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PPM-92-004

To
T. Miccolis
Department
Code 300.1
From
K. Sahu KS.
Department
7809
Subject
Radiation Report on 54AC374DMQB
SMEX Common Buy Part No. 5962-8769401RA
Control Number: 1660

Date
January 16, 1992
Location
Lanham
Telephone
731-8954
Location
Lanham
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B. Fafaul/311
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~~XXXXXXXXXX~~

A radiation evaluation was performed on 54AC374 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 V 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 allowed to anneal under bias at +25°C for 48 and 168 hours, and then the parts were further irradiated to 200 and 300 krads (cumulative). The parts were finally annealed under bias at +100°C for 168 hours. 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 five functional tests (four at 1MHz and one at 40MHz) after each radiation and annealing step.

All eight parts passed initial (pre-irradiation) electrical measurements and all tests after the first irradiation exposure to 10 krads. At 20 krads, five parts exceeded the maximum specification limit of 160uA for ICCH, ICCL and ICCZ. Readings for ICCH, ICCL and ICCZ ranged from 16uA to 1.1mA, 24uA to 942uA and 11uA to 600uA, respectively. At 30 krads, all eight parts were exceeding the specification limits for ICCH, ICCL and/or ICCZ; however, all parts continued to pass all other tests. The same failures were observed on continued exposure to 50, 75 and 100 krads, and no significant decrease in average ICC readings was observed on annealing the parts at 25°C for 48 and 168 hours.

At 200 and 300 krads, five parts failed functional tests #1, #2 and #3, and all eight parts failed functional test #5. Also, parts exceeded the 16mA measurement limit of the test equipment for the ICC tests and some VOH failures were observed. On annealing the parts for 168 hours at 100°C, all parts recovered

to pass functional test #5, fewer parts failed functional tests #2 and #3 and no VOH failures were observed; however, all parts continued to fail the ICC tests. Table IV provides the mean and standard deviation values for each parameter after each radiation exposure and annealing treatment. Table V 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:	54AC374
SMEX Common Buy Part Number:	5962-8769401RA
SMEX Common Buy Control Number:	1660
Charge Number:	C90360
Manufacturer:	National Semiconductor Corp.
Lot Date Code:	9036A
Quantity Tested:	10
Serial Numbers of Radiation Samples:	60, 61, 62, 63, 64, 65, 66, 67
Serial Numbers of Control Samples:	58, 59
Part Function:	Octal D Flip-Flop with Tri-state
Part Technology:	CMOS
Package Style:	20-pin DIP
Test Engineer:	A. Karygiannis

TABLE II. Radiation Schedule

EVENTS	DATE
1) Initial Electrical Measurements	09/04/91
2) 10 krads irradiation @ 570 rads/hr	11/22/91
Post 10 krads Electrical Measurements	11/23/91
3) 20 krads irradiation @ 530 rads/hr	11/29/91*
Post 20 krads Electrical Measurements	11/30/91
4) 30 krads irradiation @ 500 rads/hr	11/30/91
Post 30 krads Electrical Measurements	12/02/91
5) 50 krads irradiation @ 1000 rads/hr	12/04/91
Post 50 krads Electrical Measurements	12/05/91
6) 75 krads irradiation @ 1250 rads/hr	12/05/91
Post 75 krads Electrical Measurements	12/06/91
7) 100 krads irradiation @ 1250 rads/hr	12/06/91
Post 100 krads Electrical Measurements	12/07/91
8) 48 hrs annealing at 25°C	12/07/91
Post 48 hr Electrical Measurements	12/09/91
9) 168 hrs annealing at 25°C	12/07/91
Post 168 hr Electrical Measurements	12/17/91
10) 200 krads irradiation @ 5400 rads/hr	12/17/91
Post 200 krads Electrical Measurements	12/18/91
11) 300 krads irradiation @ 6000 rads/hr	12/18/91
Post 300 krads Electrical Measurements	12/19/91
12) 168 hrs annealing at 100°C	12/19/91
Post 168 hr Electrical Measurements	12/26/91

Notes:

*Parts underwent an unscheduled annealing from 11/23/91 to 11/29/91 due to test equipment problems.

- 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 performed under bias.

