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- B. Fafaul/311**
- A. Sharma/311**
- D. Krus**
- J. Stubblefield**
- A. Moor**

To

T. Miccolis
Department**Code 300.1**
From**K. Sahu**
Department KS**7809**
Subject

Radiation Report on 54ACT244LMQB
SMEX Common Buy Part No. 5962-87760012A

A radiation evaluation was performed on 54ACT244LMQB to determine the total dose tolerance of these parts. A brief summary of the test results is provided below. For detailed information, refer to Tables I through IV and Figure 1.

The total dose testing was performed using a cobalt-60 gamma ray source. During the radiation testing, eight parts were irradiated under bias (see Figure 1 for bias configuration), and two parts were used as control samples. The total dose radiation steps were 10, 20, 30, 50, 75 and 100 krads. After 100 krads, parts were annealed at +25°C for 24 and 168 hours, and then irradiation was continued to 200 and 300 krads (cumulative) after which they were annealed at +100°C for 168 hours. The dose rate was between 0.45 and 5 krads/hour, depending on the total dose level (see Table II for radiation schedule). After each radiation exposure and annealing treatment, parts were electrically tested @ +25°C according to the test conditions and the specification limits listed in Table III. These tests included a total of two functional tests (at 1 MHz) after each radiation and annealing step.

All of the Parts passed all tests on irradiation up to 200 krads without any significant degradation in any of the electrical parameters. On continued irradiation to 300 krads, one part (SN 327) marginally exceeded the specification limits on ICCH, ICCL, ICCZ (readings were 225uA to 330uA against the specification limit of 160uA) and VOL1 (voltage level low @ VCC = 4.5V; readings were 308mV to 899mV against the specification limit of 100mV). After annealing at +100°C for 168 hours, all irradiated parts failed the AC parametric tests (readings indicate some outputs never reached the expected voltage level). six of the eight irradiated parts failed the VOH (output voltage level high) at various VCC. Some outputs did not switch to the right state hinting some degradation on the input voltage level requirements. Table IV provides the mean and standard deviation values for each parameter after different irradiation exposures and annealing treatments. It also provides a summary of functional test results after each radiation/annealing step.

Any further details about this evaluation can be obtained upon request. If you have any questions, please call me at (301)731-8954.

TABLE I. Part Information

Generic Part Number:	54ACT244LMQB
SSEX Common Buy Part Number:	5962-87760012A
SSEX Common Buy Control Number:	1758
Charge Number:	C90362
Manufacturer:	National Semiconductor Corp.
Lot Date Code:	9036A
Quantity Tested:	10
Serial Numbers of Radiation Samples:	322, 323, 324, 325, 326, 327, 328, 329
Serial Number of Control Sample:	320, 321
Part Function:	OCTAL BUFFER/DRIVER
Part Technology:	CMOS
Package Style:	20-pin LCC

TABLE II. Radiation Schedule for 54ACT244LMQB

EVENTS	DATE
1) Initial (Pre-Irradiation) Electrical Measurements	07/31/91
2) 10- KRAD IRRADIATION (0.5 krads/hour)	09/10/91
POST-10-KRAD ELECTRICAL MEASUREMENT	09/12/91
3) 20-KRAD IRRADIATION (0.5 krads/hour)	09/12/91
POST-20-KRAD ELECTRICAL MEASUREMENT	09/13/91
3) 30-KRAD IRRADIATION (1.5 krads/hour)	09/13/91
POST-30-KRAD ELECTRICAL MEASUREMENT	09/16/91
4) 50-KRAD IRRADIATION (1.0 krads/hour)	09/16/91
POST-50-KRAD ELECTRICAL MEASUREMENT	09/17/91
4) 75-KRAD IRRADIATION (1.25 krads/hour)	09/17/91
POST-75-KRAD ELECTRICAL MEASUREMENT	09/18/91
5) 100-KRAD IRRADIATION (1.25 KRADS/HOUR)	09/18/91
POST-100-KRAD ELECTRICAL MEASUREMENT	09/19/91
6) 24 HOURS ANNEALING AT +25°C	09/19/91
POST-24-HOURS ELECTRICAL MEASUREMENT	09/20/91
7) 168 HOURS ANNEALING AT +25°C	09/20/91
POST-168-HOURS ELECTRICAL MEASUREMENT	09/26/91
8) 200-KRAD IRRADIATION (5.0 KRADS/HOUR)	09/26/91
POST-200-KRAD ELECTRICAL MEASUREMENTS	09/27/91
9) 300-KRAD IRRADIATION (1.5 KRADS/HOUR)	09/27/91
POST-300-KRAD ELECTRICAL MEASUREMENTS	09/30/91
10) 168 HOURS ANNEALING AT +100°C	09/30/91
POST-168 HOURS AT +100°C ELECTRICAL MEASUREMENTS	10/25/91

