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Interoffice Memorandum

PPM-91-136

Date March 4, 1991

Location Lanham

Telephone 731-8954

Location Lanham

cc
B. Fafaul/311
J. Denis/311
V. Edson
S. Esmacher
A. Casasnovas
M. Fowler
A. Moor

To T. Miccolis

Department
Code 310.1From K. Sahu KSDepartment
7809Subject
Radiation Report on 54AC08
SMEX Common Buy Part No. 5962-8761501CA

A radiation evaluation was performed on 54AC08 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 5, 10, 15, 20, 30, 50, 75 and 100 krads. After 100 krads, parts were annealed at 25°C for 24 and 168 hours, and then irradiation was continued to 200 and 300 krads (cumulative). The dose rate was between 0.15 - 1.25 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 included a total of three functional tests (at 10 MHz) after each radiation and annealing step.

All parts except one passed all tests on irradiation up to 300 krads without any significant degradation in any of the electrical parameters. The failing part (SN 6) exceeded the specification limit on ICCH and ICCL at 300 krads (the readings were approximately 100 uA against the specification limit of 80 uA). However, SN 6 passed all tests on irradiation up to 200 krads.

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 731-8954.

TABLE I. Part Information

Generic Part Number:	54AC08
SMEX Common Buy Part Number:	5962-8761501CA
SMEX Common Buy Control Number:	1645
Manufacturer:	National Semiconductor Corporation
Quantity Procured:	103
Lot Date Code:	9036
Quantity Tested:	10
Serial Numbers of Radiation Samples:	3, 4, 5, 6, 7, 8, 9, 10
Serial Numbers of Control Samples:	1,2
Part Function:	Quad - 2 Input Nand Gate
Part Technology:	CMOS
Package Style:	14-Pin DIP

TABLE II. Radiation Schedule

EVENTS	DATE
1) Initial Electrical Measurements	01/17/91
2) 5 krad irradiation @ 250 rads/hr Post 5 krad Electrical Measurements	01/21/91 01/22/91
3) 10 krad irradiation @ 250 rads/hr Post 10 krad Electrical Measurements	01/22/91 01/23/91
4) 15 krad irradiation @ 250 rads/hr Post 15 krad Electrical Measurements	01/23/91 01/24/91
5) 20 krad irradiation @ 250 rads/hr Post 20 krad Electrical Measurements	01/24/91 01/25/91
6) 30 krad irradiation @ 147 rads/hr Post 30 krad Electrical Measurements	01/25/91 01/28/91
7) 50 krad irradiation @ 1000 rads/hr Post 50 krad Electrical Measurements	01/28/91 01/29/91
8) 75 krad irradiation @ 1250 rads/hr Post 75 krad Electrical Measurements	01/29/91 01/30/91
9) 100 krad irradiation @ 1250 rads/hr Post 100 krad Electrical Measurements	01/30/91 01/31/91
10) 24 hrs annealing Post 24 hr Electrical Measurements	01/31/91 02/01/91
11) 168 hrs annealing Post 168 hr Electrical Measurements	02/01/91 02/07/91
12) 200 krad irradiation @ 5000 rads/hr Post 200 krad Electrical Measurements	02/07/91 02/08/91
13) 300 krad irradiation @ 1470 rads/hr Post 300 krad Electrical Measurements	02/08/91 02/11/91

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.
- Annealing was performed at 25°C under bias.