Table III. Electrical Characteristics of 54AC374

FUNCTIONAL TESTS PERFORMED						
PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS AT +25C ONLY
FUNCT 1	5.0V	0.0V	4.5V	FREQ=1.000MHZ	ALL I/O	VOL<1.5V / VOH>1.5V
FUNCT 2	5.0V	0.0V	5.0V	FREQ=1.000MHZ	ALL I/O	VOL<2.5V / VOH>2.5V
FUNCT 3	5.5V	0.0V	5.5V	FREQ=1.000MHZ	ALL I/O	VOL<2.5V / VOH>2.5V
FUNCT 4	5.5V	0.0V	5.5V	FREQ=40.000MHZ	ALL I/O	VOL<2.5V / VOH>2.5V
FUNCT 5	5.5V	0.0V	5.5V	FREQ=40.000MHZ	ALL I/O	VOL<2.5V / VOH>2.5V
LOAD USED <= I _{QH} = -6.0mA V _{REF} = 1.5V I _{OL} = +6.0mA						
DC PARAMETRIC TESTS PERFORMED						
PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS AT +25C ONLY
VOH1	5.0V	0.9V	2.1V	LOAD=-50UA	OUTS	>+2.9V / <+3.0V
VOH2	5.0V	0.9V	2.1V	LOAD=-04MA	OUTS	>+2.4V / <+3.0V
VOH3	4.5V	1.35V	3.15V	LOAD=-50UA	OUTS	>+4.4V / <+4.5V
VOH4	4.5V	1.35V	3.15V	LOAD=-24MA	OUTS	>+3.7V / <+4.5V
VOH5	5.5V	1.65V	3.85V	LOAD=-50UA	OUTS	>+5.4V / <+5.5V
VOH6	5.5V	1.65V	3.85V	LOAD=-24MA	OUTS	>+4.7V / <+5.5V
VOH7	5.5V	1.65V	3.85V	LOAD=-50MA	OUTS	>+3.85V / <+5.5V
VOL1	5.0V	0.9V	2.1V	LOAD=+50UA	OUTS	>+0.0V / <+0.1V
VOL2	5.0V	0.9V	2.1V	LOAD=+12MA	OUTS	>+0.0V / <+0.5V
VOL3	4.5V	1.35V	3.15V	LOAD=+50UA	OUTS	>+0.0V / <+0.1V
VOL4	4.5V	1.35V	3.15V	LOAD=+24MA	OUTS	>+0.0V / <+0.5V
VOL5	5.5V	1.65V	3.85V	LOAD=+50UA	OUTS	>+0.0V / <+0.1V
VOL6	5.5V	1.65V	3.85V	LOAD=+24MA	OUTS	>+0.0V / <+0.5V
VOL7	5.5V	1.65V	3.85V	LOAD=+50MA	OUTS	>+0.0V / <+1.65V
I _{IH}	5.5V	0.0V	5.5V	V _{IN} = 5.5V	INS	>+0.0UA / <+1.0UA
I _{IL}	5.5V	0.0V	5.5V	V _{IN} = 0.0V	INS	>-1.0UA / <+0.0UA
I _{OZH}	5.5V	0.0V	5.5V	V _{IN} = 5.5V	INS	>+0.0UA / <+10UA
I _{OZL}	5.5V	0.0V	5.5V	V _{IN} = 5.5V	INS	>-10UA / <+0UA
I _{CCH}	5.5V	0.0V	5.5V	V _{IN} = 5.5V	VCC	>+0.0UA / <+160UA
I _{CCL}	5.5V	0.0V	5.5V	V _{IN} = 0.0V	VCC	>+0.0UA / <+160UA
I _{CCZ}	5.5V	0.0V	5.5V	V _{IN} = 0.0V	VCC	>+0.0UA / <+160UA
AC PARAMETRIC TESTS PERFORMED						
PARAMETER	VCC	VIL	VIH	DESCRIPTION	PINS	LIMITS AT +25C ONLY
T _{PLH}	4.5V	0.0V	4.5V	CLK TO Q	OUTS	>+1.0NS / <+ 9.5NS
T _{PHL}	4.5V	0.0V	4.5V	CLK TO Q	OUTS	>+1.0NS / <+ 9.0NS
T _{PLZ}	4.5V	0.0V	4.5V	EN TO Q	HIZ OUTS	>+1.0NS / <+ 8.0NS
T _{PHZ}	4.5V	0.0V	4.5V	EN TO Q	HIZ OUTS	>+1.0NS / <+10.5NS
T _{PZL}	4.5V	0.0V	4.5V	EN TO Q	LO OUTS	>+1.0NS / <+8.5NS
T _{PZH}	4.5V	0.0V	4.5V	EN TO Q	HI OUTS	>+1.0NS / <+9.0NS
T _{s(H)}	4.5V	0.0V	4.5V	DN TO CP	HI OUTS	=+4.0NS
T _{s(L)}	4.5V	0.0V	4.5V	ON TO CP	LO OUTS	=+4.0NS
T _{n(H)}	4.5V	0.0V	4.5V	DN TO CP	HI OUTS	=+1.5NS
T _{n(L)}	4.5V	0.0V	4.5V	ON TO CP	LO OUTS	=+1.5NS
T _{w(H)}	4.5V	0.0V	4.5V	PULSE WIDTH	HI OUTS	=+5.0NS
T _{w(L)}	4.5V	0.0V	4.5V	PULSE WIDTH	LO OUTS	=+5.0NS
T _{n(L)}	4.5V	0.0V	4.5V	DN TO CP	LO OUTS	=+1.5NS
COMMENTS/EXCEPTIONS						
(1) VIL & VIH were tested during VOL & VOH tests as Go/NoGo.						
(2) AC PARAMETRICS TESTED AT 4.5V ONLY.						
(3) INPUT SET AND HOLD, PULSE WIDTH PERFORMED AS GO/NOGO IN FUNCTIONAL #4						
(4) MAXIMUM FREQUENCY PERFORMED AT 40MHZ (TOP S50 SPEED) AS GO/NOGO IN FUNCTIONAL #5.						

