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At 200 and 300 krads, most parts had ICCH/L values above 15mA, which is the upper limit that the test equipment could measure. In addition, VOH failures were observed on some parts. Upon annealing the parts for 168 hours at 100°C, one part, SN 216, recovered to pass all tests, and average ICCH/L readings decreased to 2mA. 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:	54ACT74
SMEX Common Buy Part Number:	5962-87525012A
SMEX Common Buy Control Number:	2303
Charge Number:	C90275
Manufacturer:	National Semiconductor Corp.
Quantity Procured:	100
Lot Date Code:	9030A
Quantity Tested:	10
Serial Numbers of Radiation Samples:	213, 214, 215, 216, 217, 218, 219, 220
Serial Numbers of Control Samples:	211, 212
Part Function:	Dual D-type positive edge triggered Flip-Flop
Part Technology:	CMOS
Package Style:	20-pin LCC
Test Engineer:	R. Tosh

TABLE II. Radiation Schedule

EVENTS	DATE
1) Initial Electrical Measurements	07/25/91
2) 10 krads irradiation @ 530 rads/hr Post 10 krads Electrical Measurements	11/08/91 11/09/91
3) 20 krads irradiation @ 500 rads/hr Post 20 krads Electrical Measurements	11/11/91 11/12/91
4) 30 krads irradiation @ 1110 rads/hr Post 30 krads Electrical Measurements	11/13/91 11/14/91
5) 50 krads irradiation @ 1110 rads/hr Post 50 krads Electrical Measurements	11/14/91 11/15/91
6) 75 krads irradiation @ 1250 rads/hr Post 75 krads Electrical Measurements	11/15/91 11/16/91
7) 100 krads irradiation @ 570 rads/hr Post 100 krads Electrical Measurements	11/16/91 11/18/91
8) 24 hrs annealing at 25°C Post 24 hr Electrical Measurements	11/18/91 11/19/91
9) 168 hrs annealing at 25°C Post 168 hr Electrical Measurements	11/18/91 11/25/91
10) 200 krads irradiation @ 5260 rads/hr Post 200 krads Electrical Measurements	11/25/91 11/26/91
11) 300 krads irradiation @ 5400 rads/hr Post 300 krads Electrical Measurements	11/26/91 11/27/91
12) 168 hrs annealing at 100°C Post 168 hr Electrical Measurements	11/27/91 12/05/91

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 performed under bias.

Table III. Electrical Characteristics of 54ACT74 1,2,3

Tests Performed						
Parameter	VCC	VIL	VIH	Conditions	Pins	Limits -55°C to 125°C
Funct #1	4.5V	0.0V	4.5V	Freq = 1MHz	All I/O	VOL<2.25V , VOH>2.25V
Funct #2	5.5V	0.0V	5.5V	Freq = 1MHz	All I/O	VOL<2.75V , VOH>2.75V
VOH1	4.5V	0.8V	2.0V	Load = -50uA	Outs	>4.4V , <4.5V
VOH2	4.5V	0.8V	2.0V	Load = -24mA	Outs	>3.7V , <4.5V
VOH3	5.5V	0.8V	2.0V	Load = -50mA	Outs	>3.85V , <5.5V
VOL1	4.5V	0.8V	2.0V	Load = +50uA	Outs	>0.0V , <0.1V
VOL2	4.5V	0.8V	2.0V	Load = +24mA	Outs	>0.0V , <0.5V
VOL3	5.5V	0.8V	2.0V	Load = +50mA	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
DICC	5.5V	0.0V	3.4V	V <sub>IN</sub> = 3.4V	VCC	>0A , < 1.6mA
ICCH	5.5V	0.0V	5.5V	V <sub>IN</sub> = 5.5V	VCC	>0A , < 80uA
ICCL	5.5V	0.0V	5.5V	V <sub>IN</sub> = 0.0V	VCC	>0A , < 80uA
Timing Tests Performed						
Parameter	VCC	VIL	VIH	Conditions	Limits at 25°C	
TPLH CP->Q,Q <sub>̄</sub>	4.5V	0.0V	4.5V	Freq=1MHz, RL=500 Ohms	>1ns , <11ns	
TPHL CP->Q,Q <sub>̄</sub>	4.5V	0.0V	4.5V	Freq=1MHz, RL=500 Ohms	>1ns , <10ns	
Comments/Exceptions						
1) Functional tests performed with output loading of IOH=-2.0mA, IOL=2.0mA.						
2) VIL & VIH were tested during VOL & VOH tests as GO/NOGO.						
3) AC tests were performed with VMEASURE = VCC/2 per specs.						

