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PPM-92-010

To  
T. Miccolis

Department  
Code 300.1

From  
K. Sahu KS

Department  
7809

Subject  
Radiation Report on 54ACT138LMQB  
SMEX Common Buy Part No. 5962-87554012A  
Control Number : 1940

Date  
January 6, 1991

Location  
Lanham

Telephone  
731-8954

Location  
Lanham

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A radiation evaluation was performed on 54ACT138LMQB 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, 40, 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). Parts were then annealed at +100°C for 168 hours. The dose rate was between 0.1 and 5.0 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 at +25°C according to the test conditions and the specification limits listed in Table III. These tests included two functional tests (at 1 MHz) after each radiation and annealing step.

All eight parts passed all tests on irradiation up to 300 krads and on subsequent high temperature annealing for 168 hours, without any significant degradation in any of the electrical parameters. Table IV provides the mean and standard deviation values for each parameter after different radiation exposures and annealing treatments. It also provides a summary of the 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:	54ACT138
SMEX Common Buy Part Number:	5962-87554012A
SMEX Common Buy Control Number:	1940
Charge Number:	C90363
Manufacturer:	National Semiconductor Corp.
Quantity Procured:	474
Lot Date Code:	8838
Quantity Tested:	10
Serial Numbers of Radiation Samples:	32, 33, 34, 35, 36, 37, 38, 39
Serial Numbers of Control Samples:	30, 31
Part Function:	1 to 8 Decoder
Part Technology:	CMOS
Package Style:	20-pin LCC
Test Engineer:	Ki Kim

TABLE II. Radiation Schedule

EVENTS	DATE
1) Initial (Pre-Irradiation) Electrical Measurements	07/25/91
2) 10-krad Irradiation @ 230 rads/hour Post-10-krad Electrical Measurement	11/27/91 11/29/91
3) 20-krad Irradiation @ 530 rads/hour Post-20-krad Electrical Measurement	11/29/91 11/30/91
*4) 40-krad Irradiation @ 450 rads/hour Post-40-krad Electrical Measurement	11/30/91 12/02/91
5) 50-krad Irradiation @ 500 rads/hour Post-50-krad Electrical Measurement	12/02/91 12/03/91
6) 75-krad Irradiation @ 1250 rads/hour Post-75-krad Electrical Measurement	12/03/91 12/04/91
7) 100-krad Irradiation @ 1250 rads/hour Post-100-krad Electrical Measurement	12/04/91 12/05/91
8) 24 Hours Annealing at +25°C Post-24-hours Electrical Measurement	12/05/91 12/06/91
9) 168 Hours Annealing at +25°C Post-168-hours Electrical Measurement	12/05/91 12/12/91
10) 200-krad Irradiation @ 5000 rads/hour Post-200-krad Electrical Measurements	12/12/91 12/13/91
11) 300-krad Irradiation 1470 rads/hour Post-300-krad Electrical Measurements	12/13/91 12/16/91
12) 168 Hours Annealing at +100°C Post-168 Hours at +100°C Electrical Measurements	12/16/91 12/23/91

\*Parts were scheduled to receive 30 krads; however, the dose rate was calculated erroneously and the parts received 40 krads instead.

