PPM 93-050

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Paramax Systems
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Memorandum

PARAMAX
A Unisys Company

PPM-93-050

DATE: April 12, 1993
TO: B. Fafaul/311
FROM: K. Sahu/300.1 KS
SUBJECT: Radiation Report on FAST/MUE
Part No. M38510/75703BRA (54AC240)
Control No. 7341

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

A radiation evaluation was performed on 54AC240 (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). The dose rate was between 0.15 and 2.10 krads/hour, depending on the total dose level (see Table II for radiation schedule). Finally the parts were annealed for 168 hours at 100°C. 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 three functional tests at 1.0 MHz with Vcc = 3.0, 4.5 and 5.5 V.

All ten parts passed initial (pre-rad) electrical tests. All eight irradiated parts passed all electrical tests up to and including the 5-krad level. At the 10 krad level, six parts (S/N 252, 253, 254, 255, 256 and 257) exceeded the maximum specification limit of 2 uA for ICCH, with readings ranging from 2.2 to 4.9 uA.

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*The term rads, as used in this document, means rads(silicon). All radiation levels cited are cumulative.
**These are manufacturers' non-irradiated data specification limits. No post-irradiation limits were provided by the manufacturer at the time these tests were performed.

After 20 krads, all irradiated parts exceeded the maximum specification limit for ICCH, with readings ranging from 5.7 to 13.2 uA. After 40 krads, ICCH failures continued with readings ranging from 3.8 to 64.6 uA. In addition, six parts (S/N 252, 253, 254, 255, 257 and 258) exceeded the maximum specification limit of 2.0 uA for ICCL, with readings ranging from 2.2 to 10.8 uA and five parts (S/N 252, 253, 254, 255 and 257) exceeded the maximum specification limit of 2.0 uA for ICCZ, with readings ranging from 2.7 to 9.0 uA. At the 60-krad level, the same parts failed the same tests, with readings for ICCH ranging from 2.9 to 236 uA, readings for ICCL from 2.2 to 31.7 uA and readings for ICCZ from 2.5 to 30.3 uA.

After annealing at 25°C for 168 hours, all irradiated parts continued to fail ICCH, with readings ranging from 2.1 to 76.9 uA and one part (S/N 255) exceeded the maximum specification limits for ICCL and ICCZ, with readings of 4.4 and 4.1 uA, respectively. All other parts read within specification limits.

Upon continued irradiation to 100 krads (cumulative) all irradiated parts continued to fail ICCH, with readings ranging from 9.4 uA to 1.4 mA. In addition, six parts, (S/N 252, 253, 254, 255, 257 and 258) failed ICCL and ICCZ, with readings ranging from 2.7 to 493 uA and 2.2 to 482 uA, respectively. After a final annealing at 100°C, no rebound effects were observed.

All parts passed all functional tests throughout all irradiation and annealing steps.

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.

TABLE I. Part Information

Generic Part Number:	54AC240
Part Number:	M38510/75703BRA*
FAST/MUE Control Number:	7341
Charge Number:	C33175
Manufacturer:	National Semiconductor Corp.
Lot Date Code:	9138A
Quantity Tested:	10
Serial Numbers of Radiation Samples:	252, 253, 254, 255, 256, 257, 258, 259
Serial Numbers of Control Samples:	250, 251
Part Function:	Octal Buffer/Line Driver
Part Technology:	CMOS
Package Style:	20-pin DIP
Test Equipment:	S-50
Test Engineer:	T. Scharer

* No radiation tolerance/hardness was guaranteed by the manufacturer for this part.

