PPM 92-062

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UNISYS

Interoffice Memorandum

PPM-92-062

To
T. Miccolis

Department
Code 300.1

From
K. Sahu KS

Department
7809

Subject
Radiation Report on 54AC540LMQB
SMEX Part No. 5962-87695012A
Control No. 1405

Date
February 14, 1992

Location
Lanham

Telephone
731-8954

Location
Lanham

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A radiation evaluation was performed on the 54AC540LMQB 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, the parts were annealed under bias at 25°C for 168 hours. After this annealing, the parts were irradiated to 200 and 300 krads (cumulative). Finally, the parts were annealed under bias for 168 hours at 100°C. The dose rate was between 200 and 5,160 rads/hour, depending on the total dose level (see Table II for radiation schedule). After each radiation exposure and annealing treatment, the 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 parts passed both functional tests on irradiation up to 300 krads and on subsequent annealing treatment under bias for 168 hours at 100°C. Also, all parts stayed within the specification limits for all parameters on irradiation up to 10 krads. However, at 20 krads, four parts exceeded the maximum specification limits of 160 uA for ICCH and ICCL with readings as high as 1.8 mA. In addition, two of these parts marginally exceeded the same specification limit for ICCZ and marginally exceeded the IOZH specification limit of 10 uA. Upon further irradiation to 50 krads, five parts were exceeding the limits for these same parameters. The ICCH and ICCL readings increased to a maximum of 15 mA. The ICCZ readings approached 5 mA and IOZH readings were as high as 900 uA. After further irradiation to 100 krads, six parts were exceeding the limits for these same parameters as they continued to degrade. The ICCH readings reached 34 mA. In addition, five parts were marginally exceeding the specification limits for TPZH. After 168 hours of annealing at 25°C, the parts recovered slightly. However, six parts continued to fail one or more of the above tests. On continued irradiation to 200 krads, seven parts exceeded the specification limits for ICC and IOZ tests and one part did not meet the specification limits for VOH1 and VOH4. At 300 krads, more VOH failures were observed and all parts exceeded the

specification limits on various tests. However, after annealing the parts for 168 hours at 100°C, no VOH failures were observed, average ICC readings decreased significantly as only two parts exceeded the specification limit for the ICC and IOZ tests. Table IV provides the mean and standard deviation values for each parameter after each radiation exposure and annealing treatment. 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.

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

TABLE I. Part Information

Generic Part Number:	54AC540LMQB
SMEX Common Buy Part Number:	5962-87695012A
SMEX Common Buy Control Number:	1405
Charge Number:	C90352
Manufacturer:	National Semiconductor Corp.
Lot Date Code:	9040A
Quantity Tested:	8
Serial Numbers of Radiation Samples:	663, 664, 665, 666, 667, 668, 669, 670
Serial Number of Control Sample:	661, 662
Part Function:	OCTAL BUFFER LINE DRIVER
Part Technology:	CMOS
Package Style:	20-pin LCC

TABLE II. Radiation Schedule for 54AC540LMQB

EVENTS	DATE
1) Initial (Pre-Irradiation) Electrical Measurements	10/24/91
2) 10 KRAD IRRADIATION (500 rads/hour)	12/05/91
POST 10 KRAD ELECTRICAL MEASUREMENT	12/06/91
3) 20 KRAD IRRADIATION (500 rads/hour)	12/06/91
POST 20 KRAD ELECTRICAL MEASUREMENT	12/07/91
4) 30 KRAD IRRADIATION (210 rads/hour)	12/07/91
POST 30 KRAD ELECTRICAL MEASUREMENT	12/09/91
5) 50 KRAD IRRADIATION (950 rads/hour)	12/09/91
POST 50 KRAD ELECTRICAL MEASUREMENT	12/10/91
6) 75 KRAD IRRADIATION (1,220 rads/hour)	12/10/91
POST 75 KRAD ELECTRICAL MEASUREMENT	12/11/91
7) 100 KRAD IRRADIATION (1,250 rads/hour)	12/11/91
POST 100 KRAD ELECTRICAL MEASUREMENT	12/12/91
8) 24 HOURS ANNEALING AT 25°C	12/12/91
POST 24 HOURS ELECTRICAL MEASUREMENT	12/13/91
9) 168 HOURS ANNEALING AT 25°C	12/12/91
POST 168 HOURS ELECTRICAL MEASUREMENT	12/19/91
10) 200 KRAD IRRADIATION (5,130 rads/hour)	12/19/91
POST 200 KRAD ELECTRICAL MEASUREMENT	12/20/91
11) 300 KRAD IRRADIATION (5,160 rads/hour)	12/20/91
POST 300 KRAD ELECTRICAL MEASUREMENT	12/23/91
12) 168 HOURS ANNEALING AT +100°C	12/23/91
POST ANNEALING ELECTRICAL MEASUREMENTS	12/30/91

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 Annealing steps were performed under bias except as noted.