Notes:

- All parts were radiated under bias at the cobalt-60 gamma ray facility at GSFC.
- All electrical measurements were performed off-site at +25°C.
- All Annealings were performed under bias.

Table III. Electrical Characteristics of 54ACT244LMQB

PARAMETER	VCC	VIL	VIH	TESTS PERFORMED		PINS	LIMITS @ +25C	
				CONDITIONS	ALL I/O		VOL < 1.0V	VOH > 2.5V
FUNCT #1	4.5V	0.0V	4.5V	FREQ = 1.0MHZ	ALL I/O	ALL I/O	VOL < 1.0V	VOH > 2.5V
FUNCT #2	5.5V	0.0V	5.5V	FREQ = 1.0MHZ	ALL I/O	ALL I/O	VOL < 1.0V	VOH > 3.5V
V _{OH1}	4.5V	0.80V	2.00V	LOAD = -50UA	OUPS	OUPS	> 4.40V	< 5.50V
V _{OH2}	5.5V	0.80V	2.00V	LOAD = -50UA	OUPS	OUPS	> 5.40V	< 5.50V
V _{OH3}	4.5V	0.80V	2.00V	LOAD = -24MA	OUPS	OUPS	> 3.70V	< 5.50V
V _{OH4}	5.5V	0.80V	2.00V	LOAD = -24MA	OUPS	OUPS	> 4.70V	< 5.50V
V _{OH5}	5.5V	0.80V	2.00V	LOAD = -50MA	OUPS	OUPS	> 3.85V	< 5.50V
V _{OL1}	4.5V	0.80V	2.00V	LOAD = +50UA	OUPS	OUPS	> 0.00V	< 0.10V
V _{OL2}	5.5V	0.80V	2.00V	LOAD = +50UA	OUPS	OUPS	> 0.00V	< 0.10V
V _{OL3}	4.5V	0.80V	2.00V	LOAD = +24MA	OUPS	OUPS	> 0.00V	< 0.50V
V _{OL4}	5.5V	0.80V	2.00V	LOAD = +24MA	OUPS	OUPS	> 0.00V	< 0.50V
V _{OL5}	5.5V	0.80V	2.00V	LOAD = +50MA	OUPS	OUPS	> 0.00V	< 1.65V
I _{IH}	5.5V	0.00V	5.50V	VIN = 5.5V	INS	>	0.0UA	< +1.0UA
I _{IL}	5.5V	0.00V	5.50V	VIN = 0.0V	INS	>	-1.0UA	< 0.0UA
I _{OZH}	5.5V	0.00V	5.50V	VOUT = 5.5V	OUPS	>	0.0UA	< +10.0UA
I _{OZL}	5.5V	0.00V	5.50V	VOUT = 0.0V	OUPS	>	-10.0UA	< 0.0UA
I _{CC1}	5.5V	0.00V	5.50V		VCC	>	0.0UA	< 160.0UA
I _{CC2}	5.5V	0.00V	5.50V		VCC	>	0.0UA	< 160.0UA
I _{CC3}	5.5V	0.00V	5.50V		VCC	>	0.0UA	< 160.0UA
DLT _{ICG}	5.5V	0.00V	5.40V		VCC	>	0.0UA	< 1.60 MA

