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**UNISYS**

Interoffice Memorandum

PPM-91-441

To  
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Date  
July 02, 1991

Department  
Code 300.1

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Subject  
Radiation Report on 54AC86  
SMEX Common Buy Part No. 5962-895501CA

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A radiation evaluation was performed on 54AC86 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 krad. After 100 krad, parts were annealed at 25°C for 24 and 192 hours, and then the irradiation was continued to 160 and 260 krad (cumulative). The dose rate was between 0.25 - 5 krad/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 two functional tests (10MHz) at 3.0 V and 5.5 V.

All (8) parts passed initial measurements. All parts continued to pass functional tests up to 260 krad, and stayed within the specification limits up to 50 krad. At 75 and 100 krad, two parts marginally exceeded the specification limits on VOL3 and I<sub>CCL</sub>. However, on annealing for 192 hours, all parts passed all tests and stayed within the specification limits for all parameters. On continued irradiation to 160 and 260 krad, seven parts exceeded the specification limits on VOL6. Also, one part (SN 9) exceeded the specification limits for I<sub>CCH</sub> and I<sub>CCL</sub>. However, all parts passed all other tests on irradiation up to 260 krad. 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 I. Part Information

Generic Part Number:	54AC86
ISTP Non-Common Buy Part Number:	5962-8955001CA (HA124245)
ISTP Non-Common Buy Control Number:	1650
Charge Number:	C90091
Manufacturer:	National Semiconductor Corp.
Quantity Procured:	100
Lot Date Codes:	9036A
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:	2 Input Exclusive - OR Gate
Part Technology:	CMOS
Package Style:	14 Pin DIP

TABLE II. Radiation Schedule

EVENTS	DATE
1) Initial Electrical Measurements	03/07/91
2) 10 krads irradiation @ 250 rads/hr Post 10 krads Electrical Measurements	03/08/91 03/09/91
3) 20 krads irradiation @ 250 rads/hr Post 20 krads Electrical Measurements	03/09/91 03/10/91
4) 30 krads irradiation @ 250 rads/hr Post 30 krads Electrical Measurements	03/10/91 03/11/91
5) 50 krads irradiation @ 250 rads/hr Post 50 krads Electrical Measurements	03/11/91 03/12/91
6) 75 krads irradiation @ 1250 rads/hr Post 75 krads Electrical Measurements	03/12/91 03/13/91
7) 100 krads irradiation @ 1250 rads/hr Post 100 krads Electrical Measurements	03/13/91 03/14/91
8) 24 hour annealing Post 24 hr Electrical Measurements	03/14/91 03/15/91
9) 192 hour annealing Post 192 hr Electrical Measurements	03/15/91 03/23/91
10) 160 krads irradiation @ 5000 rads/hr* Post 160 krads Electrical Measurements	03/22/91 03/23/91
11) 260 krads irradiation @ 1470 rads/hr Post 260 krads Electrical Measurements	03/23/91 03/24/91

Notes:

- 1) All parts were radiated under bias at the cobalt-60 gamma ray facility at GSFC.
- 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 54AC86

PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS: -55C TO +125C
FUNC 1	3.0V	0.0V	3.0V	FREQ = 10MHz	ALL I/O	VOH > 1.5V, VOL < 1.5V
FUNC 2	5.5V	0.0V	5.5V	FREQ = 10MHz	ALL I/O	VOH > 1.5V, VOL < 1.5V
VOH1	3.0V; INPUTS AT 0.90V AND 2.10V,		EACH OUTPUT AT -50UA			2.90V MIN
VOH2	4.5V; INPUTS AT 1.35V AND 3.15V,		EACH OUTPUT AT -50UA			4.40V MIN
VOH3	5.5V; INPUTS AT 1.65V AND 3.85V,		EACH OUTPUT AT -50UA			5.40V MIN
VOH4	3.0V; INPUTS AT 0.90V AND 2.10V,		EACH OUTPUT AT -4MA			2.40V MIN
VOH5	4.5V; INPUTS AT 1.35V AND 3.15V,		EACH OUTPUT AT -24MA			3.70V MIN
VOH6	5.5V; INPUTS AT 1.65V AND 3.85V,		EACH OUTPUT AT -24MA			4.70V MIN
VOH7	5.5V; INPUTS AT 1.65V AND 3.85V,		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
IIL	5.5V; EACH INPUT TESTED AT VIN=0.0V					-1UA TO 0.0UA
IIH	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

