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Interoffice Memorandum

To
T. Miccolis
Department
Code 300.1
From
K. Sahu KS
Department
7809
Subject
Radiation Report on 54AC153LMQB
SMEX Common Buy Part No. 5962-87625012A
Control Number : 1396

PPM-91-762
Date
December 31, 1991
Location
Lanham
Telephone
731-8954
Location
Lanham
cc
B. Fafaul/311
A. Sharma/311
D. Krus
J. Stubblefield
A. Moor

A radiation evaluation was performed on 54AC153LMQB 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 krad^s. After 100 krad^s, parts were annealed at +25°C for 24 and 168 hours, and then irradiation was continued to 200 and 300 krad^s (cumulative). Parts were then annealed at +100°C for 168 hours. The dose rate was between 0.5 and 5.0 krad^s/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 a total of two functional tests (at 1 MHz) after each radiation and annealing step.

All eight parts passed both functional tests to 300 krad^s and on subsequent high temperature annealing. After the first radiation exposure to 10 krad^s, all parts exceeded the maximum specification limit of 80uA for ICCH and ICCL. ICCH readings ranged from 140uA to 600uA and ICCL readings ranged from 160uA to 670uA. All parts passed all other tests. At 20 krad^s, average ICCH/L readings decreased although all parts continued to exceed the specification limit for these parameters. The maximum ICCH and ICCL readings were 252uA and 278uA, respectively. At 30 and 50 krad^s, average ICCH and ICCL readings decreased slightly and one part passed these tests at 50 krad^s. At 75 krad^s, there was a significant decrease in ICCH/L, as all parts passed all tests. Parts continued to pass all tests throughout the rest of the radiation testing to 300 krad^s and on subsequent high temperature annealing for 168 hours. Tables IV provides the mean and standard deviation values for each parameter after different

radiation 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.

*In this report, the term "rads" is used as an abbreviation for rads (Si).

TABLE I. Part Information

Generic Part Number:	54AC153
SMEX Common Buy Part Number:	5962-87625012A
SMEX Common Buy Control Number:	1396
Charge Number:	C90349
Manufacturer:	National Semiconductor Corp.
Quantity Procured:	100
Lot Date Code:	8812A
Quantity Tested:	10
Serial Numbers of Radiation Samples:	203, 204, 205, 206, 207, 208, 209, 210
Serial Numbers of Control Samples:	201, 202
Part Function:	Dual 4-input MUX
Part Technology:	CMOS
Package Style:	20-pin LCC

TABLE II. Radiation Schedule for 54AC153LMQB

EVENTS	DATE
1) Initial (Pre-Irradiation) Electrical Measurements	07/25/91
2) 10- KRAD IRRADIATION (0.5 krads/hour) POST-10-KRAD ELECTRICAL MEASUREMENT	11/19/91 11/20/91
3) 20-KRAD IRRADIATION (0.5 krads/hour) POST-20-KRAD ELECTRICAL MEASUREMENT	11/20/91 11/21/91
4) 30-KRAD IRRADIATION (0.5 krads/hour) POST-30-KRAD ELECTRICAL MEASUREMENT	11/21/91 11/22/91
5) 50-KRAD IRRADIATION (1.2 krads/hour) POST-50-KRAD ELECTRICAL MEASUREMENT	11/22/91 11/23/91
6) 75-KRAD IRRADIATION (0.6 krads/hour) POST-75-KRAD ELECTRICAL MEASUREMENT	11/23/91 11/25/91
7) 100-KRAD IRRADIATION (1.3 KRADS/HOUR) POST-100-KRAD ELECTRICAL MEASUREMENT	11/25/91 11/26/91
8) 24 HOURS ANNEALING AT +25°C POST-24-HOURS ELECTRICAL MEASUREMENT	11/26/91 11/27/91
9) 168 HOURS ANNEALING AT +25°C POST-168-HOURS ELECTRICAL MEASUREMENT	11/27/91 12/03/91
10) 200-KRAD IRRADIATION (5.0 KRADS/HOUR) POST-200-KRAD ELECTRICAL MEASUREMENTS	12/03/91 12/04/91
11) 300-KRAD IRRADIATION (5.0 KRADS/HOUR) POST-300-KRAD ELECTRICAL MEASUREMENTS	12/04/91 12/05/91
12) 168 HOURS ANNEALING AT +100°C POST-168 HOURS AT +100°C ELECTRICAL MEASUREMENTS	12/05/91 12/13/91

