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UNISYS

Interoffice Memorandum

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To: T. Miccolis

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Department Code 300.1

Location Lanham

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Location Lanham

Subject: Radiation Report on 54AC00
SMEX Common Buy Part No. 5962-8754901CA

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A radiation evaluation was performed on 54AC00 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, parts were annealed at 25°C for 24 and 168 hours, and then the irradiation was continued to 160 and 260 krads (cumulative). The dose rate was between 0.25 - 5 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 according to the test conditions and the specification limits listed in Table III. These tests include a functional test (10 MHz) at 5.5V.

All parts passed all tests on initial measurements as well as on irradiation up to 10 krads. However, after 20, 30, 50, 75, and 100 krad exposures, parts showed increasing degradation in I_{CCL} and I_{CCH} . After 100 krads, readings for these parameters were approximately 4 mA against the specification limit of 80 uA. However, all parts passed functionally and stayed within the specification limit for all other parameters on exposures up to 100 krads. No significant recovery was observed on annealing for 24 and 168 hours. On continued exposures to 160 and 260 krads, parts showed increasing degradation in I_{CCL} and I_{CCH} . However, parts passed functionally and stayed within the specification limits for all other 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 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 1. Part Information

Generic Part Number:	54AC00
SMEX Non-Common Buy Part Number:	5962-8754901CA (HA1244213)
SMEX Non-Common Buy Control Number:	1642
Charge Number:	C90088
Manufacturer:	National Semiconductor Corp.
Quantity Procured:	112
Lot Date Codes:	9032A
Quantity Tested:	10
Serial Numbers of Radiation Samples:	72, 73, 74, 75, 76, 77, 78, 79
Serial Numbers of Control Samples:	70, 71
Part Function:	2-Input Nand Gate
Part Technology:	CMOS
Package Style:	14 Pin DIP

TABLE II. Radiation Schedule

EVENTS	DATE
1) Initial Electrical Measurements	03/05/91
2) 10 krads irradiation @ 250 rads/hr Post 10 krads Electrical Measurements	03/07/91 03/08/91
3) 20 krads irradiation @ 250 rads/hr Post 20 krads Electrical Measurements	03/08/91 03/09/91
4) 30 krads irradiation @ 250 rads/hr Post 30 krads Electrical Measurements	03/09/91 03/10/91
5) 50 krads irradiation @ 250 rads/hr Post 50 krads Electrical Measurements	03/10/91 03/11/91
6) 75 krads irradiation @ 1250 rads/hr Post 75 krads Electrical Measurements	03/11/91 03/12/91
7) 100 krads irradiation @ 1250 rads/hr Post 100 krads Electrical Measurements	03/12/91 03/13/91
8) 24 hour annealing Post 24 hr Electrical Measurements	03/13/91 03/14/91
9) 168 hour annealing Post 168 hr Electrical Measurements	03/13/91 03/20/91
10) 160 krads irradiation @ 5000 rads/hr Post 160 krads Electrical Measurements*	03/20/91 03/22/91
11) 260 krads irradiation @ 1470 rads/hr Post 260 krads Electrical Measurements	03/22/91 03/23/91

Notes:

- 1) All parts were radiated under bias at the cobalt-60 gamma ray facility at GSEC.
- 2) All electrical measurements were performed off-site at 25°C.
- 3) Annealing performed at 25°C under bias.

* Anomalous event: Due to a power outage, the parts received a cumulative dose of 160 krads instead of the scheduled 200 krads.

