXIM
CAV./PAD SIZE: 118X118	PKG. DESIGN			BUILDSHEET NUMBER: 05-1901-0235 / REV.: A

RS232
MAX221

Burn in Board circuit
06-5388

I = 20mA