AC PARAMETRIC TESTS PROPAGATION DELAY TIMING

PARAMETER	VCC	VIL	VIH	PINS	LIMITS @25C	
					MIN	MAX
TPHL	4.5V	0.0V	4.5V	OUT	1.0NS	9.0NS
TPLH	4.5V	0.0V	4.5V	OUT	1.0NS	9.0NS
TPLZ	4.5V	0.0V	4.5V	OUT	1.0NS	9.5NS
TPZL	4.5V	0.0V	4.5V	OUT	1.0NS	9.0NS
TPHZ	4.5V	0.0V	4.5V	OUT	1.0NS	9.0NS
TPZH	4.5V	0.0V	4.5V	OUT	1.0NS	8.0NS

COMMENTS/EXCEPTIONS

- (1) THE FUNCTIONAL TESTS WERE PERFORMED WITH IOH = -24.0mA AND IOL = 24mA
- (2) VIL & VIH WERE TESTED DURING THE VOL & VOH TESTS AS GO/NO GO
- (3) AC PARAMETERS WERE TESTED.

TABLE IV: Summary of Electrical Measurements After
Total Dose Exposures and Annealing for 54ACT244LMQB 11/21

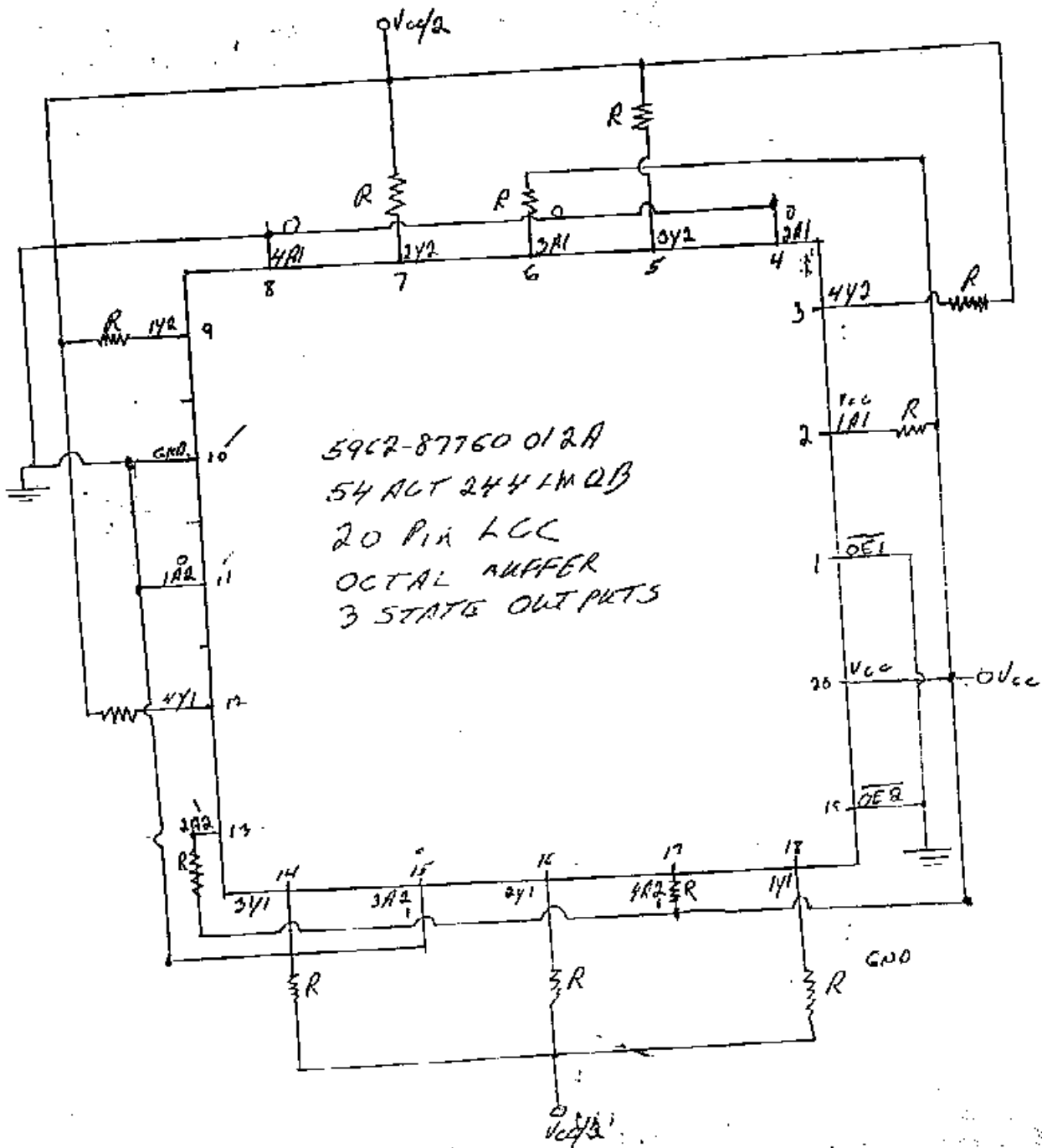
Parameter	Spec. Limits	min	max	Total Dose Exposure (TDE) (krads)										Anneal				Total Dose (krads)				Anneal	
				0		10		30		50		100		24 hours +25°C		168 hours +25°C		200		300		168 hours +100°C	
				mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd
FUNC1 @1MHz				P		P		P		P		P		P		P		P		P			
FUNC2 @1MHz				P		P		P		P		P		P		P		P		P			
VOB1	V	4.4	5.5	4.49	.0046	4.49	.0029	4.49	.0039	4.49	.0027	4.49	.0031	4.49	.0017	4.49	.0012	4.49	.0014	4.49	.0017	4.45	.1021
VOH2	V	5.4	6	5.49	.0031	5.49	.0033	5.49	.0033	5.49	.0029	5.49	.0048	5.49	.0017	5.49	.0001	5.49	.0012	5.49	.0001	4.90	1.30
VOH3	V	3.7	5.5	4.19	.0106	4.19	.0139	4.19	.0122	4.18	.0155	4.18	.0109	4.18	.0109	4.18	.0117	4.17	.0121	4.17	.0146	4.09	.1001
