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Memorandum

PARAMAX
A Unisys Company

PPM-92-317

DATE: Jan. 5, 1993
TO: B. Fafaul/311
FROM: K. Sahu/300.1 *KS*
SUBJECT: Radiation Report on FAST/MUE
Part No. M38510/75705BRA(54AC244)
Control No. 6305

cc: R. Kolecki/740.4
T. Miccolis/300.1
A. Sharma/311
Library/300.1 ✓
L. Cusick/740.4
SMEX, PPM File

A radiation evaluation was performed on 54AC244 (Octal Buffer/Line Driver) 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 levels were 5, 10, 20, 40 and 60 krads*. After 60 krads, parts were annealed at 25°C for 168 hours. The irradiation was then continued to 100 krads (cumulative). Finally, the parts were annealed for 168 hours at 100°C. The dose rate was between 0.23 and 2.0 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 at 25°C according to the test conditions and the specification limits** listed in Table III.

All ten parts passed initial (pre-rad) electrical tests. All eight irradiated parts passed all electrical tests up to and including the 5-krad step. After the 10-krad exposure, all eight irradiated parts exceeded the maximum specification limits of 2.0 uA for ICCH, with readings ranging from 3.1 to 35.6 uA. In addition, three parts (SN 5, 7 and 10) exceeded the maximum

*The term rads, as used in this document, means rads(silicon).
All radiation levels cited are cumulative.

**These are manufacturers' non-irradiated data sheet specification limits. No post-irradiation limits were provided by the manufacturer at the time these tests were performed.

specification limit of 2.0 uA for ICCZ, with readings ranging from 3.3 to 16.4 uA and one part (SN 7) exceeded the maximum specification limit of 2.0 uA for ICCL, with a reading of 4.4 uA. After the 20-krad irradiation, all irradiated parts except for SN 8 failed all ICC tests. SN 8 did not fail ICCL. Readings for ICCH ranged from 9.1 to 784 uA, failure readings for ICCL ranged from 2.3 to 255.2 uA and readings for ICCZ ranged from 3.3 to 490.7 uA. After the 40-krad irradiation, all eight irradiated parts failed all ICC tests. Readings for all ICC tests ranged from 3.3 to 4790 uA. After the 60-krad irradiation, all eight irradiated parts continued to fail all ICC tests with readings ranging from 7.5 uA to 10.26 mA.

After annealing for 168 hours at 25°C, some recovery was observed, but all eight parts continued to fail at least one ICC test. After continued irradiation to 100 krads (cumulative) all eight parts failed all ICC tests with readings ranging from 5.0 uA to 17.1 mA.

After a final annealing at 100°C, no rebound effects were observed.

Table IV provides a summary of the functional test results, as well as the mean and standard deviation values for each parameter after different irradiation exposures and annealing steps.

Any further details about this evaluation can be obtained upon request. If you have any questions, please call me at (301) 731-8954.

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TABLE I. Part Information

Generic Part Number:	54AC244
Part Number:	M38510/75705BRA
FAST/MUE Control Number:	6305
Charge Number:	C33036
Manufacturer:	National Semiconductor Corp.
Lot Date Code:	9237A
Quantity Tested:	10
Serial Numbers of Radiation Samples:	4, 5, 6, 7, 8, 9, 10, 11
Serial Numbers of Control Samples:	2, 3
Part Function:	Octal Buffer/Line Driver
Part Technology:	Bipolar
Package Style:	20-lead DIP
Test Engineer:	K. Kim