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 54ACT138

FUNCTIONAL TESTS PERFORMED						
PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS AT +25C ONLY
FUNCT 1	4.5V	0.0V	4.5V	FREQ=1.000MHZ	ALL I/O	VOL < 1.5V / VDH > 1.5V
FUNCT 2	5.5V	0.0V	5.5V	FREQ=1.000MHZ	ALL I/O	VOL < 2.0V / VDH > 2.0V
				ICLH = -4.0mA		
				VREF = VCC * 0.5		
				ICL = 4.0mA		
DC PARAMETRIC TESTS PERFORMED						
PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS AT -55 TO 125
VOH1	4.5V	0.6V	2.0V	LOAD = -30.0UA	OUTS	> +4.4V / < +6.0V
VOH2	5.5V	0.6V	2.0V	LOAD = -30.0UA	OUTS	> +5.4V / < +6.0V
VOH3	4.5V	0.8V	2.0V	LOAD = -24.0MA	OUTS	> +3.7V / < +6.0V
VOH4	5.5V	0.8V	2.0V	LOAD = -24.0MA	OUTS	> +4.7V / < +6.0V
VOH5	5.5V	0.6V	2.0V	LOAD = -30.0MA	OUTS	> +3.85V / < +6.0V
VOL1	4.5V	0.6V	2.0V	LOAD = +50.0UA	OUTS	> +0.0V / < +0.1V
VOL2	5.5V	0.6V	2.0V	LOAD = +50.0UA	OUTS	> +0.0V / < +0.1V
VOL3	4.5V	0.8V	2.0V	LOAD = +24.0MA	OUTS	> +0.0V / < +0.5V
VOL4	5.5V	0.8V	2.0V	LOAD = +24.0MA	OUTS	> +0.0V / < +0.5V
VOL5	5.5V	0.6V	2.0V	LOAD = +50.0MA	OUTS	> +0.0V / < +1.65V
I <sub>IH</sub>	5.5V	0.0V	5.5V	V <sub>IN</sub> = 5.5V	INS	> +0.0UA / < +1.0UA
I <sub>IL</sub>	5.5V	0.0V	5.5V	V <sub>IN</sub> = 0.0V	INS	> -1.0UA / < +0.0UA
ICC1	5.5V	0.0V	5.5V	V <sub>IN</sub> = 5.5V	VCC	> +0.0A / < +160UA
ICCL1	5.5V	0.0V	5.5V	V <sub>IN</sub> = 0.0V	VCC	> +0.0A / < +160UA
ICC2	5.5V	0.4V	3.4V	V <sub>IN</sub> = 3.4V	VCC	> +0.0A / < +9.6MA
ICCL2	5.5V	0.4V	3.4V	V <sub>IN</sub> = 0.4V	VCC	> +0.0A / < +9.6MA
TIMING TESTS PERFORMED						
PARAMETER	VCC	VIL	VIH	CONDITIONS		LIMITS @ +25C
TPLH	4.5V	0.0V	3.0V	FRQ=1MHZ, RL=500 OHMS		> 1NS / < 11.0NS
TPHL	4.5V	0.0V	3.0V	FRQ=1MHZ, RL=500 OHMS		> 1NS / < 11.0NS
TPLH	4.5V	0.0V	3.0V	FRQ=1MHZ, RL=500 OHMS		> 1NS / < 12.0NS
TPHL	4.5V	0.0V	3.0V	FRQ=1MHZ, RL=500 OHMS		> 1NS / < 11.5NS
TPLH	4.5V	0.0V	3.0V	FRQ=1MHZ, RL=500 OHMS		> 1NS / < 12.0NS
TPHL	4.5V	0.0V	3.0V	FRQ=1MHZ, RL=500 OHMS		> 1NS / < 11.5NS
TPLH	4.5V	0.0V	3.0V	FRQ=1MHZ, RL=500 OHMS		> 1NS / < 12.5NS
TPHL	4.5V	0.0V	3.0V	FRQ=1MHZ, RL=500 OHMS		> 1NS / < 10.5NS
COMMENTS/EXCEPTIONS						
(1) VIL & VIH were tested during VOL & VOH tests as Go/NoGo.						
(2) FOR ICC2 TESTS, THE TOTAL LIMIT IS (1.6MA * 6) = 9.6MA						
(3) AC TESTS WERE PERFORMED WITH VMEASURE = VCC/2 PER SPECS.						