VCH4	V	4.7	5.5	5.23	.0089	5.22	.0128	5.22	.0116	5.22	.0140	5.22	.0094	5.22	.0094	5.22	.0111	5.21	.0103	5.21	.0119	4.92	1.04
VOH5	V	3.85	5.5	4.92	.0181	4.91	.0269	4.91	.0249	4.91	.0306	4.90	.0206	4.91	.0223	4.90	.0215	4.89	.0229	4.89	.0262	4.41	1.07
VOL1	V	0	0.1	0.00	-	0.00	-	0.00	-	0.00	-	0.00	-	0.00	-	0.00	-	0.00	-	0.00	-	0.00	-
VOL2	V	0	0.1	0.00	-	0.00	-	0.00	-	0.00	-	0.00	-	0.00	-	0.00	-	0.00	-	0.00	-	0.00	-
VOL3	V	0	0.5	0.20	.0081	0.21	.0169	0.20	.0110	0.20	.0138	0.20	.0086	0.20	.0089	0.20	.0102	0.20	.0107	0.20	.0117	0.23	.0311
VOL4	V	0	0.5	0.17	.0077	0.19	.0166	0.17	.0105	0.18	.0136	0.17	.0078	0.17	.0082	0.18	.0096	0.18	.0097	0.17	.0098	0.20	.0302
VOL5	V	0	1.65	0.37	.0168	0.40	.0382	0.37	.0223	0.38	.0286	0.37	.0168	0.37	.0177	0.38	.0206	0.38	.0210	0.37	.0218	0.44	.0926
I IH	nA	0	1000	1.90	7.83	0.19	1.19	0.19	1.19	0.55	2.69	0.00	-	0.00	-	0.00	-	0.00	-	0.00	-	0.00	-
I IL	nA	-1000	0	-1.23	4.67	0.00	-	0.00	-	0.00	-	0.00	-	0.00	-	0.00	-	0.00	-	0.00	-	0.00	-
IOZH	nA	0	10	0.01	18.4	3.05	19.5	5.95	33.3	10.3	50.0	22.9	87.8	18.7	76.2	15.7	68.5	76.5	180	514	1200	7.8	22.7
IOZL	nA	-10	0	0.00	-	0.00	-	0.00	-	0.00	-	0.00	-	0.00	-	0.00	-	0.00	-	0.00	-	0.00	-
ICCH	uA	0	160	0.00	-	0.43	0.23	4.44	1.14	4.30	1.65	4.28	1.59	2.38	0.64	1.49	0.35	8.06	6.35	51.36	106	0.00	-
ICCL	uA	0	160	0.00	-	0.00	-	0.39	0.16	1.41	0.62	1.98	0.73	0.86	0.30	1.80	0.11	6.35	7.43	39.58	71.7	0.00	-
ICCZ	uA	0	160	0.1	0.26	0.11	0.30	0.68	0.59	2.19	1.43	3.05	2.19	1.64	1.40	0.93	1.05	6.26	6.72	41.44	89.2	0.00	-
