RELIABILITY REPORT

FOR

DG412FEUE+

PLASTIC ENCAPSULATED DEVICES

April 26, 2017

MAXIM INTEGRATED

160 RIO ROBLES

SAN JOSE, CA 95134

 Eric Wright Reliability Engineer	 Brian Standley Manager, Reliability

Conclusion

The DG412FEUE+ 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 DG411F/DG412F/DG413F are quad, single-pole/single-throw (SPST), fault-protected analog switches. They are pin compatible with the industry-standard nonprotected DG411/DG412/DG413. These new switches feature fault-protected inputs and rail-to-rail signal-handling capability. All terminals are protected from overvoltage faults up to ±36V with power on and up to ±40V with power off. During a fault condition, the COM, NO, or NC terminal becomes an open circuit and only microamperes of leakage current flow from the source. On-resistance is 35 (max) and is matched between switches to 1.5 (max) at +25°C. The DG411F has four normally closed (NC) switches. The DG412F has four normally open (NO) switches. The DG413F has two NC and two NO switches. These CMOS switches operate with dual power supplies ranging from ±4.5V to ±20V or a single supply between +9V and +36V. All digital inputs have +0.8V and +2.4V logic thresholds, ensuring both TTL and CMOS logic compatibility when using ±15V or a single +12V supply. For supply voltages of ±5V, +5V, and +3V, refer to the MAX4711/MAX4712/MAX4713 data sheet.

II. Manufacturing Information

A. Description/Function:	Quad, Rail-to-Rail, Fault-Protected, SPST Analog Switches
B. Process:	S5
C. Fabrication Location:	USA
D. Assembly Location:	Malaysia, Philippines, Thailand
E. Date of Initial Production:	4/27/2002

III. Packaging Information

A. Package Type:	16-pin TSSOP
B. Lead Frame:	Copper
C. Lead Finish:	100% matte Tin
D. Die Attach:	Conductive
E. Bondwire:	Au (1 mil dia.)
F. Mold Material:	Epoxy with silica filler
G. Assembly Diagram:	#05-1201-0288
H. Flammability Rating:	Class UL94-V0
I. Classification of Moisture Sensitivity per JEDEC standard J-STD-020-C	Level 1
J. Single Layer Theta Ja:	106°C/W
K. Single Layer Theta Jc:	27°C/W
L. Multi Layer Theta Ja:	90°C/W
M. Multi Layer Theta Jc:	27°C/W

IV. Die Information

A. Dimensions:	86 X 138 mils
B. Passivation:	Si_3N_4/SiO_2 (Silicon nitride/ Silicon dioxide)
C. Interconnect:	Al/0.5%Cu with Ti/TiN Barrier
D. Backside Metallization:	None
E. Minimum Metal Width:	5.0 microns (as drawn)
F. Minimum Metal Spacing:	5.0 microns (as drawn)
G. Isolation Dielectric:	SiO_2
H. Die Separation Method:	Wafer Saw

V. Quality Assurance Information

A. Quality Assurance Contacts:	Eric Wright (Reliability Engineering) Brian Standley (Manager, Reliability) Bryan Preeshl (Vice President of QA)
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:

$$\lambda = \frac{1}{MTTF} = \frac{1.83}{192 \times 4340 \times 80 \times 2}$$ (Chi square value for MTTF upper limit)

(where 4340 = Temperature Acceleration factor assuming an activation energy of 0.8eV)

$\lambda = 13.7 \times 10^{-9}$

$\lambda = 13.7$ F.I.T. (60% confidence level @ 25°C)

The following failure rate represents data collected from Maxim"s reliability monitor program. Maxim performs quarterly life test monitors on its processes. This data is published in the Reliability Report found at http://www.maxim-ic.com/qa/reliability/monitor. Cumulative monitor data for the S5 Process results in a FIT Rate of 0.09 @ 25C and 1.55 @ 55C (0.8 eV, 60% UCL)

B. Moisture Resistance Tests

The industry standard 85°C/85%RH or HAST testing is monitored per device process once a quarter.

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

The AH88-1 die type has been found to have all pins able to withstand an HBM transient pulse of +/-200 V per Mil-Std 883 Method 3015.7. Latch-Up testing has shown that this device withstands a current of +/-250 mA.

Table 1
Reliability Evaluation Test Results

DG412FEUE+

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	80	0
Moisture Testing (Note 2)				
HAST	Ta = 130°C RH = 85% Biased Time = 96hrs.	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