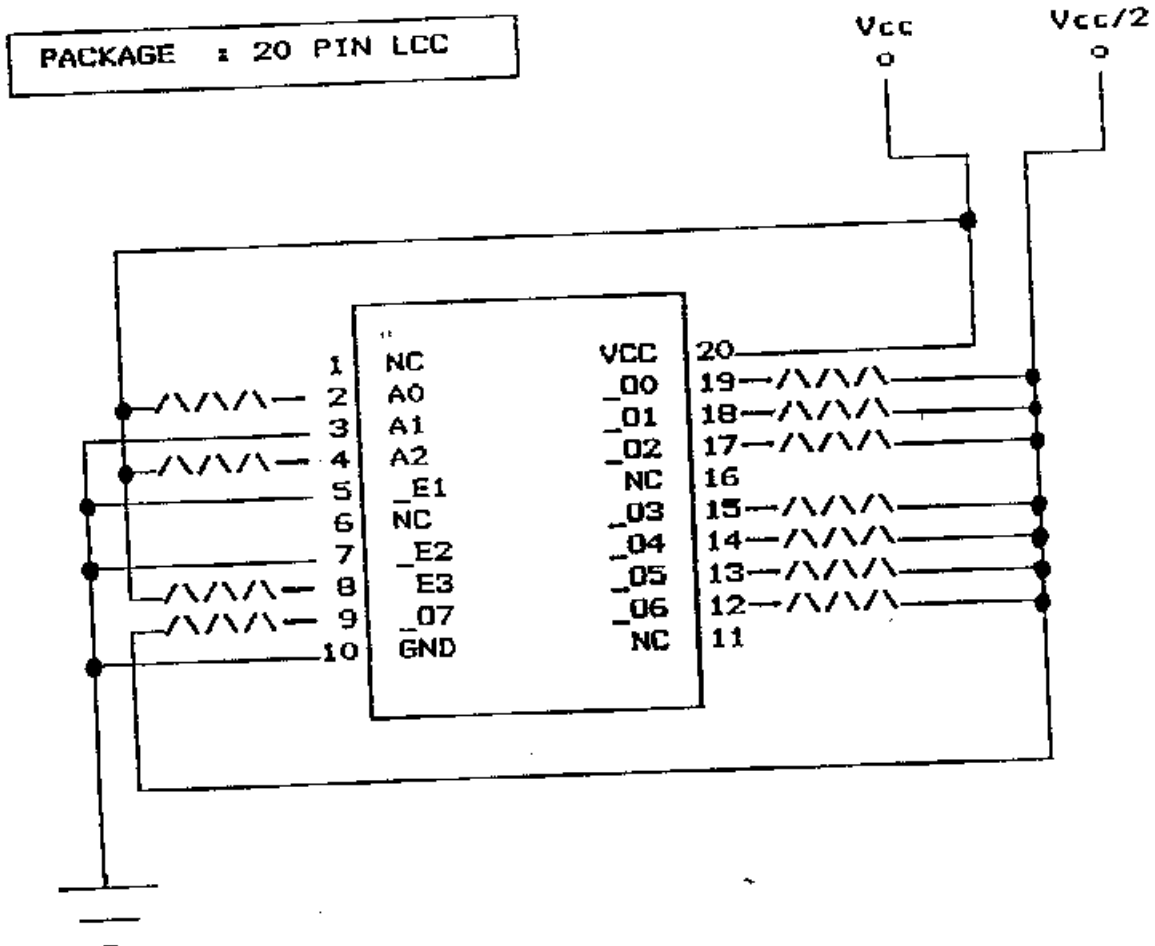
TABLE IV: Summary of Electrical Measurements  
after Total Dose Exposures and Annealing for 54ACT138 1/, 2/, 3/