TABLE II. Radiation Schedule for 54AC240

EVENTS	DATE
1) INITIAL ELECTRICAL MEASUREMENTS	03/10/93
2) 5 KRAD IRRADIATION (0.25 KRADS/HOUR)	03/10/93
POST-5 KRAD ELECTRICAL MEASUREMENT	03/11/93
3) 10 KRAD IRRADIATION (0.25 KRADS/HOUR)	03/11/93
POST-10 KRAD ELECTRICAL MEASUREMENT	03/12/93
4) 20 KRAD IRRADIATION (0.15 KRADS/HOUR)	03/12/93
POST-20 KRAD ELECTRICAL MEASUREMENT	03/17/93
5) 40 KRAD IRRADIATION (2.10 KRADS/HOUR)	03/17/93
POST-40 KRAD ELECTRICAL MEASUREMENT	03/18/93
6) 60 KRAD IRRADIATION (2.00 KRADS/HOUR)	03/23/93
POST-60 KRAD ELECTRICAL MEASUREMENT	03/24/93
7) 168 HOUR ANNEALING @25°C	03/24/93
POST-168 HOUR ANNEAL ELECTRICAL MEASUREMENT	03/31/93
8) 100 KRAD IRRADIATION (2.00 KRADS/HOUR)	03/31/93
POST-100 KRAD ELECTRICAL MEASUREMENT	04/01/93
9) 168 HOUR ANNEALING @100°C*	04/01/93
POST-168 HOUR ANNEAL ELECTRICAL MEASUREMENT	04/08/93

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 54AC240

FUNCTIONAL TESTS PERFORMED

PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS
FUNCT #1	3.0V	0.45V	2.5V	FREQ= 1.0MHZ	ALL I/O	VOH>1.50V , VOL<1.50V
FUNCT #2	4.5V	0.6V	3.7V	FREQ= 1.0MHZ	ALL I/O	VOH>2.50V , VOL<2.50V
FUNCT #3	5.5V	0.0V	5.5V	FREQ= 1.0MHZ	ALL I/O	VOH>2.75V , VOL<2.75V

LOADS IOH=-4MA VCOM=VCC/2 IOL=4MA

DC TESTS PERFORMED

PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS @ +25C	
VOH1	3.0V	0.9V	2.1V	LOAD= -50.0UA	OUTPUTS	>2.90V	<3.00V
VOH2	4.5V	1.35V	3.15V	LOAD= -50.0UA	OUTPUTS	>4.40V	<4.50V
VOH3	5.5V	1.65V	3.85V	LOAD= -50.0UA	OUTPUTS	>5.40V	<5.50V
VOH4	3.0V	0.9V	2.1V	LOAD= -4.0MA	OUTPUTS	>2.40V	<3.00V
VOH5	4.5V	1.35V	3.15V	LOAD= -24.0MA	OUTPUTS	>3.70V	<4.50V
VOH6	5.5V	1.65V	3.85V	LOAD= -24.0MA	OUTPUTS	>4.70V	<5.50V
VOH7	5.5V	1.65V	3.85V	LOAD= -50.0MA	OUTPUTS	>3.85V	<5.50V
VOL1	3.0V	0.9V	2.1V	LOAD= +50.0UA	OUTPUTS	>0.00V	<0.10V
VOL2	4.5V	1.35V	3.15V	LOAD= +50.0UA	OUTPUTS	>0.00V	<0.10V
VOL3	5.5V	1.65V	3.85V	LOAD= +50.0UA	OUTPUTS	>0.00V	<0.10V
VOL4	3.0V	0.9V	2.1V	LOAD= +12.0MA	OUTPUTS	>0.00V	<0.40V
VOL5	4.5V	1.35V	3.15V	LOAD= +24.0MA	OUTPUTS	>0.00V	<0.40V
VOL6	5.5V	1.65V	3.85	LOAD= +24.0MA	OUTPUTS	>0.00V	<0.40V
VOL7	5.5V	1.65V	3.85V	LOAD= +50.0MA	OUTPUTS	>0.00V	<1.65V
VIC+	0.0V			IIN = +1MA	INPUTS	>0.40V	<1.5V
VIC-	OPEN			IIN = -1MA	INPUTS	>-1.5V	<-0.4V
IIL	5.5V	0.0V	5.5V	VTEST=0.0V	INPUTS	>-0.1UA	<0UA
IIH	5.5V	0.0V	5.5V	VTEST=5.5V	INPUTS	> 0UA	<0.1UA
ICCH	5.5V	0.0V	5.5V	OUTPUTS HIGH	VCC	>+0.0MA	<2UA
ICCL	5.5V	0.0V	5.5V	OUTPUTS LOW	VCC	>+0.0MA	<2UA
ICCZ	5.5V	0.0V	5.5V	OUTPUTS DISABLED	VCC	>+0.0MA	<2UA
IOZL	5.5V	0.0V	5.5V	VTEST=0.0V	OUTPUTS	>-0.5UA	<0.0A
IOZH	5.5V	0.0V	5.5V	VTEST=5.5V	OUTPUTS	> 0.0A	<+0.5UA