TABLE IV: Summary of Electrical Measurements
after Total Dose Exposures and Annealing for 54AC374

1/, 2/, 3/

Parameters		Spec. Limits min max		Total Dose Exposure (krads)														
				Pre-Rad		10		20		30		50		75		100		
				mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	
VOH1	V	2.9	3.0	2.99	0	3.00	0	3.00	0	2.99	0	2.99	.01	2.99	.01	2.99	.01	
VOH2	V	2.4	3.0	2.92	0	2.93	0	2.93	0	2.92	0	2.92	0	2.92	.01	2.92	0	
VOH3	V	4.4	4.5	4.49	0	4.49	0	4.49	0	4.49	0	4.49	0	4.49	0	4.49	0	
VOH4	V	3.7	4.5	4.15	.03	4.17	.01	4.17	.01	4.16	.01	4.16	.01	4.16	.01	4.15	.01	
VOH5	V	5.4	5.5	5.49	0	5.49	0	5.49	0	5.49	0	5.49	0	5.49	0	5.49	0	
VOH6	V	4.7	5.5	5.19	.03	5.20	.01	5.20	.01	5.20	.01	5.20	.01	5.20	.01	5.19	.01	
VOH7	V	3.85	5.5	4.84	.04	4.87	.02	4.87	.02	4.86	.02	4.86	.01	4.85	.01	4.85	.02	
VOL1	mV	0	100	0	0	0	0	0	0	0	0	0	0	0.6	1.6	0	0	
VOL2	mV	0	500	146	9	140	7	139	6	140	8	138	6	138	6	135	5	
VOL3	mV	0	100	0	0	0	0	0	0	1.4	3.7	0.7	1.5	3.3	2.9	0.5	1.3	
VOL4	mV	0	500	214	16	204	12	204	10	208	15	205	9	204	8	204	8	
VOL5	mV	0	100	3.0	2.4	0.3	1.1	0	0	3.9	7	3.6	2.6	6.5	3.1	3.1	2.6	
VOL6	mV	0	500	191	16	180	12	181	10	187	17	182	9	183	8	183	8	
VOL7	mV	0	1650	406	36	384	28	384	20	394	32	386	17	384	16	386	15	
I IH	uA	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
I IL	uA	-1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
I OZH	uA	0	10	0	.01	0	0	.15	1.1	9.5	31.9	54.8	0.2	113	353	54.7	171	
I OZL	uA	-10	0	0	0	0	0	-.02	.14	0.7	2.4	-6	19	-16	51	-4.2	15	
I CCH	uA	0	160	.02	.02	28.7	32.5	497	410	1.9E3	1.3E3	7.9E3	3.8E3	>16E3	-	4.6E3	3.1E3	
I CCL	uA	0	160	0	.01	47.8	57.6	485	362	2.0E3	1.4E3	8.1E3	4.3E3	>16E3	-	5.2E3	3.8E3	
I CCZ	uA	0	160	0	0	21.6	25.7	284	225	1.7E3	1.2E3	8.1E3	4.1E3	>16E3	-	5.8E3	4.2E3	
T PLH	3/	ns	1	9.5	7.9	0.2	8.8	0.3	8.8	0.3	9.0	0.2	8.8	0.2	9.4	0.2	8.7	0.3
T PHL	3/	ns	1	9.0	7.1	0.4	8.2	0.3	8.2	0.3	8.4	0.3	8.3	0.3	9.0	0.3	8.2	0.3
T PLZ	3/	ns	1	8.0	6.6	0.1	5.8	0.3	5.8	0.3	5.8	0.3	5.9	0.2	6.6	0.2	5.8	0.3
T PHZ	3/	ns	1	10.5	7.4	0.6	6.9	0.5	7.1	0.5	7.1	0.5	7.3	0.5	8.2	0.5	7.1	0.5
T PZL	3/	ns	1	8.5	4.8	0.2	4.9	0.1	5.0	0.1	5.7	0.1	5.7	0.1	6.5	0.1	5.8	0.1
T PZH	3/	ns	1	9.0	7.6	0.5	8.5	0.9	8.7	0.9	8.1	0.7	8.2	0.6	9.3	0.5	8.3	0.7