COMMENTS/EXCEPTIONS

- \* VIL AND VIH WERE TESTED WHILE PERFORMING VOL AND VOH TESTS.
- \* AC TESTS ARE NOT PERFORMED

TABLE IV: Summary of Electrical Measurements after  
Total Dose Exposures and Annealing for 54AC86

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Parameter	Spec. Limits	Initial	Total Dose Exposure (krads)												Annealing				Total Dose Exposure (krads)							
			10		20		30		50		75		100		24 hrs		192 hrs		160		260					
			mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd				
Test #1		BP/OF		BP/OF		BP/OF		BP/OF		BP/OF		BP/OF		BP/OF		BP/OF		BP/OF		BP/OF		BP/OF		BP/OF		
Test #2		BP/OF		BP/OF		BP/OF		BP/OF		BP/OF		BP/OF		BP/OF		BP/OF		BP/OF		BP/OF		BP/OF		BP/OF		
IIL	nA	-1000 0.0	.058	.635	0.0	---	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	---	0.0	---	0.0	---	0.0	---
ICCH	μA	0.0 80	0.0	---	.001	.001	.7	.7	.9	.9	1.75	1.88	3.2	4.9	11	30	5.5	15.2	1.65	4.24	64	197	158	483		
ICCL	μA	0.0 80	0.0	---	.001	.001	.4	.4	.5	.5	1.02	1.3	1.9	2.8	8	22	3.7	10.3	.001	2.2	58	150	59	489		
VOH1	V	2.9 5.5	3.0	.001	3.0	.001	3.0	.001	3.0	.001	3.0	.001	3.0	.001	3.0	.001	3.0	.001	3.0	.001	3.0	.001	3.0	.001	3.0	.001
VOH2	V	4.4 5.5	4.5	.002	4.5	0.0	5.0	.001	4.5	0.0	4.5	0.0	4.5	0.0	4.5	0.0	4.5	0.0	4.5	0.0	4.5	0.0	4.5	0.0	4.5	0.0
VOH3	V	5.4 5.5	5.5	.006	5.5	.007	5.5	.005	5.5	.004	5.5	.005	5.5	.005	5.5	.004	5.5	.005	5.5	.005	5.5	.005	5.5	.005	5.5	.005
VOH4	V	2.4 5.5	3.0	.003	3.0	.005	3.0	.006	3.0	.007	3.0	.004	3.0	.005	3.0	.004	3.0	.004	3.0	.005	3.0	.007	3.0	.008	3.0	.008
VOH5	V	3.7 5.5	4.2	.013	4.1	.031	4.2	.069	4.1	.041	4.1	.025	4.1	.023	4.1	.023	4.1	.024	4.14	.031	4.1	.05	4.1	.042	4.1	.042
VOH6	V	4.7 5.5	5.2	.013	4.1	.031	4.1	.039	4.1	.041	4.1	.025	4.1	.023	4.1	.023	4.1	.024	4.14	.031	4.1	.05	4.1	.042	4.1	.042
VOH7	V	3.85 5.5	4.9	.026	4.8	.073	4.8	.072	4.8	.071	4.8	.072	4.8	.051	4.8	.059	4.8	.062	4.8	.077	4.8	.095	4.8	.097	4.8	.097
VOL1	mV	0.0 100	0.0	---	0.0	---	0.0	---	0.0	---	0.0	---	0.0	---	0.0	---	0.0	---	0.0	---	0.0	---	0.0	---	0.0	---
VOL2	mV	0.0 100	0.0	---	0.0	---	0.0	---	0.0	---	0.0	---	1.5	2.0	0.0	---	0.0	---	0.0	---	0.0	---	0.0	---	0.0	---
VOL3	mV	0.0 100	.2	1.2	1.5	3.1	.8	1.2	0.0	---	.7	2.3	107	363	1.1	2.7	113	405	.7	2.3	754	502	552	812		
VOL4	mV	0.0 500	140	3.4	147	12.4	147	10.9	145	10	146	10	146	11	145	8	144	11	148	14	148	14	152	18		
VOL5	mV	0.0 500	204	5.9	220	24.5	219	21	215	20	217	20	218	22	217	16	215	23	221	23	222	25	233	40		
VOL6	mV	0.0 500	180	5.6	197	25	197	22	192	20	194	20	196	22	194	16	455	598	197	28	738	787	605	725		
VOL7	mV	0.0 1650	393	12.4	427	82	423	63	408	43	415	52	413	45	412	36	694	602	426	92	433	80	454	90		

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.

Figure 1: Radiation Bias Circuit for 54AC86