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 54AC153LMQB

TESTS PERFORMED						
PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS @ -55C TO +125C
FUNCT #1	3.0V	0.0V	3.0V	FREQ = 1MHz I _{OH} = -4.0mA VREF = 1.5V I _{OL} = 4.0mA Load <=	ALL I/O	VOL < 1.50V / VDH > 1.50V
FUNCT #2	5.5V	0.0V	5.5V	FREQ = 1MHz I _{OH} = -24.0mA VREF = 1.5V I _{OL} = 24.0mA Load <=	ALL I/O	VOL < 2.75V / VDH > 2.75V
PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS @ -55C TO +125C
V _{OH1}	3.0V	0.00V	2.10V	LOAD = -30uA	JUTS	> 2.90V / < 5.50V
V _{OH2}	4.5V	1.35V	3.15V	LOAD = -30uA	OUTS	> 4.40V / < 5.50V
V _{OH3}	5.5V	1.65V	3.85V	LOAD = -30uA	OUTS	> 5.40V / < 5.50V
V _{OH4}	3.0V	0.90V	2.10V	LOAD = -4mA	OUTS	> 2.40V / < 5.50V
V _{OH5}	4.5V	1.35V	3.15V	LOAD = -4mA	OUTS	> 3.70V / < 5.50V
V _{OH6}	5.5V	1.65V	3.85V	LOAD = -4mA	OUTS	> 4.70V / < 5.50V
V _{OH7}	3.0V	1.65V	3.85V	LOAD = -50mA	OUTS	> 3.35V / < 5.50V
PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS @ -55C TO +125C
V _{OL1}	3.0V	0.00V	2.10V	LOAD = +30uA	OUTS	> 0.00V / < 0.10V
V _{OL2}	4.5V	1.35V	3.15V	LOAD = +30uA	OUTS	> 0.00V / < 0.10V
V _{OL3}	5.5V	1.65V	3.85V	LOAD = +30uA	OUTS	> 0.00V / < 0.10V
V _{OL4}	3.0V	0.90V	2.10V	LOAD = +12mA	JUTS	> 0.00V / < 0.50V
V _{OL5}	4.5V	1.35V	3.15V	LOAD = +24mA	OUTS	> 0.00V / < 0.50V
V _{OL6}	5.5V	1.65V	3.85V	LOAD = +24mA	OUTS	> 0.00V / < 0.50V
V _{OL7}	3.0V	1.65V	3.85V	LOAD = +50mA	OUTS	> 0.00V / < 1.65V
PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS @ -55C TO +125C
I _{IH}	5.5V	0.00V	5.50V	V _{IN} = 5.5V	INS	> 0.00A / < +1.00A
I _{IL}	5.5V	0.00V	5.50V	V _{IN} = 0.0V	INS	> -1.00A / < 0.00A
PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS @ -55C TO +125C
I _{CC1}	5.5V	0.00V	5.50V		VCC	> 0.00A / < 80.00A
I _{CC2}	5.5V	ALL INPUTS AT 0.00V			VCC	> 0.00A / < 80.00A
AC PARAMETRIC TESTS PERFORMED						
PARAMETER	VCC	VIL	VIH	FREQUENCY	PINS	LIMITS AT +25C ONLY
TPLH1	4.5V	0.0V	4.5V	1.0 MHz	In TO OUTS	> 1.0ns / < 9.0ns
TPHL1	4.5V	0.0V	4.5V	1.0 MHz	In TO OUTS	> 1.0ns / < 8.5ns
TPLH2	4.5V	0.0V	4.5V	1.0 MHz	S _n TO OUTS	> 1.0ns / < 11.0ns
TPHL2	4.5V	0.0V	4.5V	1.0 MHz	S _n TO OUTS	> 1.0ns / < 11.0ns
TPLH3	4.5V	0.0V	4.5V	1.0 MHz	E _n TO OUTS	> 1.0ns / < 9.5ns
TPHL3	4.5V	0.0V	4.5V	1.0 MHz	E _n TO OUTS	> 1.0ns / < 8.0ns
PARAMETER	VCC	VIL	VIH	FREQUENCY	PINS	LIMITS AT -55C TO +125C
TPLH1	4.5V	0.0V	4.5V	1.0 MHz	In TO OUTS	> 1.0ns / < 11.5ns
TPHL1	4.5V	0.0V	4.5V	1.0 MHz	In TO OUTS	> 1.0ns / < 10.5ns
TPLH2	4.5V	0.0V	4.5V	1.0 MHz	S _n TO OUTS	> 1.0ns / < 14.0ns
TPHL2	4.5V	0.0V	4.5V	1.0 MHz	S _n TO OUTS	> 1.0ns / < 13.5ns
TPLH3	4.5V	0.0V	4.5V	1.0 MHz	E _n TO OUTS	> 1.0ns / < 12.5ns
TPHL3	4.5V	0.0V	4.5V	1.0 MHz	E _n TO OUTS	> 1.0ns / < 10.0ns
COMMENTS/EXCEPTIONS						
(1) VIL & VIH WERE TESTED DURING THE VOL & VDH TESTS AS GO/NO GO						
(2) C _{in} and C _{pd} tests are not performed.						
(3) This program detects improper DUT insertion.						