TABLE III. Electrical Characteristics of 54AC08

PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS: -55C TO +125C	
=====	===	===	===	=====	=====	=====	=====
FUNC 1	2.0V	0.0V	2.0V	FREQ = 10MHz	ALL I/O	VOH>1.7V,	VOL<0.5V
FUNC 2	3.0V	0.9V	2.1V	FREQ = 10MHz	ALL I/O	VOH>2.0V,	VOL<1.0V
FUNC 3	5.5V	1.65V	3.85V	FREQ = 10MHz	ALL I/O	VOH>3.5V,	VOL<1.0V
VOH1*	3.0V; INPUTS AT 0.00V AND 3.00V,		EACH OUTPUT AT -50UA		2.90V MIN		
VOH2*	4.5V; INPUTS AT 0.00V AND 4.50V,		EACH OUTPUT AT -50UA		4.40V MIN		
VOH3*	5.5V; INPUTS AT 0.00V AND 5.50V,		EACH OUTPUT AT -50UA		5.40V MIN		
VOH4*	3.0V; INPUTS AT 0.00V AND 3.00V,		EACH OUTPUT AT -4MA		2.40V MIN		
VOH5*	4.5V; INPUTS AT 0.00V AND 4.50V,		EACH OUTPUT AT -24MA		3.70V MIN		
VOH6*	5.5V; INPUTS AT 0.00V AND 5.50V,		EACH OUTPUT AT -24MA		4.70V MIN		
VOH7*	5.5V; INPUTS AT 0.00V AND 5.50V,		EACH OUTPUT AT -50MA		3.85V MIN		
VOL1	3.0V; INPUTS AT 0.90V AND 2.10V,		EACH OUTPUT AT 50UA		0.1V MAX		
VOL2	4.5V; INPUTS AT 1.35V AND 3.15V,		EACH OUTPUT AT 50UA		0.1V MAX		
VOL3	5.5V; INPUTS AT 1.65V AND 3.85V,		EACH OUTPUT AT 50UA		0.1V MAX		
VOL4	3.0V; INPUTS AT 0.90V AND 2.10V,		EACH OUTPUT AT 12MA		0.5V MAX		
VOL5	4.5V; INPUTS AT 1.35V AND 3.15V,		EACH OUTPUT AT 24MA		0.5V MAX		
VOL6	5.5V; INPUTS AT 1.65V AND 3.85V,		EACH OUTPUT AT 24MA		0.5V MAX		
VOL7	5.5V; INPUTS AT 1.65V AND 3.85V,		EACH OUTPUT AT 50MA		1.65V MAX		
II	5.5V; EACH INPUT TESTED AT VIN=0.0V				-1.0UA TO 0.0UA		
II	5.5V; EACH INPUT TESTED AT VIN=5.5V				0.0UA TO +1.0UA		
ICCH	5.5V; INPUTS AT 5.5V				80.0UA MAX		
ICCL	5.5V; INPUTS AT 0.0V				80.0UA MAX		
PARAMETER	VCC	CONDITIONS		PINS	LIMITS: 25C		
=====	===	=====		=====	=====		
TPLH1 A TO Y	3.0V	VIN = 0V TO VCC		COMP = 1.5V	1NS TO 10.0NS		
TPLH1 B TO Y	3.0V	VIN = 0V TO VCC		COMP = 1.5V	1NS TO 10.0NS		
TPHL1 A TO Y	3.0V	VIN = 0V TO VCC		COMP = 1.5V	1NS TO 9.0NS		
TPHL1 B TO Y	3.0V	VIN = 0V TO VCC		COMP = 1.5V	1NS TO 9.0NS		
TPLH2 A TO Y	4.5V	VIN = 0V TO VCC		COMP = 2.25V	1NS TO 7.5 NS		
TPLH2 B TO Y	4.5V	VIN = 0V TO VCC		COMP = 2.25V	1NS TO 7.5 NS		
TPHL2 A TO Y	4.5V	VIN = 0V TO VCC		COMP = 2.25V	1NS TO 7.0 NS		
TPHL2 B TO Y	4.5V	VIN = 0V TO VCC		COMP = 2.25V	1NS TO 7.0 NS		
COMMENTS/EXCEPTIONS							
* VOH TESTS WERE PERFORMED WITH VIL= 0.0V AND VIH=VCC DUE TO "ATE" NOISES.							
IIL TEST WAS PERFORMED WITH OTHER INPUTS AT GROUND.							
AC TESTS WERE PERFORMED WITH 10ma OUTPUT LOADING.							