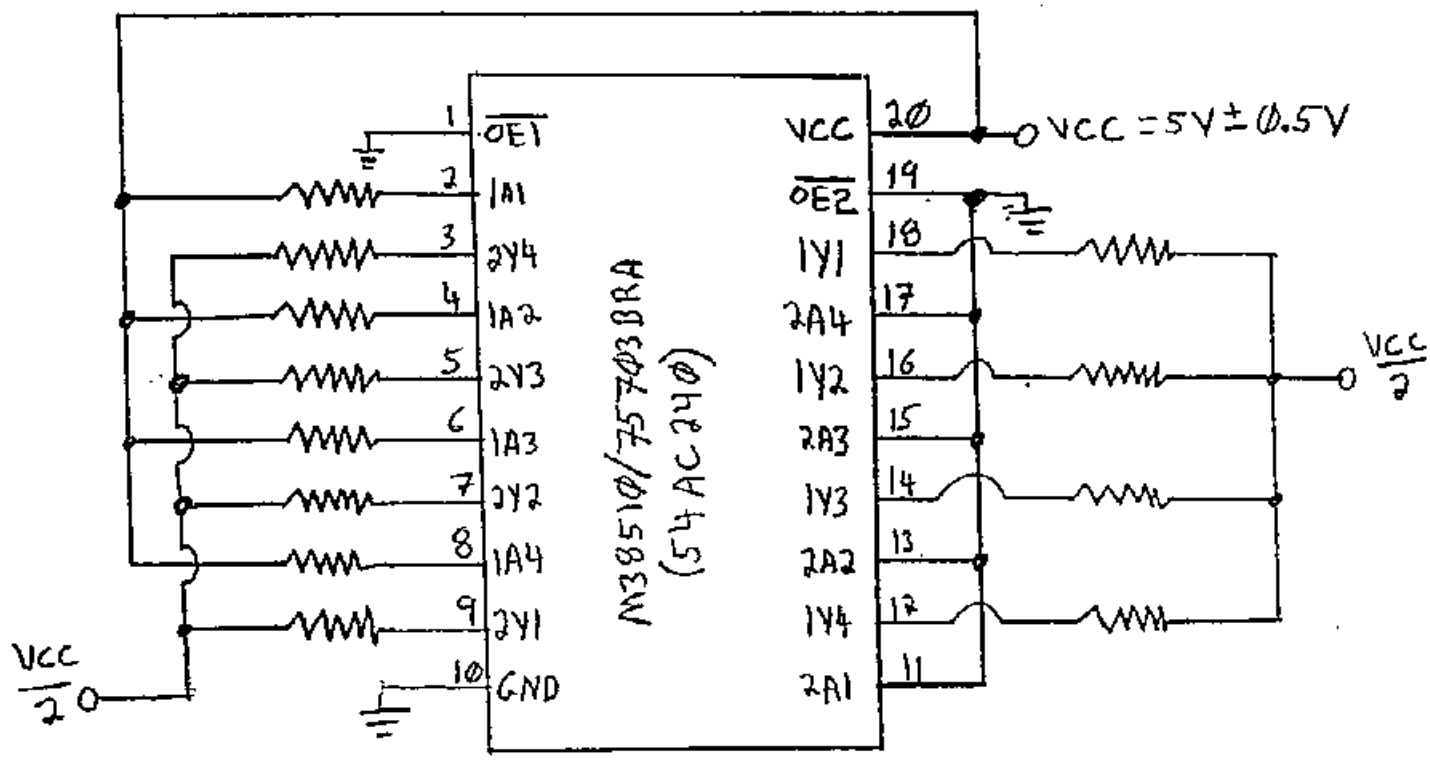
TABLE IV: Summary of Electrical Measurements After Total Dose Exposures and Annealing for 54AC240 1/