Table III. Electrical Characteristics of 54AC540LMQB

FUNCTIONAL TESTS PERFORMED

PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS @ +25C
FUNCT #1	3.0V	0.0V	3.0V	FREQ = 1MHz	ALL I/O	VOL<1.00V ; VOH>2.00V
FUNCT #2	5.5V	0.0V	5.5V	FREQ = 1MHz	ALL I/O	VOL<1.00V ; VOH>3.00V

LOAD USED <= { IOH =-5.0mA, VREF= 1.5V, IOL =+5.0mA }

DC PARAMETRIC TESTS PERFORMED

PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS @ +25C
VOH1	3.0V	0.90V	2.10V	LOAD = -50UA	OUTS	>2.90V ; <5.50V
VOH2	4.5V	1.35V	3.15V	LOAD = -50UA	OUTS	>4.40V ; <5.50V
VOH3	5.5V	1.65V	3.85V	LOAD = -50UA	OUTS	>5.40V ; <5.50V
VOH4	3.0V	0.90V	2.10V	LOAD = -4MA	OUTS	>2.40V ; <5.50V
VOH5	4.5V	1.35V	3.15V	LOAD = -24MA	OUTS	>3.70V ; <5.50V
VOH6	5.5V	1.65V	3.85V	LOAD = -24MA	OUTS	>4.70V ; <5.50V
VOH7	5.5V	1.65V	3.85V	LOAD = -50MA	OUTS	>3.85V ; <5.50V

PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS @ +25C
VOL1	3.0V	0.90V	2.10V	LOAD = +50UA	OUTS	>0.00V ; <0.10V
VOL2	4.5V	1.35V	3.15V	LOAD = +50UA	OUTS	>0.00V ; <0.10V
VOL3	5.5V	1.65V	3.85V	LOAD = +50UA	OUTS	>0.00V ; <0.10V
VOL4	3.0V	0.90V	2.10V	LOAD = +12MA	OUTS	>0.00V ; <0.50V
VOL5	4.5V	1.35V	3.15V	LOAD = +24MA	OUTS	>0.00V ; <0.50V
VOL6	5.5V	1.65V	3.85V	LOAD = +24MA	OUTS	>0.00V ; <0.50V
VOL7	5.5V	1.65V	3.85V	LOAD = +50MA	OUTS	>0.00V ; <1.65V

PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS @ +25C
IIH	5.5V	0.00V	5.50V	VIN = 5.5V	INS	> 0.00UA ; <+1.00UA
IIL	5.5V	0.00V	5.50V	VIN = 0.0V	INS	> -1.00UA ; < 0.00UA
IOZH	5.5V	0.00V	5.50V	VOUT = 5.5V	OUTS	> 0.00UA ; <+10.00UA
IOZL	5.5V	0.00V	5.50V	VOUT = 0.0V	OUTS	> -10.00UA ; < 0.00UA
ICCH	5.5V	0.00V	5.50V	VIN = 0.0V	VCC	> 0.00A ; <160.00UA
ICCL	5.5V	0.00V	5.50V	VIN = 5.5V	VCC	> 0.00A ; <160.00UA
ICCZ	5.5V	0.00V	5.50V	VIN = 5.5V	VCC	> 0.00A ; <160.00UA

AC PARAMETRIC TESTS PERFORMED

PARAMETER	VCC	VIL	VIH	PINS	LIMITS 25C	
TPHL_DQ	4.5V	0.0V	4.5V	DN TO QN	> 1.0NS	< 5.5NS
TPLH_DQ	4.5V	0.0V	4.5V	DN TO QN	> 1.0NS	< 6.0NS
TPZH_EQ	4.5V	0.0V	4.5V	OE TO QN	> 1.0NS	< 8.5NS
TPZL_EQ	4.5V	0.0V	4.5V	OE TO QN	> 1.0NS	< 7.5NS
TPHZ_EQ	4.5V	0.0V	4.5V	OE TO QN	> 1.0NS	<10.5NS
TPLZ_EQ	4.5V	0.0V	4.5V	OE TO QN	> 1.0NS	< 8.0NS

COMMENTS/EXCEPTIONS

(1) VIL & VIH WERE TESTED DURING THE VOL & VOH TESTS AS GO/NO GO.
(2) THIS PROGRAM CHECKS FOR PROPER OUT ORIENTATION.
(3) AC PARAMETERS ARE TESTED AT 4.5V ONLY

TABLE IV: Summary of Electrical Measurements After Total Dose Exposures and Annealing for 54AC540LMQB 1/ 2/