TABLE IV: Summary of Electrical Measurements
after Total Dose Exposures and Annealing for 54AC08

1/ 2/

Parameters	Spec. Limits min max	Initials				Total Dose Exposure (krads)								Anneal 168 hrs		Total Dose (krads)			
						10		20		50		100				200		300	
		mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd
Func1, 10MHz		Pass		Pass		Pass		Pass		Pass		Pass		Pass		Pass		Pass	
Func2, 10MHz		Pass		Pass		Pass		Pass		Pass		Pass		Pass		Pass		Pass	
Func3, 10MHz		Pass		Pass		Pass		Pass		Pass		Pass		Pass		Pass		Pass	
VOH1 V	2.9 5.5	3.0	0	3.0	0	2.9	0	3.0	0	3.0	0	3.0	0	3.0	0	3.0	0	3.0	0
VOH2 V	4.4 5.5	4.5	0	4.5	-	4.5	-	4.5	-	4.5	-	4.5	-	4.5	-	4.5	-	4.5	-
VOH3 V	5.4 5.5	5.49	0	5.5	-	5.5	-	5.5	-	5.5	-	5.5	-	5.5	-	5.5	-	5.5	0
VOH4 V	2.4 5.5	2.9	0	2.9	.01	2.9	0	2.9	0	2.9	0	2.9	0	2.9	0	2.9	.01	2.9	0
VOH5 V	3.7 5.5	4.2	0	4.2	.01	4.2	.02	4.2	.01	4.2	.03	4.2	.03	4.2	.03	4.2	.04	4.2	.03
VOH6 V	4.7 5.5	5.2	0	5.2	.01	5.2	.02	5.2	.01	5.2	.03	5.2	.02	5.2	.03	5.2	.03	5.2	.03
VOH7 V	3.85 5.5	5.0	.01	5.0	-	5.0	.03	5.0	.01	5.0	.04	5.0	.04	4.9	.05	4.9	.04	4.9	.04
VOL1 mV	0 100	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
VOL2 mV	0 100	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
VOL3 mV	0 100	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
VOL4 mV	0 500	130	2	132	2	132	6	130	2	133	7	135	7	134	9	135	9	135	9
VOL5 mV	0 500	181	2	185	4	187	10	184	2	190	14	191	14	196	18	198	17	198	17
VOL6 mV	0 500	156	2	159	3	161	10	158	2	164	13	165	14	170	18	172	17	172	17
VOL7 mV	0 1650	332	6	341	6	345	23	338	4	351	29	333	31	366	44	368	37	368	37
IIL nA	-1E3 0	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
IILH nA	0 1E3	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
ICCH uA	0 80	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	11.4	32
ICCL uA	0 80	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	12.4	35
TPLH1 ns	1 10	6.24	1.01	6.06	1.0	6.17	1.0	6.04	1.0	6.75	1.2	6.56	0.4	6.62	0.4	6.67	0.5	6.67	0.5
TPHL1 ns	1 9	6.94	1.00	6.76	1.0	6.84	1.0	6.66	1.0	6.29	1.1	6.20	0.2	6.21	0.3	6.44	0.4	6.44	0.4
TPLH2 * ns	1 7.5	6.96	1.01	7.66	1.0	7.79	1.0	7.65	1.0	7.24	1.2	6.98	0.3	6.22	0.4	6.24	0.4	6.24	0.4
TPHL2 ns	1 7	6.31	1.07	6.09	1.0	6.23	1.0	6.99	1.0	6.55	1.1	6.47	0.3	6.42	0.2	6.55	0.3	6.55	0.3