TABLE IV: Summary of Electrical Measurements After
Total Dose Exposures and Annealing for 54AC153LMQB 1/2/

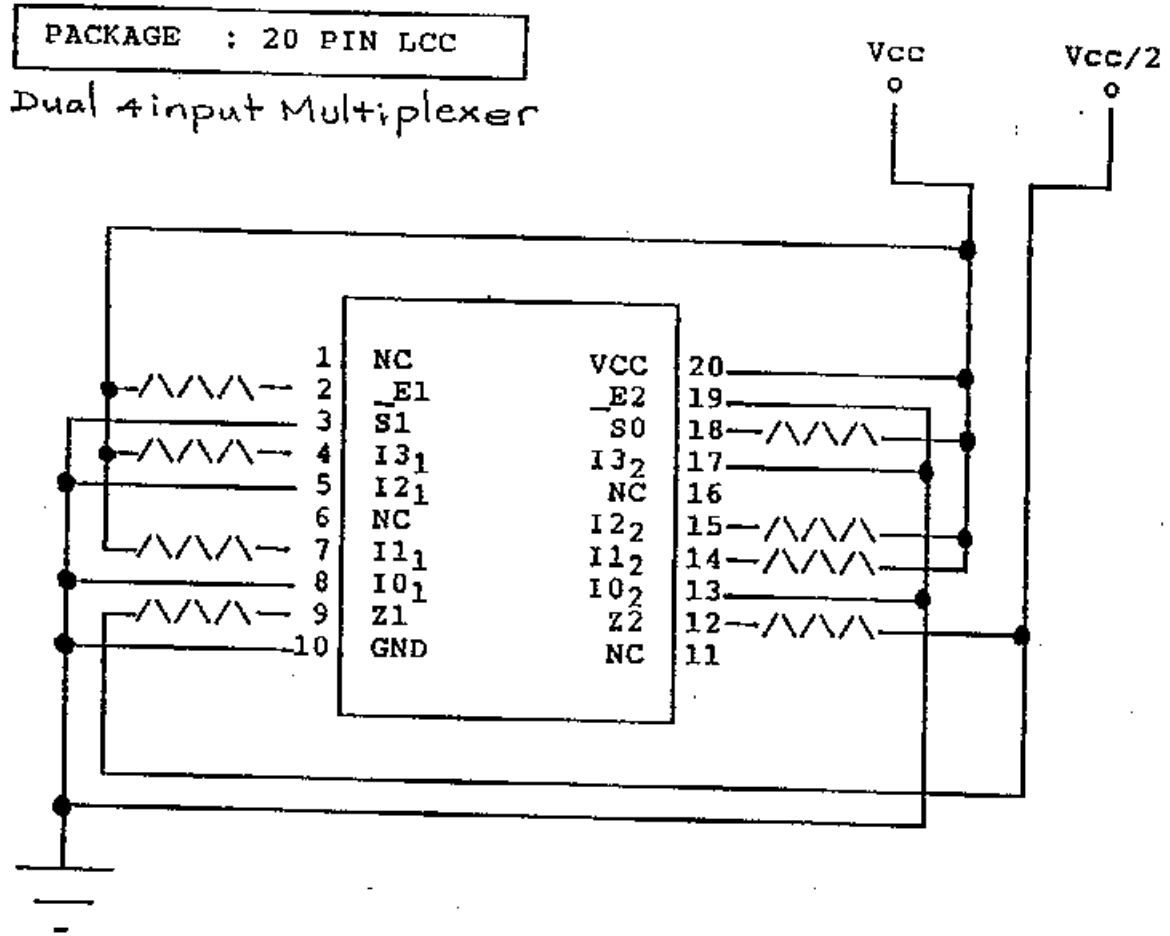
Parameter	Spec. Limits	min	max	Total Dose Exposure (TDE) (krads)										Anneal		Total Dose (krads)				Anneal		
				0 (Pre-Rad)		10		30		50		100		168 hours +25°C		200		300		168 hours +100°C		
				mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	
FUNC1 @1MHz				Pass		Pass		Pass		Pass		Pass		Pass		Pass		Pass		Pass		
FUNC2 @1MHz				Pass		Pass		Pass		Pass		Pass		Pass		Pass		Pass		Pass		
VOH1 V	2.9	5.5	2.99	0.00	2.99	0.00	2.99	0.00	2.99	0.00	2.99	0.00	2.99	0.00	2.99	0.00	2.99	0.00	2.99	0.00	2.99	0.00
VOH2 V	4.4	5.5	4.49	0.01	4.49	0.00	4.49	0.00	4.49	0.00	4.49	0.00	4.49	0.00	4.49	0.00	4.49	0.00	4.49	0.00	4.49	0.00
VOH3 V	5.4	5.5	5.49	0.01	5.49	0.00	5.49	0.00	5.49	0.00	5.49	0.00	5.49	0.00	5.49	0.00	5.49	0.00	5.49	0.00	5.49	0.00
VOH4 V	2.4	5.5	2.92	0.01	2.92	0.01	2.92	0.00	2.92	0.00	2.92	0.00	2.92	0.00	2.92	0.00	2.92	0.01	2.91	0.00	2.91	0.00
VOH5 V	3.7	5.5	4.16	0.03	4.16	0.01	4.16	0.01	4.15	0.02	4.15	0.01	4.15	0.01	4.15	0.01	4.15	0.01	4.14	0.01	4.14	0.01
VOH6 V	4.7	5.5	5.19	0.03	5.20	0.01	5.19	0.01	5.19	0.02	5.20	0.01	5.20	0.01	5.19	0.01	5.19	0.01	5.19	0.01	5.19	0.01
VOH7 V	3.85	5.5	4.83	0.11	4.85	0.03	4.85	0.03	4.84	0.04	4.85	0.02	4.85	0.01	4.84	0.03	4.83	0.02	4.84	0.02	4.84	0.02
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	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	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
VOL3 V	0	0.1	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
VOL4 V	0	0.5	0.15	0.02	0.14	0.01	0.14	0.01	0.14	0.01	0.14	0.00	0.14	0.00	0.14	0.00	0.14	0.00	0.14	0.00	0.15	0.02
VOL5 V	0	0.5	0.22	0.03	0.20	0.01	0.20	0.01	0.20	0.02	0.19	0.00	0.20	0.00	0.20	0.01	0.19	0.00	0.21	0.02	0.21	0.02