<Table IV continued on next page>

Table IV. (continued)

Parameters		Spec. Limits min max		Pre-Rad mean sd		Anneal @25°C				TDE (krads)				Anneal 100°C	
						48 hrs		168 hrs		200		300		168 hrs	
						mean	sd	mean	sd	mean	sd	mean	sd	mean	sd
VOH1	V	2.9	3.0	2.99	0	2.99	.01	2.99	.01	2.80	0.7	2.57	1.0	2.99	.01
VOH2	V	2.4	3.0	2.92	0	2.92	0	2.92	0	2.91	.01	2.50	1.0	2.91	.01
VOH3	V	4.4	4.5	4.49	0	4.49	0	4.49	0	4.49	.01	4.48	.01	4.49	.01
VOH4	V	3.7	4.5	4.15	.03	4.15	.01	4.16	.01	4.14	.01	4.13	.02	4.14	.01
VOH5	V	5.4	5.5	5.49	0	5.49	0	5.49	0	5.48	.01	5.46	.01	5.49	.01
VOH6	V	4.7	5.5	5.19	.03	5.19	.01	5.20	.01	5.18	.01	5.18	.01	5.19	.01
VOH7	V	3.85	5.5	4.84	.04	4.85	.02	4.86	.01	4.83	.02	4.82	.02	4.84	.01
VOL1	mV	0	100	0	0	0	0	0	0	5.3	3.4	7.4	3.5	1.5	2.3
VOL2	mV	0	500	146	9	135	6	134	5	138	6	138	7	133	6
VOL3	mV	0	100	0	0	0.6	1.4	0.5	1.4	9.2	3.8	12	4	4.3	4.1
VOL4	mV	0	500	214	16	204	11	200	8	208	9	210	10	202	8
VOL5	mV	0	100	3.0	2.4	3.1	2.8	3.5	2.8	12.5	3.9	15	4	7.4	4.1
VOL6	mV	0	500	191	16	183	10	179	8	189	10	192	10	183	8
VOL7	mV	0	1650	405	36	386	21	379	15	391	17	395	18	382	16
I _{IH}	uA	0	1	0	0	0	0	0	0	0	0	0	.03	0	0
I _{IL}	uA	-1	0	0	0	0	0	0	0	0	0	0	0	0	0
IOZH	uA	0	10	0	.01	52	164	50	156	262	813	324	1000	179	560
IOZL	uA	-10	0	0	0	-3.8	13	-3.2	12	-38	112	-45	129	-10	43
ICCH	uA	0	160	.02	.02	4.3E3	2.9E3	3.9E3	2.7E3	>16E3	-	>16E3	-	>16E3	-
ICCL	uA	0	160	0	.01	4.9E3	3.6E3	4.5E3	3.4E3	>16E3	-	>16E3	-	>16E3	-
IC CZ	uA	0	160	0	0	5.4E3	4.0E3	5.0E3	3.8E3	>16E3	-	>16E3	-	>16E3	-
TPLH	3/	ns	1 9.5	7.9	0.2	8.7	0.2	10.5	0.2	10.2	0.2	10.0	0.2	10.4	0.3
TPHL	3/	ns	1 9.0	7.1	0.4	8.2	0.3	10.0	0.3	9.9	0.3	9.8	0.3	10.1	0.3
TPLZ	3/	ns	1 8.0	6.6	0.1	5.8	0.2	7.5	0.2	7.6	0.2	7.6	0.2	7.7	0.3
TPHZ	3/	ns	1 10.5	7.4	0.6	7.2	0.5	9.0	0.4	9.2	0.6	9.3	0.7	9.1	0.5
TPZL	3/	ns	1 8.5	4.8	0.2	5.7	0.1	7.5	0.1	7.4	0.1	7.4	0.1	7.2	0.2
TPZH	3/	ns	1 9.0	7.6	0.5	8.3	0.6	10.6	0.5	10.2	0.5	10.3	0.5	10.9	0.7