TABLE II. Radiation Schedule for 54AC244

EVENTS	DATE
1) Initial Electrical Measurements	11/20/92
2) 5 KRAD IRRADIATION (0.25 krads/hour)	11/23/92
POST-5 KRAD ELECTRICAL MEASUREMENT	11/24/92
3) 10 KRAD IRRADIATION (0.25 krads/hour)	11/24/92
POST-10 KRAD ELECTRICAL MEASUREMENT	11/25/92
4) 20 KRAD IRRADIATION (0.23 krads/hour)	11/25/92
POST-20 KRAD ELECTRICAL MEASUREMENT	11/27/92
5) 40 KRAD IRRADIATION (0.30 KRADS/HOUR)	11/27/92
POST-40 KRAD ELECTRICAL MEASUREMENT	11/30/92
6) 60 KRAD IRRADIATION (1.0 KRADS/HOUR)	11/30/92
POST-60 KRAD ELECTRICAL MEASUREMENT	12/01/92
7) 168 HOUR ANNEALING @25°C	12/01/92
POST-168 HOUR ANNEAL ELECTRICAL MEASUREMENT	12/08/92
8) 100 KRAD IRRADIATION (2.0 KRADS/HOUR)	12/08/92
POST-100 KRAD ELECTRICAL MEASUREMENT	12/09/92
9) 168 HOUR ANNEALING @100°C*	12/09/92
POST-168 HOUR ANNEAL ELECTRICAL MEASUREMENT	12/18/92

ALL ELECTRICAL MEASUREMENTS WERE PERFORMED AT 25°C.

PARTS WERE IRRADIATED AND ANNEALED UNDER BIAS; SEE FIGURE 1.

*High temperature annealing is performed to accelerate long term time dependent effects (TDE), namely, the "rebound" effect due to the growth of interface states after the radiation exposure. For more information on the need to perform this test, refer to MIL-STD-883D, Method 1019, Para. 3.10.1.

Table III. Electrical Characteristics of 54AC244

FUNCTIONAL TESTS PERFORMED						
PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS @ -55C TO +125C
FUNCT #1	3.0V	0.45V	2.3V	FREQ = 1.0MHZ	ALL I/O	VOL < 1.5V / VDH > 1.5V
FUNCT #2	4.5V	0.60V	3.7V	FREQ = 1.0MHZ	ALL I/O	VOL < 2.25V / VDH > 2.25V
DC PARAMETRIC TESTS PERFORMED						
PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS @ -55C TO +125C
VDM1	3.0V	0.90V	2.10V	LOAD = -50UA	OUTS	> 2.90V / < 3.00V
VDM2	4.5V	1.35V	3.15V	LOAD = +50UA	OUTS	> 4.40V / < 4.50V
VDM3	3.0V	1.65V	3.85V	LOAD = -50UA	OUTS	> 3.40V / < 3.50V
VDM4	3.0V	0.90V	2.10V	LOAD = -4MA	OUTS	> 2.40V / < 3.00V
VDM5	4.5V	1.35V	3.15V	LOAD = -24MA	OUTS	> 3.70V / < 4.50V
VDM6	3.0V	1.65V	3.85V	LOAD = -24MA	OUTS	> 4.70V / < 5.50V
VDM7	3.0V	1.65V	3.85V	LOAD = -50UA	OUTS	> 3.85V / < 5.50V
PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS @ -55C TO +125C
VOL2	3.0V	0.90V	2.10V	LOAD = +50UA	OUTS	> 0.00V / < 0.10V
VOL3	4.5V	1.35V	3.15V	LOAD = +50UA	OUTS	> 0.00V / < 0.10V
VOL4	3.0V	1.65V	3.85V	LOAD = +50UA	OUTS	> 0.00V / < 0.10V
VOL5	3.0V	1.65V	3.85V	LOAD = +50UA	OUTS	> 0.00V / < 1.65V
PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS @ -55C TO +25C
VOL4	3.0V	0.90V	2.10V	LOAD = +12MA	OUTS	> 0.00V / < 0.40V
VOL5	4.5V	1.35V	3.15V	LOAD = +24MA	OUTS	> 0.00V / < 0.40V
VOL6	3.0V	1.65V	3.85V	LOAD = +24MA	OUTS	> 0.00V / < 0.40V
PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS @ +125C ONLY
VOL4	3.0V	0.90V	2.10V	LOAD = +12MA	OUTS	> 0.00V / < 0.50V
VOL5	4.5V	1.35V	3.15V	LOAD = +24MA	OUTS	> 0.00V / < 0.50V
VOL6	3.0V	1.65V	3.85V	LOAD = +24MA	OUTS	> 0.00V / < 0.50V
PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS @ -55C TO +25C
VIC+	GND			Iin = +1mA	OUTS	> 0.4V / < 1.50V
VIC-	OPEN			Iin = -1mA	OUTS	> -1.5V / < -0.4V
PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS @ -55C TO +25C
IIN	3.0V	0.00V	3.50V	VIN = 3.5V	INS	> 0.00A / < +0.10A
IIL	3.0V	0.00V	3.50V	VIN = 0.0V	INS	> -0.10A / < 0.00A
PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS @ +125C ONLY
IIN	3.0V	0.00V	3.50V	VIN = 3.5V	INS	> 0.00A / < +1.00A
IIL	3.0V	0.00V	3.50V	VIN = 0.0V	INS	> -1.00A / < 0.00A
PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS @ -55C TO +25C
IOZH	3.0V	0.00V	3.50V	VOU = 3.5V	OUTS	> 0.00A / < +0.50A
IOZL	3.0V	0.00V	3.50V	VOU = 0.0V	OUTS	> -0.50A / < 0.00A
PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS @ +125C ONLY
IOZH	3.0V	0.00V	3.50V	VOU = 3.5V	OUTS	> 0.00A / < +10.00A
IOZL	3.0V	0.00V	3.50V	VOU = 0.0V	OUTS	> -10.00A / < 0.00A
PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS @ -55C TO +25C
ICCH	3.0V	0.00V	3.50V	VIN=VCC, OE=GND	VCC	> 0.00A / < 2.00A
ICCL	3.0V	0.00V	3.50V	VIN=GND, OE=GND	VCC	> 0.00A / < 2.00A
ICCZ	3.0V	0.00V	3.50V	OE=VCC	VCC	> 0.00A / < 2.00A
PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS @ +125C ONLY
ICCH	3.0V	0.00V	3.50V	VIN=VCC, OE=GND	VCC	> 0.00A / < 10.00A
ICCL	3.0V	0.00V	3.50V	VIN=GND, OE=GND	VCC	> 0.00A / < 10.00A
ICCZ	3.0V	0.00V	3.50V	OE=VCC	VCC	> 0.00A / < 10.00A