Table III. Electrical Characteristics of 54AC00

PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS: -55C TO +125C
=====	=====	=====	=====	=====	=====	=====
FUNC 1	5.5V	0.00V	5.50V	FREQ = 10MHz	ALL I/O	VOH > 2.75V, VOL < 2.75V
V _{OH1}	3.0V	INPUTS	AT	0.90V AND 2.10V	EACH OUTPUT	AT -50UA 2.90V MIN
V _{OH2}	4.5V	INPUTS	AT	1.35V AND 3.15V	EACH OUTPUT	AT -50UA 4.40V MIN
V _{OH3}	5.5V	INPUTS	AT	1.65V AND 3.85V	EACH OUTPUT	AT -50UA 5.40V MIN
V _{OH4}	3.0V	INPUTS	AT	0.90V AND 2.10V	EACH OUTPUT	AT -4MA 2.40V MIN
V _{OH5}	4.5V	INPUTS	AT	1.35V AND 3.15V	EACH OUTPUT	AT -24MA 3.70V MIN
V _{OH6}	5.5V	INPUTS	AT	1.65V AND 3.85V	EACH OUTPUT	AT -24MA 4.70V MIN
V _{OH7}	5.5V	INPUTS	AT	1.65V AND 3.85V	EACH OUTPUT	AT -50MA 3.85V MIN
V _{OL1}	3.0V	INPUTS	AT	0.90V AND 2.10V	EACH OUTPUT	AT +50UA 0.1V MAX
V _{OL2}	4.5V	INPUTS	AT	1.35V AND 3.15V	EACH OUTPUT	AT +50UA 0.1V MAX
V _{OL3}	5.5V	INPUTS	AT	1.65V AND 3.85V	EACH OUTPUT	AT +50UA 0.1V MAX
V _{OL4}	3.0V	INPUTS	AT	0.90V AND 2.10V	EACH OUTPUT	AT +12MA 0.5V MAX
V _{OL5}	4.5V	INPUTS	AT	1.35V AND 3.15V	EACH OUTPUT	AT +24MA 0.5V MAX
V _{OL6}	5.5V	INPUTS	AT	1.65V AND 3.85V	EACH OUTPUT	AT +24MA 0.5V MAX
V _{OL7}	5.5V	INPUTS	AT	1.65V AND 3.85V	EACH OUTPUT	AT +50MA 1.65V MAX
I _{CC1}	5.5V	EACH INPUT TESTED AT VIN=0.0V				-1UA TO 0.0UA
I _{CC2}	5.5V	EACH INPUT TESTED AT VIN=5.5V				0.0UA TO +1.0UA
I _{CC3}	5.5V	INPUTS	AT	5.5V		80.0UA MAX
I _{CC4}	5.5V	INPUTS	AT	0.0V		80.0UA MAX

COMMENTS/EXCEPTIONS

* VIL AND VIH WERE TESTED WHILE PERFORMING VOL AND VOH TESTS.

TABLE IV: Summary of Electrical Measurements after
Total Dose Exposures and Annealing for 54AC00 1/, 2/