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/ '>16E3' indicates that some or all of the parts were exceeding 16mA, the upper measurement limit of the test equipment.

3/ AC timing measurements throughout the testing were affected by calibration problems with the S-50. The average readings in this table overestimate, by 2ns to 3ns, the actual timing characteristics of the parts and are not indicative of AC failures.

TABLE V: Summary of Functional Test Results
after Total Dose Exposures and Annealing for 54AC374 1/

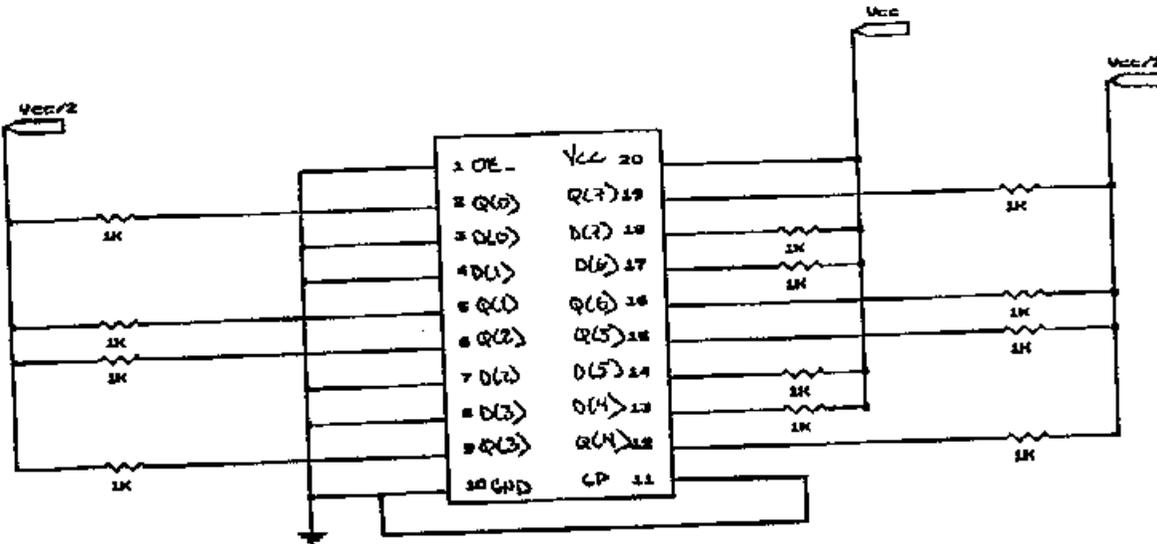
Func. Test	Freq. (MHz)	Pre-Rad	Total Dose Exposure TDE (krads)						Annealing at 25°C	
			10	20	30	50	75	100	48 hrs	168 hrs
1	1.0	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
2	1.0	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
3	1.0	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
4	1.0	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
5	40.0	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	7P/1F

Func. Test	Freq. (MHz)	TDE (krads)		Annealing at 100°C
		200	300	168 hrs
1	1.0	3P/5F	3P/5F	3P/5F
2	1.0	3P/5F	3P/5F	6P/2F
3	1.0	3P/5F	3P/5F	7P/1F
4	1.0	Pass	Pass	Pass
5	40.0	Fail	Fail	Pass

Note:

1/ See Table III for functional test conditions.

Figure 1. Radiation Bias Circuit for 54AC374



$V_{cc} = 5.0$ volts $\pm .2$ volts
 $V_{cc}/2 = 2.5$ volts $\pm .25$ volts
 ALL RESISTORS ARE 1/4 WATT