TABLE IV: Summary of Electrical Measurements  
after Total Dose Exposures and Annealing for 54ACT74

1/ 2/

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		
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 4.5	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 3.7 4.5	4.16	.01	4.16	.01	4.15	.02	4.15	.02	4.15	.01	4.15	.01	4.14	.01	4.14	.01
VOH3	V 3.85 5.5	4.86	.02	4.86	.02	4.85	.03	4.84	.03	4.84	.02	4.85	.02	4.84	.02	4.84	.02
VOL1	mV 0 100	0	0	0	0	0	0	0	0	0	0	0.2	0.9	0.2	1.0	0.2	1.0
VOL2	mV 0 500	195	8	202	6	204	12	204	12	202	9	197	6	199	6.5	199	6.5
VOL3	mV 0 1650	374	10	377	12	381	26	381	25	375	15	368	12	371	13	371	13
IIH	nA 0 1000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
IIL	nA -1000 0	0	0	-0.09	0.7	0	0	0	0	0	0	0	0	0	0	0	0
DICC	mA 0 1.6	0.5	0.1	0.5	0.1	0.5	0.1	0.8	0.4	2.3	0.4	5.1	3.5	7.3	4.8	7.3	4.8
ICCH	mA 0 .08	0	0	.01	.004	.12	.14	.55	.57	2.9	1.0	6.1	4.3	8.1	5.2	8.1	5.2
ICCL	mA 0 .08	0	0	.004	.002	.06	.07	.27	.34	1.8	0.7	4.4	3.3	6.7	4.6	6.7	4.6
TPLE	ns 1 11	6.9	1.4	6.9	1.4	6.8	1.4	6.9	1.4	6.9	1.4	6.9	1.4	7.0	1.4	7.0	1.4
TFHL	ns 1 10	7.4	1.1	7.4	1.1	7.3	1.1	7.3	1.1	7.3	1.1	7.3	1.1	7.3	1.1	7.4	1.2

<Table IV continued on next page>

Table IV. (continued)

Parameters	Spec. Limits min max	Pre-Rad		Anneal @25°C				TDE (krads)				Anneal 100°C	
		mean	sd	24 hrs		168 hrs		200		300		168 hrs	
				mean	sd	mean	sd	mean	sd	mean	sd	mean	sd
Func1 @VCC=4.5V		Pass		Pass		Pass		Pass		Pass		Pass	
Func2 @VCC=5.5V		Pass		Pass		Pass		Pass		Pass		Pass	
VOH1	V 4.4 4.5	4.49	0	4.49	0	4.49	0	4.48	.01	4.48	.01	4.49	0
VOH2	V 3.7 4.5	4.16	.01	4.14	.02	4.14	.01	4.12	.02	4.12	.02	4.14	.01
VOH3	V 3.85 5.5	4.86	.02	4.83	.04	4.84	.03	3.88	1.5	3.56	1.9	4.82	.02
VOL1	mV 0 100	0	0	0.2	1.0	0.2	0.9	4.3	5.0	4.9	4.6	0	0
VOL2	mV 0 500	195	8	207	20	201	10	203	9.3	201	8.4	195	8
VOL3	mV 0 1650	374	10	385	37	376	20	378	18	376	16	367	16
I <sub>IH</sub>	nA 0 1000	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
DICC	mA 0 1.6	0.5	0.1	7.0	4.6	5.8	4.0	>15		>15		2.1	1.7
ICCH	mA 0 .08	0	0	8.0	5.5	6.6	4.8	>15		>15		2.1	2.0
ICCL	mA 0 .08	0	0	6.4	4.5	5.3	3.9	>15		>15		1.8	1.7
TPLH	ns 1 11	6.9	1.4	6.9	1.4	7.0	1.4	7.1	1.4	7.2	1.4	7.8	1.4
TPHL	ns 1 10	7.4	1.1	7.3	1.2	7.4	1.2	7.5	1.4	7.6	1.4	7.5	1.4

## 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/ '>15' indicates that some or all parts were exceeding 15mA for ICC, the upper limit that the test equipment could measure.