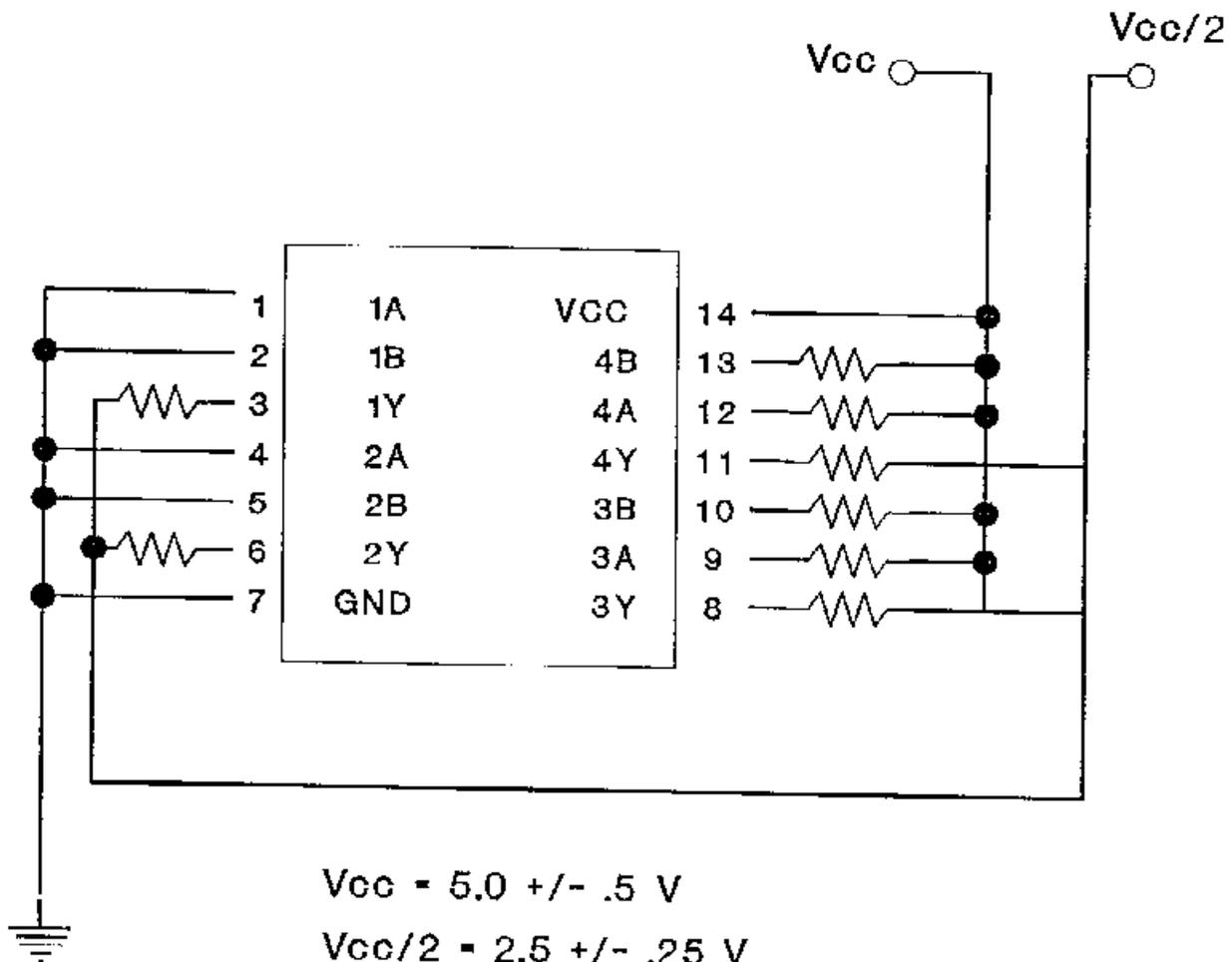
Parameter	Spec. Limits	Initials	Total Dose Exposure (krads)										Total Dose Exposure (krads)								
			min		max		10		20		50		100		168 hrs		160		260		
			mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	
Func1 10MHz		8P/0F		8P/0F		8P/0F		8P/0F		8P/0F		8P/0F		8P/0F		8P/0F		8P/0F		8P/0F	
IIL	nA	-1000	0.0	0.0	---	0.0	---	0.0	---	0.0	---	0.0	---	0.0	---	0.0	---	0.0	---	0.0	---
IIH	nA	0.0	1000	0.0	---	0.0	---	0.0	---	0.0	---	0.0	---	0.0	---	0.0	---	0.0	---	0.0	---
ICCH	μA	0.0	80	0.0	---	46	25	430	127	1945	279	4066	386	3707	408	6446	489	7174	519		
ICCL	μA	0.0	80	0.0	---	6.0	4	156	54	1289	205	3074	312	2814	323	5378	421	6194	460		
VOH1	V	2.9	5.5	3.0	.002	3.0	.001	3.0	.001	3.0	.002	3.0	.004	3.0	.005	3.0	.003	3.0	.002		
VOH2	V	4.4	5.5	4.5	.009	4.5	---	4.5	---	4.5	---	4.5	.007	4.5	.01	4.5	.003	4.5	.002		
VOH3	V	5.4	5.5	5.48	.017	5.49	.003	5.49	.004	5.49	.004	5.48	.017	5.48	.019	5.48	.007	5.49	.005		
VOH4	V	2.4	5.5	3.0	.006	3.0	.005	3.0	.006	3.0	.006	2.91	.008	2.91	.005	2.91	.007	2.9	.006		
VOH5	V	3.7	5.5	4.1	.04	4.1	.031	4.1	.043	4.1	.035	4.1	.040	4.1	.081	4.1	.043	4.1	.035		
VOH6	V	4.7	5.5	5.2	.046	5.2	.031	5.1	.038	5.2	.031	5.1	.044	5.1	.096	5.1	.052	5.1	.033		
VOH7	V	3.85	5.5	4.8	.083	4.8	.064	4.7	.083	4.8	.006	4.7	.131	4.7	.1	4.7	.086	4.7	.069		
VOL1	mV	0.0	100	0.0	---	0.0	---	0.0	---	0.0	---	0.0	---	0.0	---	1.18	2.8	3.19	4.28		
VOL2	mV	0.0	100	0.0	---	1.0	2.6	0.0	---	.001	2.47	1.38	3.69	1.5	3.9	6.22	6.8	8.3	8.1		
VOL3	mV	0.0	100	0.0	---	2.6	6.9	0.0	---	1.85	4.07	2.56	6.24	2.31	6.2	10.5	8.56	13.8	10.8		
VOL4	mV	0.0	500	149	8.7	154	12	154	15	148	11	147	12	152	17	150	17	146	15		
VOL5	mV	0.0	500	216	15	228	24	230	28	220	20	223	22	232	34	237	33	232	30		
VOL6	mV	0.0	500	189	14	204	27	206	28	195	21	200	24	211	36	220	37	219	37		
VOL7	mV	0.0	1650	404	30	432	54	437	63	415	48	424	49	448	81	454	66	459	83		

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/ The table does not include Post 30 krad, Post 75 krad and Post 24 hour annealing electrical measurement data. This data is available and can be obtained upon request.

Figure 1: Radiation Bias Circuit for 54AC00



$V_{cc} = 5.0 \pm .5 \text{ V}$

$V_{cc}/2 = 2.5 \pm .25 \text{ V}$

All Resistors are 1 kohms, 1/4 W