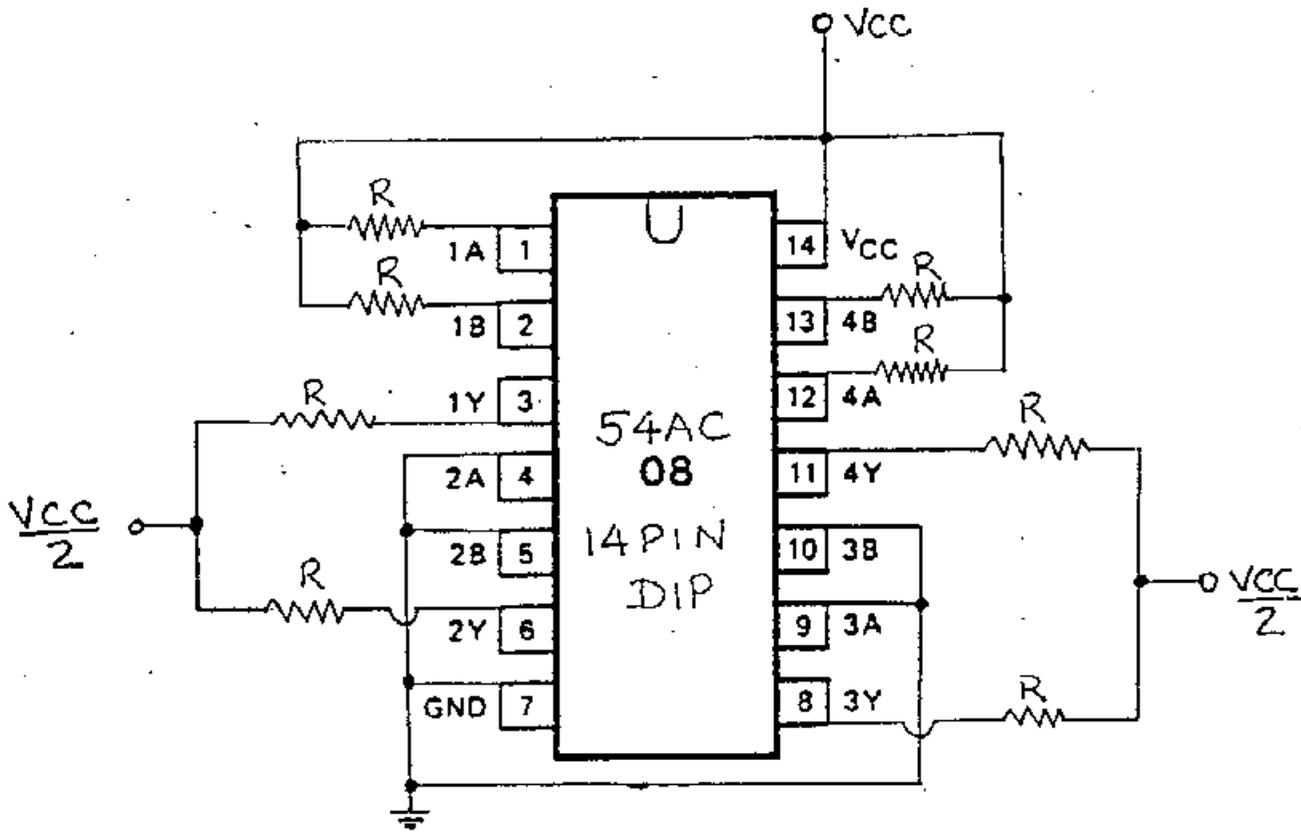
Notes:

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/ 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.

* The TPLH2 measurements for some of the parts at 10, 20, 50, and 100 krads were greater than 7.5 ns. However, these were not considered radiation induced degradation, but were caused by the recalibration of the automatic tester.

Figure 1. Radiation Bias Circuit for 54AC08



54AC08
14 PIN DIP

$$VCC = 5.0V \pm 10\%, \frac{VCC}{2} = 2.5V \pm 10\%$$

$$R = 1.0 K \Omega, 5\%, \frac{1}{4} W$$

$$T_A = 25^\circ C$$