VOL6 V	0	0.5	0.19	0.03	0.18	0.01	0.18	0.01	0.18	0.02	0.17	0.00	0.17	0.00	0.17	0.01	0.17	0.00	0.18	0.01	0.18	0.01
VOL7 V	0	1.65	0.40	0.06	0.38	0.03	0.38	0.03	0.38	0.04	0.36	0.01	0.37	0.01	0.37	0.02	0.37	0.01	0.39	0.02	0.39	0.02
I IH nA	0	1000	5.81	10.1	0.34	1.48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
I IL nA	-1000	0	-6.22	11.0	-0.21	1.17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ICCH uA	0	80	0.03	0.07	350.7	141	128.2	30.6	125.4	40.3	52.19	5.97	16.66	0.62	28.66	6.51	25.55	2.35	18.46	1.78	18.46	1.78
ICCL uA	0	80	0.03	0.07	389.3	157	142.1	34.8	143.7	47.9	58.79	7.41	14.48	0.52	29.94	7.81	27.24	3.28	18.69	2.04	18.69	2.04
TPH1 ns	1	9	6.99	0.17	6.69	0.11	6.71	0.11	6.63	0.10	6.68	0.11	7.39	0.12	7.36	0.11	7.44	0.15	7.62	0.31	7.62	0.31
TPHL1 ns	1	8.5	5.30	0.19	5.97	0.07	6.01	0.07	5.93	0.08	6.00	0.06	6.21	0.12	6.21	0.11	6.27	0.10	6.51	0.34	6.51	0.34
TPH2 ns	1	11	8.55	0.12	8.35	0.14	8.32	0.13	8.32	0.15	8.28	0.20	8.52	0.16	8.48	0.15	8.29	0.18	9.13	0.33	9.13	0.33
TPHL2 ns	1	11	7.06	0.32	7.73	0.25	8.10	0.28	8.17	0.27	8.21	0.28	8.40	0.33	8.45	0.32	8.48	0.24	8.62	0.53	8.62	0.53
TPH3 ns	1	9.5	7.50	0.13	7.70	0.14	7.72	0.14	8.03	0.33	8.04	0.13	8.01	0.13	8.04	0.13	8.19	0.14	8.35	0.48	8.35	0.48
TPHL3 ns	1	8	5.57	0.12	6.18	0.15	6.06	0.16	6.10	0.19	6.07	0.30	6.08	0.14	6.04	0.16	5.93	0.32	6.45	0.19	6.45	0.19

Notes:

1/ The mean and standard deviation values were calculated over the eight parts irradiated in this testing. However, SNS 207 and 209 are not included in the 10-krad statistics and SN 207 is not included in the 50-krad statistics due to testing problems with these parts at these steps. 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 54AC153



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