Table III. Electrical Characteristics of 54AC244 (cont.)

AC PARAMETRIC TESTS PERFORMED						
PARAMETER	VCC	VIL	VIH	PINS	LIMITS @ -55C TO +25C	
					MIN	MAX
TPLH	4.5V	0.0V	4.5V	OUT	1.0NS	7.0NS
TPHL	4.5V	0.0V	4.5V	OUT	1.0NS	7.0NS
TPZL	4.5V	0.0V	4.5V	OUT	1.0NS	9.0NS
TPZH	4.5V	0.0V	4.5V	OUT	1.0NS	9.0NS
TPLZ	4.5V	0.0V	4.5V	OUT	1.0NS	9.0NS
TPHZ	4.5V	0.0V	4.5V	OUT	1.0NS	9.0NS
PARAMETER	VCC	VIL	VIH	PINS	LIMITS @ +125C ONLY	
					MIN	MAX
TPLH	4.5V	0.0V	4.5V	OUT	1.0NS	9.5NS
TPHL	4.5V	0.0V	4.5V	OUT	1.0NS	9.5NS
TPZL	4.5V	0.0V	4.5V	OUT	1.0NS	10.5NS
TPZH	4.5V	0.0V	4.5V	OUT	1.0NS	10.5NS
TPLZ	4.5V	0.0V	4.5V	OUT	1.0NS	10.5NS
TPHZ	4.5V	0.0V	4.5V	OUT	1.0NS	10.5NS

TABLE IV: Summary of Electrical Measurements After
Total Dose Exposures and Annealing for 54AC244 1/