		Spec Limits		Total Dose Exposure (TDE) (krads)												Anneal		TDE (krads)				Anneal	
				0 (Pre-Rad)		10		20		30		50		100		168 hrs @ 25°C		200		300		168 hrs @ 100°C	
Parameters		min	max	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd
FUNC1 @ 1 MHz				Pass		Pass		Pass		Pass		Pass		Pass		Pass		Pass		Pass		Pass	
FUNC2 @ 1 MHz				Pass		Pass		Pass		Pass		Pass		Pass		Pass		Pass		Pass		Pass	
VOH1_3.0V	V	2.9	5.5	2.99	0	2.99	0	2.99	0	2.99	0	2.99	0	2.98	0.01	2.99	0.01	2.86	0.34	2.35	0.65	2.99	0
VOH2_4.5V	V	4.4	5.5	4.49	0	4.49	0	4.49	0	4.49	0	4.49	0	4.48	0.01	4.48	0.01	4.47	0.02	3.86	0.63	4.49	0
VOH3_5.5V	V	5.4	5.5	5.49	0	5.49	0	5.49	0	5.49	0	5.49	0.01	5.48	0.01	5.48	0.01	5.47	0.02	4.92	0.65	5.49	0
VOH4_3.0V	V	2.4	5.5	2.93	0	2.93	0	2.93	0	2.93	0	2.93	0.01	2.92	0.01	2.92	0.01	2.77	0.39	2.18	0.72	2.92	0
VOH5_4.5V	V	3.7	5.5	4.20	0.01	4.20	0.01	4.20	0.01	4.20	0.01	4.19	0.01	4.18	0.01	4.18	0.01	4.16	0.02	3.52	0.95	4.17	0.01
VOH6_5.5V	V	4.7	5.5	5.23	0.01	5.23	0.01	5.23	0.01	5.23	0.01	5.23	0.01	5.21	0.01	5.22	0.01	5.20	0.02	4.52	0.73	5.21	0.01
VOH7_5.5V	V	3.85	5.5	4.94	0.01	4.93	0.01	4.93	0.01	4.93	0.01	4.93	0.01	4.90	0.02	4.90	0.02	4.87	0.03	4.32	0.92	4.89	0.02
VOL1_3.0V	V	0	0.10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VOL2_4.5V	V	0	0.10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VOL3_5.5V	V	0	0.10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VOL4_3.0V	V	0	0.50	0.12	0	0.12	0	0.12	0	0.12	0	0.12	0	0.12	0	0.12	0	0.11	0	0.12	0.01	0.13	0.01
VOL5_4.5V	V	0	0.50	0.17	0	0.17	0.01	0.17	0.01	0.17	0.01	0.17	0.01	0.17	0.01	0.17	0.01	0.17	0.01	0.17	0.01	0.18	0.02
VOL6_5.5V	V	0	0.50	0.15	0	0.15	0	0.15	0.01	0.15	0.01	0.15	0.01	0.15	0.01	0.15	0.01	0.15	0.01	0.16	0.01	0.16	0.01
VOL7_5.5V	V	0	1.65	0.33	0.01	0.33	0.01	0.33	0.01	0.32	0.01	0.32	0.01	0.33	0.01	0.33	0.01	0.33	0.01	0.33	0.01	0.34	0.03
IIH	uA	0	1.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
IIL	uA	-1.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
IOZH	uA	0	10	0.01	0.03	0.01	0.04	2.04	7.20	22.75	66.1	147.2	312.0	549.1	951.0	444.9	806.0	1144	1875	1802	2666	10.42	51.47
IOZL	uA	-10	0	0	0	0	0	-0.01	0.02	-33.30	77.7	-0.08	0.12	-0.04	0.08	-0.07	0.11	-0.01	0.15	-0.10	0.22	0.01	0.03
ICCH	uA	0	160	0.10	0.14	18.41	30.18	451.5	602.2	1426	1569	5297	5014	14738	12673	10758	10013	24716	21080	36586	26873	539.8	973.6
ICCL	uA	0	160	0.05	0.13	18.09	30.04	408.2	554.6	1186	1320	3895	3556	10052	8497	6960	6565	15410	13501	22286	15638	435.8	894.5
ICCZ	uA	0	160	0.04	0.10	4.25	6.62	106.1	158.8	374.2	452.7	1671	1646	5432	4677	3677	3532	9356	8460	11042	10788	197.8	439.9

TABLE IV (Continued): Summary of Electrical Measurements After Total Dose Exposures and Annealing for 54AC540LMQB 1/ 2/

