Test Report:
Total Dose Testing of 54ACTQ244 Octal Buffer/Line Driver
National Semiconductor

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1. Introduction

This report describes the testing and characterization of the 54ACTQ244 in July 2006 for its response to doses of ionizing radiation. The part is manufactured by National Semiconductor.

2. Device Description

The 54ACTQ244 is a Quiet Series Octal Buffer/Line Driver w/TRI-STATE Output. Table I contains the relevant information on the part and the testing conditions.

Table I.
54ACTQ244 Device and Test Information

Generic Part Number:	54ACTQ244LMQB
Full Part Number	5962-9218601M2A
Manufacturer:	National Semiconductor
Lot Date Code (LDC):	0548B
Quantity Tested:	5
Serial Numbers of Control Sample:	5
Serial Numbers of Radiation Samples:	1, 2, 3, and 4
Part Function:	Octal Buffer/Line-Driver with tri-state output.
Part Technology:	CMOS
Package Style:	20-pin LCC
Test Equipment:	Parametric Analyzer, dual power supply
Test Engineer:	A. Phan
Dose Levels (krad (Si))	0, 10, 20, 30, 40, 50 and anneal after 1 week
Target dose rate (rad (Si)/sec)	2 rads/sec
Case Markings	HSA0548B 54ACTQ244LMQB/Q 5962-9218601M2A

3. Test Method

There were five devices. Four devices were exposed to gamma rays at the GSFC Co^{60} cell per MIL-STD-883 Method 1019.6; one device was used as a control. The dose levels were 10, 20, 30, 40, 50(Si), and the dose rate was approximately 2 rad (Si)/sec. At each dose level the devices were characterized using the parametric measurements given in Table II at a minimum. Only one of the eight channels in each device was tested. During exposure the devices were biased with V_{dd} = 5 V, inputs grounded, and outputs floating. Following the 50 krad(Si) dose, the parts were annealed for 160 hours and then re-measured.

Table II.

54ACTQ244 Parametric Characteristics.

DC Electrical Characteristics for 'ACTQ Family Devices

Symbol	Parameter	V_{CC} (V)	54ACTQ −55°C to +125°C Guaranteed Limits	Units	Conditions
V_{IH}	Minimum High Level Input Voltage	4.5 5.5	2.0 2.0	V	V_{OUT} = 0.1V or V_{CC} − 0.1V
V_{IL}	Maximum Low Level Input Voltage	4.5 5.5	0.8 0.8	V	V_{OUT} = 0.1V or V_{CC} − 0.1V
V_{OH}	Minimum High Level Output Voltage	4.5 5.5	4.4 5.4	V	I_{OUT} = −50 μA
		4.5 5.5	3.70 4.70	V	(Note 9) V_{IN} = V_{IL} or V_{IH} I_{OH} = −24 mA I_{OH} = −24 mA
V_{OL}	Maximum Low Level Output Voltage	4.5 5.5	0.1 0.1	V	I_{OUT} = 50 μA
		4.5 5.5	0.50 0.50	V	(Note 9) V_{IN} = V_{IL} or V_{IH} I_{OL} = 24 mA I_{OL} = 24 mA
I_{IN}	Maximum Input Leakage Current	5.5	±1.0	μA	V_I = V_{CC}, GND
I_{OZ}	Maximum TRI-STATE Leakage Current	5.5	±5.0	μA	V_I = V_{IL}, V_{IH} V_O = V_{CC}, GND
I_{CC}	Maximum Quiescent Supply Current	5.5	80.0	μA	V_{IN} = V_{CC} or GND (Note 11)

4. Results

Table III
Supply Current (Icc) As a Function of Dose.
(Specification is 80.0E-06 A)

ICC							
TID	**DUT#1**	**DUT#2**	**DUT#3**	**DUT#4**	**Control**	**Average**	**St. Dev.**
0	1.09E-10	1.02E-10	1.08E-10	1.35E-10	1.25E-10	1.14E-10	1.47E-11
10	2.54E-05	2.35E-05	1.88E-05	2.85E-05	1.23E-10	2.41E-05	4.06E-06
20	9.82E-04	9.43E-04	7.44E-04	6.76E-07	1.24E-10	6.67E-04	4.57E-04
30	9.45E-04	9.69E-04	6.71E-04	1.98E-04	3.80E-10	6.96E-04	3.58E-04
40	2.26E-03	2.29E-03	1.68E-03	1.25E-03	1.21E-10	1.87E-03	5.00E-04
50	2.99E-03	3.09E-03	2.21E-03	2.21E-03	1.26E-10	2.63E-03	4.81E-04
Anneal	5.92E-04	6.21E-04	3.86E-04	3.62E-04	1.13E-10	4.90E-04	1.35E-04