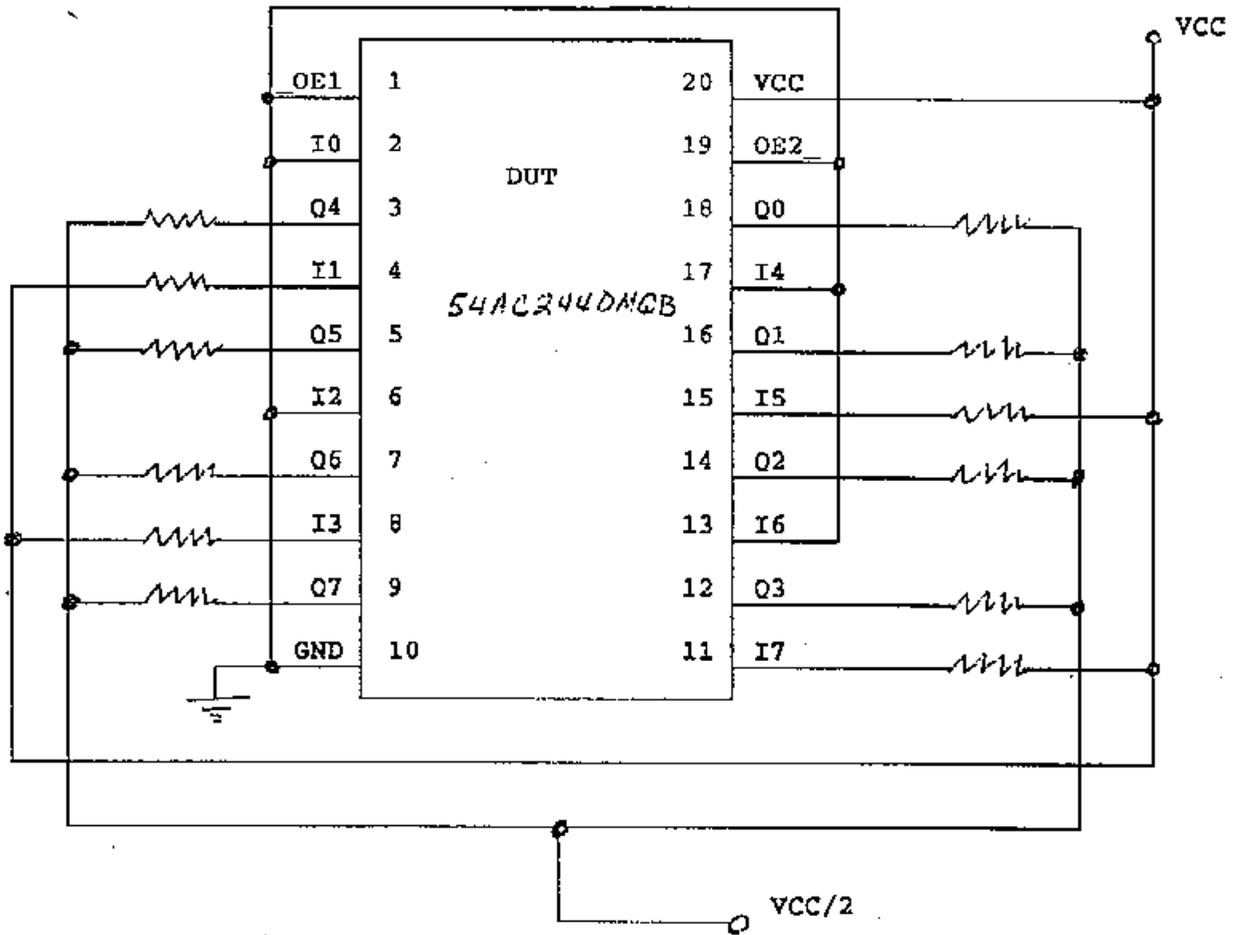
Parameters	Spec. Lim./2	Total Dose Exposure (TDE) (krads)										Anneal		TDE		Anneal			
		Initial		5		10		20		40		60		168 hrs @25°C		100 krads		168 hrs @100°C	
		mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd
FUNC1, 1 MHz, 3.0 V		PASS		PASS		PASS		PASS		PASS		PASS		PASS		PASS		PASS	
FUNC2, 1 MHz, 4.5 V		PASS		PASS		PASS		PASS		PASS		PASS		PASS		PASS		PASS	
VOH1 /3 V	2.9 3.0	2.99	0	2.99	0	2.99	0	2.99	0	2.99	0	2.99	0	2.99	0	2.99	0	2.99	0
VOH3 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	5.49	0	5.49	0
VOH5 V	3.7 4.5	4.16	.01	4.14	.02	4.13	.03	4.17	.01	4.15	.02	4.15	.02	4.15	.02	4.15	.01	4.14	.03
VOH7 V	3.85 5.5	4.85	.03	4.81	.05	4.78	.08	4.87	.01	4.83	.04	4.84	.03	4.84	.03	4.83	.04	4.81	.06
VOL1 mV	0 100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VOL7 mV	0 1650	447	18	458	25	518	53	448	24	478	47	486	25	481	42	458	31	518	70
VIC+ mV	400 1500	792	4.8	788	4.6	789	4.8	786	3.2	785	3.5	782	3.3	782	3.4	782	4.4	788	4.3
VIC- mV	-1500 -400	-742	.84	-740	1.3	-742	2.4	-741	0.6	-742	1.7	-742	.96	-741	1.5	-743	3.1	-741	2.4
IIH nA	0 100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
IIL nA	-100 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
IOZH nA	0 500	0.22	1.2	0.33	1.9	0.52	2.6	1.16	4.9	2.64	11	7.14	30	5.81	25	18.8	77	5.13	35