Parameters		Spec. Lim./2 min	Spec. Lim./2 max	Total Dose Exposure (TDE) (krads) Initial mean	Initial sd	5 mean	5 sd	10 mean	10 sd	20 mean	20 sd	40 mean	40 sd	60 mean	60 sd	Anneal 168 hrs @25°C mean	Anneal 168 hrs @25°C sd	TDE 100 krads mean	TDE 100 krads sd	Anneal 168 hrs @100°C mean	Anneal 168 hrs @100°C sd
FUNC1, 1 MHz, 3.5 V				PASS		PASS		PASS		PASS		PASS		PASS		PASS		PASS		PASS	
FUNC1, 1 MHz, 4.5 V				PASS		PASS		PASS		PASS		PASS		PASS		PASS		PASS		PASS	
FUNC3, 1 MHz, 5.5 V				PASS		PASS		PASS		PASS		PASS		PASS		PASS		PASS		PASS	
VOH1/3	V	2.9	3.0	2.99	.01	2.99	.01	2.99	.01	2.99	.01	2.99	.01	3.00	.01	3.00	0	3.00	0	2.99	0
VOH3/3	V	5.4	5.5	5.50	0	5.49	0	5.50	.01	5.49	0	5.49	0	5.49	0	5.49	0	5.49	0	5.49	0
VOH5/3	V	3.7	4.5	4.20	.01	4.19	.01	4.19	.01	4.17	.02	4.18	.01	4.19	.01	4.18	.01	4.18	.01	4.18	.01
VOH7/3	V	3.85	5.5	4.93	.01	4.91	.03	4.92	.01	4.87	.05	4.90	.02	4.92	.01	4.91	.01	4.90	.02	4.91	.01
VOL1/3	mV	0	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VOL7/3	mV	0	1650	385	22	384	19	383	21	402	79	393	24	385	15	391	15	396	26	398	18
VIC+	mV	400	1500	789	4.1	789	3.9	784	3.2	785	4.2	783	2.9	778	2.4	778	2.5	777	2.8	784	3.5
VIC-	mV	-1500	-400	-743	.79	-744	.65	-740	1.3	-743	2.5	-744	.87	-740	1.1	-739	.83	-741	1.1	-741	2.3
IIL	nA	-100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
IIH	nA	0	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ICCH	uA	0	2.0	0	0	0.08	.19	2.79	1.1	8.09	2.9	20.5	19	39.4	75	12.6	24	188	450	0.83	2.0
ICCL	uA	0	2.0	0	0	0	0	0.15	.15	0.25	.22	4.70	3.3	7.09	9.5	1.08	1.3	67.8	161	0	0
ICCZ	uA	0	2.0	0	0	0	0	0.08	.13	0.18	.19	3.88	2.7	6.38	9.2	0.90	1.2	65.9	157	0	0
IOZL	nA	-500	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
IOZH	nA	0	500	0	0	0	0	0	0	0	0	0.38	2.1	1.31	5.5	0.77	3.5	5.30	15	0	0

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, VOH4, VOH6 or VOL2-6 throughout all irradiation and annealing steps. Further data are available on request.

Radiation-sensitive parameters were ICCH, ICCL and ICCZ.

Figure 1. Radiation Bias Circuit for 54AC240



1) Vcc = 5.0VDC±0.5VDC

2) Vcc/2 = 2.5VDC±0.25VDC

3) All resistors R = 1.0Kohms±10%, 1/4W

4) Iout ~ 2.5V/iK = 2.5 mA<5.0mA maximum