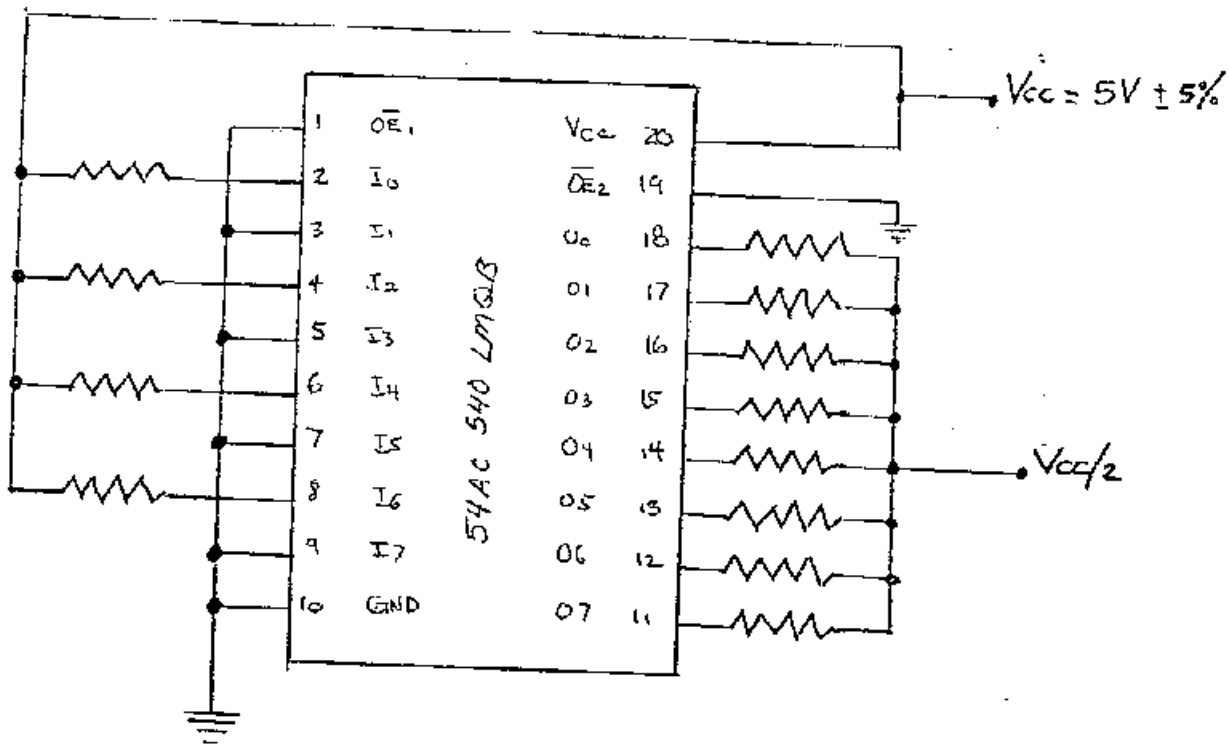
Parameters		Spec Limits min	Spec Limits max	Total Dose Exposure (TDE) (krads) 0 (Pre-Rad) mean	0 (Pre-Rad) sd	10 mean	10 sd	20 mean	20 sd	30 mean	30 sd	50 mean	50 sd	100 mean	100 sd	Anneal 168 hrs @ 25°C mean	Anneal 168 hrs @ 25°C sd	TDE (krads) 200 mean	200 sd	300 mean	300 sd	Anneal 168 hrs @ 100°C mean	Anneal 168 hrs @ 100°C sd
TPHL_DQ	nS	1.0	5.5	4.77	0.36	4.93	0.40	4.80	0.42	4.82	0.42	4.79	0.43	4.69	0.39	5.71	0.48	5.38	0.50	5.07	0.54	5.31	0.47
TPLH_DQ	nS	1.0	6.0	4.36	0.60	4.13	0.41	4.14	0.41	4.15	0.42	4.20	0.43	4.23	0.47	5.15	0.67	5.26	0.74	5.32	0.81	5.55	0.54
TPZH_EQ	nS	1.0	8.5	6.32	0.14	6.12	0.14	6.14	0.27	6.49	0.64	7.11	0.87	7.24	0.90	8.21	0.92	8.45	0.94	8.45	0.94	7.96	0.39
TPZL_EQ	nS	1.0	7.5	6.84	0.20	6.72	0.20	6.66	0.21	6.70	0.23	6.71	0.23	6.70	0.28	7.60	0.36	7.56	0.54	7.73	0.19	7.69	0.28
TPHZ_EQ	nS	1.0	10.5	4.84	1.00	4.41	0.77	4.41	0.82	4.38	0.82	4.34	0.80	4.21	0.73	5.23	0.90	5.02	0.88	4.74	0.87	5.70	1.05
TPLZ_EQ	nS	1.0	8.0	4.95	0.14	5.60	0.13	5.52	0.13	5.54	0.12	5.55	0.13	5.51	0.15	6.41	0.14	6.29	0.18	6.31	0.20	6.00	0.17

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/ Post 75 krads and post 24 hour annealing measurements at 25°C are not included in Table IV. This data is available upon request.

Figure 1. Radiation Bias Circuit for 54AC540LMQB



ALL RESISTORS ARE 1KΩ 5% ¼ W