Table IV.
Input Bias Current (Iin) as a Function of Total Dose.
(Specification is 1.0E-06 A)

Iin							
TID	**DUT#1**	**DUT#2**	**DUT#3**	**DUT#4**	**Control**	**Average**	**St. Dev.**
0	6.67E-12	9.39E-12	1.22E-11	1.79E-11	1.20E-11	1.15E-11	4.80E-12
10	7.48E-12	1.01E-11	1.44E-11	1.72E-11	1.28E-11	1.23E-11	4.34E-12
20	8.33E-12	1.09E-11	1.90E-11	1.90E-11	1.27E-11	1.43E-11	5.52E-12
30	7.80E-12	1.96E-11	1.52E-11	1.71E-11	1.96E-11	1.49E-11	5.08E-12
40	1.04E-11	1.39E-11	1.96E-11	2.39E-11	1.14E-11	1.70E-11	5.99E-12
50	1.44E-11	1.91E-11	2.56E-11	2.66E-11	1.17E-11	2.14E-11	5.74E-12
Anneal	1.24E-11	1.61E-11	1.72E-11	1.74E-11	8.01E-12	1.58E-11	2.32E-12

Table V.
High Output Voltage (VoutHI) as a Function of Total Dose.
(Specified Minimum is 5.4 V)

VoutHI							
TID	**DUT#1**	**DUT#2**	**DUT#3**	**DUT#4**	**Control**	**Average**	**St. Dev.**
0	5.5012	5.501	5.5006	5.5004	5.5008	5.50E+00	0.0004
10	5.5008	5.5008	5.5008	5.5006	5.5008	5.50E+00	0.0001
20	5.4996	5.4994	5.5002	5.5008	5.5008	5.50E+00	0.0006
30	5.4998	5.4994	5.4974	5.5008	5.5008	5.50E+00	0.0014
40	5.4974	5.4972	5.496	5.4996	5.4998	5.50E+00	0.0015
50	5.4954	5.4952	5.5004	5.4972	5.5008	5.50E+00	0.0024
Anneal	5.4998	5.5	5.5	5.5	5.5006	5.50E+00	0.0001

Table VI
Low Output Voltage (VoutLO) as a Function of Total Dose
(Specified Maximum is 0.1 V)

VoutLO							
TID	**DUT#1**	**DUT#2**	**DUT#3**	**DUT#4**	**Control**	**Average**	**St. Dev.**
0	0	0	0.00E+00	-2.00E-05	0	-5.00E-06	1.00E-05
10	4.00E-05	4.00E-05	8.00E-05	0	0	4.00E-05	3.27E-05
20	4.80E-04	5.20E-04	4.00E-04	2.00E-05	2.00E-05	3.55E-04	2.29E-04
30	4.60E-04	4.60E-04	2.80E-04	8.00E-05	2.00E-05	3.20E-04	1.81E-04
40	1.18E-03	1.06E-03	8.00E-04	6.00E-04	0	9.10E-04	2.61E-04
50	1.56E-03	1.52E-03	1.08E-03	1.04E-03	2.00E-05	1.30E-03	2.78E-04
Anneal	2.80E-04	2.40E-04	1.80E-04	0	4.00E-05	1.75E-04	1.24E-04

Table VII
Tristate Output Leakage Current (IOZ) as a Function of Total Dose.
(Specified value is 5.0E-06 A)

IOZ							
TID	**DUT#1**	**DUT#2**	**DUT#3**	**DUT#4**	**Control**	**Average**	**St. Dev.**
0	1.00E-08	8.00E-09	8.00E-09	-2.00E-09	6.00E-09	6.00E-09	5.42E-09
10	2.00E-09	4.00E-09	6.00E-09	2.00E-09	4.00E-09	3.50E-09	1.91E-09
20	1.02E-06	8.76E-07	5.86E-07	4.00E-09	4.00E-09	6.22E-07	4.49E-07
30	2.22E-06	1.65E-06	1.23E-06	2.40E-07	2.00E-09	1.34E-06	8.35E-07
40	4.20E-06	3.70E-06	2.78E-06	2.30E-07	2.00E-09	2.73E-06	1.77E-06
50	5.96E-06	5.13E-06	3.82E-06	4.01E-06	2.00E-09	4.73E-06	1.00E-06
Anneal	4.83E-06	3.42E-06	2.31E-06	2.23E-06	0	3.20E-06	1.22E-06

5. Conclusions

All parametric values were within specifications after being exposed to 50 krad(Si) followed by a one week anneal except for the supply current which exceeds specifications after 20 krad(Si) and Tristate Output Leakage Current which exceeds specifications after a total dose of 50 krad(Si). However, after annealing for 160 hours under bias, all parametric values were within specifications.