IOZL nA	-500 0	0	0	0	0	0	0	0	0	0	0	0.1	.99	0	0	0.3	3.1	0	0
ICCH uA	0 2.0	0	0	0	0	9.81	10	175	255	1330	1754	3303	4001	2596	3311	5631	6390	645	860
ICCL uA	0 2.0	0	0	0	0	1.25	1.3	41.8	81.6	676	960	2247	2817	1737	2289	4452	5189	431	619
IC CZ uA	0 2.0	0	0	0	0	3.44	5.0	105	160	1132	1516	3251	3996	2554	3287	6010	6911	667	901
TPHL ns	1.0 7.0	5.26	.19	5.34	.20	5.33	.19	5.31	.18	5.39	.18	5.38	.18	5.40	.18	5.34	.19	5.45	.19
TPLH ns	1.0 7.0	6.50	.30	6.59	.30	6.58	.27	6.51	.27	6.58	.30	6.58	.28	6.69	.36	6.42	.29	6.61	.29
TPLZ ns	1.0 9.0	7.26	.13	7.46	.14	7.41	.14	7.39	.13	7.42	.16	7.39	.14	7.29	.16	7.21	.12	7.29	.14
TPZL ns	1.0 9.0	6.59	.12	6.67	.16	6.65	.14	6.62	.14	6.67	.15	6.66	.13	6.67	.15	6.50	.17	6.81	.21
TPHZ ns	1.0 9.0	6.48	.12	6.63	.16	6.50	.12	6.60	.11	6.60	.15	6.55	.15	6.53	.12	6.43	.14	6.41	.14
TPZH ns	1.0 9.0	6.47	.24	6.62	.28	6.64	.25	6.61	.25	6.71	.27	6.71	.25	6.77	.24	6.74	.19	6.85	.26

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/These are manufacturers' non-irradiated data sheet specification limits. No post-irradiation limits were provided by the manufacturer at the time the tests were performed.

3/ No significant variation was observed in VOH2-5 or VOL2-7 during irradiation and annealing. Additional data are available on request.

Figure 1. Radiation Bias Circuit for 54AC244



VCC = 5.0 +/- 0.5 V.
R = 2K OHM +/- 10%, 1/4 WATT.