DLT_ICC	mA	0	1.6	0.3	0.13	0.26	0.13	0.25	0.12	0.24	0.12	0.23	0.12	0.22	0.12	0.22	0.12	0.20	0.11	0.21	0.12	0.17	0.09
TPHL	ns	0	9	6.49	0.34	7.51	0.29	7.50	0.30	7.57	0.32	7.53	0.33	7.60	0.32	7.64	0.33	7.70	0.40	7.80	0.47	54.82	207
TPLH	ns	0	9	5.06	0.27	5.18	0.27	5.12	0.25	5.16	0.24	5.15	0.25	5.14	0.23	5.24	0.26	5.22	0.26	5.22	0.32	5.32	0.74
TPLZ	ns	0	9.5	5.85	0.21	5.20	0.16	6.17	0.17	6.18	0.16	6.17	0.20	6.16	0.19	6.26	0.18	6.26	0.20	6.33	0.23	5.96	0.21
TPZL	ns	0	9	5.70	0.24	7.83	0.22	7.82	0.23	7.88	0.24	7.89	0.23	7.86	0.22	7.97	0.24	7.97	0.26	8.00	0.29	147	341
TPSZ	ns	0	9	3.79	0.28	4.58	0.28	4.52	0.28	4.53	0.29	4.48	0.29	4.48	0.29	4.53	0.31	4.49	0.32	4.51	0.32	421	486
TPZH	ns	0	8	7.21	0.23	7.51	0.25	7.50	0.28	7.59	0.29	7.57	0.20	7.64	0.21	7.75	0.25	7.82	0.25	7.89	0.26	238	416

Notes:

1/ The mean and standard deviation values were calculated over the eight parts irradiated in this testing. The control samples remained constant throughout the testing and are not included in this table.

2/ Table IV provides radiation characteristics of parts at selected total dose exposures and annealing treatments. The data at other radiation exposures and annealing treatments is available and can be obtained upon request.

Figure 1. Radiation Bias Circuit for 54ACT244LMQB



$R = 1k\ \text{ohm} \pm 5\%$, $1/4\ \text{W}$
 $V_{CC} = 5.0V \pm 10\%$, $V_{CC}/R = 2.5V \pm 10\%$
 $T_A = 25^\circ\text{C}$