Parameters	Spec. Limits min max		Pre-Rad mean sd		Total Dose Exposure (krads)						Anneal		Total Dose (krads)				Anneal		
					10		50		100		168 hrs @25°C		200		300		168 hrs @100°C		
					mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean
FUNC1 VCC=4.5V			Pass		Pass		Pass		Pass		Pass		Pass		Pass		Pass		
FUNC2 VCC=5.5V			Pass		Pass		Pass		Pass		Pass		Pass		Pass		Pass		
VOH1	V	4.4	6	4.49	0	4.49	0	4.49	0	4.49	0	4.49	0	4.49	0	4.49	0	4.49	0
VOH2	V	5.4	6	5.49	0	5.49	0	5.49	0	5.49	0	5.49	0	5.49	0	5.49	0	5.49	0
VOH3	V	3.7	6	4.20	.01	4.20	.02	4.20	.01	4.20	.01	4.20	.01	4.19	.01	4.18	.01	4.19	.01
VOH4	V	4.7	6	5.24	.01	5.24	.01	5.24	.01	5.24	.01	5.24	.01	5.23	.01	5.23	.01	5.23	.01
VOH5	V	3.85	6	4.95	.02	4.95	.03	4.95	.02	4.94	.03	4.94	.02	4.93	.02	4.92	.02	4.91	.02
VOL1	mV	0	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VOL2	mV	0	100	0	0	0	0	0	0	0.1	0.6	0	0	0	0	0	0	0	0
VOL3	mV	0	500	198	8	202	10	197	9	201	16	197	9	196	9	201	9	182	7
VOL4	mV	0	500	170	7	175	10	170	8	174	16	170	8	170	9	174	8	182	7
VOL5	mV	0	1650	365	16	375	20	365	17	373	32	364	18	365	18	372	18	385	15
I <sub>IH</sub>	nA	0	1000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
I <sub>IL</sub>	nA	-1000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ICCH1	uA	0	160	0	0	0	0	2.4	.01	2.1	.01	0	0	6.8	8.8	8.7	8.7	19	2.5
ICCL1	uA	0	160	0	0	0	0	2.4	.01	2.1	.01	0	0	6.7	8.7	7.3	9.5	4.2	7.3
ICCH2	mA	0	9.6	2.8	0.1	2.8	0.1	2.5	0.1	2.2	0.1	2.2	0.1	1.9	0.1	1.6	.08	1.6	.08
ICCL2	mA	0	9.6	0	0	0	0	0	.01	.01	.01	0	0	.07	.01	0.2	.04	.02	.01
TP <sub>LH</sub> _A	ns	1	11	6.2	0.5	6.2	0.5	6.6	0.7	6.6	0.7	6.6	0.7	6.5	0.7	7.5	0.7	8.2	0.8
TP <sub>HL</sub> _A	ns	1	11	6.2	0.7	7.2	0.8	7.6	0.8	7.7	0.8	7.8	0.8	7.9	0.9	9.1	1.0	9.2	0.8
TP <sub>LH</sub> _E1	ns	1	12	7.5	0.3	7.5	0.3	8.0	0.4	7.8	0.4	7.8	0.4	7.8	0.4	8.9	0.4	9.1	0.4
TP <sub>HL</sub> _E1	ns	1	11.5	6.3	0.3	7.3	0.3	7.8	0.4	7.8	0.5	7.8	0.5	7.9	0.5	9.0	0.5	9.4	0.4
TP <sub>LH</sub> _E2	ns	1	12	7.7	0.3	7.4	0.3	8.0	0.4	7.8	0.4	7.9	0.4	7.8	0.4	8.7	0.4	8.9	0.3
TP <sub>HL</sub> _E2	ns	1	11.5	6.5	0.3	7.0	0.4	8.0	0.4	7.9	0.5	7.9	0.4	8.1	0.5	8.8	0.5	9.2	0.4
TP <sub>LH</sub> _E3	ns	1	12.5	7.9	0.3	8.0	0.3	8.6	0.4	8.8	0.4	8.7	0.4	9.0	0.4	10.3	0.4	10.2	0.4
TP <sub>HL</sub> _E3	ns	1	10.5	5.5	0.3	6.0	0.3	6.5	0.4	6.5	0.4	6.5	0.4	6.4	0.5	7.5	0.4	8.3	0.4

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.
- 3/ SN 35 is not included in the final annealing data since reliable data was not obtained for this part at this step.

Figure 1. Radiation Bias Circuit for 54ACT138



1.  $V_{cc} = 5.0 \pm 0.5$  Volts
2.  $V_{cc}/2 = 2.5 \pm 0.25$  Volts
3. All Resistors are 1k Ohms, 1/4 watts