PPM 92-270

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Memorandum

PARAMAX
A Unisys Company

DATE: October 28, 1992 PPM-92-270
TO: B. Fafaul/311
FROM: K. Sahu KS
SUBJECT: Radiation Report on FAST/MUE
Part No. M38510/76202BEA (54AC153)

cc: R. Kolecki/740.4
T. Miccolis
A. Sharma/311
Library/300.1
L. Cusick/740.4

A radiation evaluation was performed on 54AC153 (Dual 4-Input Multiplexer) 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, 20, 40 and 60 krads*. After 60 krads, parts were annealed at +25°C for 168 hours, and then the irradiation was continued to 100 krads (cumulative). The dose rate was between 0.07 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 according to the test conditions and the specification limits** listed in Table III. These tests included two functional tests (1.0 MHz) at 3.0V and 4.5V.

All 10 parts passed initial (pre-rad) electrical tests. After the 5-krad irradiation, one part (SN 32) exceeded the maximum specification limits of 2 uA for ICCH and ICCL with readings of 66.9 and 99.7 uA, respectively. After the 10-krad irradiation, four parts marginally exceeded the limits for ICCH and ICCL with a maximum reading of 2.7 uA, while SN 32 showed readings of 1.72 and 2.10 mA. After the 20-krad irradiation, all eight irradiated parts exceeded the limits for ICCH and ICCL. SN 32 indicated readings of 10<ICC<16 uA, while the other seven parts had readings between 8.2 and 21.6 uA. After the 40-krad irradiation, all eight irradiated parts passed all electrical tests. All irradiated parts continued to pass all electrical tests after the 60-krad exposure and after annealing for 168 hours at 25°C.

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

On continued irradiation to 100 krads cumulative exposure, all eight irradiated parts passed all electrical tests. After a final annealing at 100°C, all irradiated parts passed all electrical tests except for SN 32, which again failed ICCH and ICCL, with readings of 17.67 and 18.67 mA.

All parts passed both 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:	54AC153
Part Number:	M38510/76202BEA
FAST/MUE Control Number:	6000
Charge Number:	C23992
Manufacturer:	National Semiconductor Corp.
Lot Date Code:	9212A
Quantity Tested:	10
Serial Numbers of Radiation Samples:	25, 26, 27, 28, 29, 30, 31, 32
Serial Numbers of Control Samples:	23, 24
Part Function:	4-Input Multiplexer
Part Technology:	CMOS
Package Style:	16-pin DIP
Test Engineer:	K. Kim

TABLE II. Radiation Schedule for 54AC153

EVENTS	DATE
1) Initial Electrical Measurements	09/17/92
2) 5 KRAD IRRADIATION (0.25 krads/hour)	09/17/92
POST-5 KRAD ELECTRICAL MEASUREMENT	09/18/92
3) 10 KRAD IRRADIATION (0.074 krads/hour)	09/18/92
POST-10 KRAD ELECTRICAL MEASUREMENT	09/21/92
4) 20 KRAD IRRADIATION (0.53 krads/hour)	09/21/92
POST-20 KRAD ELECTRICAL MEASUREMENT	09/22/92
5) 40 KRAD IRRADIATION (1.0 KRADS/HOUR)	09/22/92
POST-40 KRAD ELECTRICAL MEASUREMENT	09/23/92
6) 60 KRAD IRRADIATION (1.0 KRADS/HOUR)	09/23/92
POST-60 KRAD ELECTRICAL MEASUREMENT	09/24/92
7) 168 HOUR ANNEALING @25°C	09/24/92
POST-168 HOUR ANNEAL ELECTRICAL MEASUREMENT	10/01/92
8) 100 KRAD IRRADIATION (2.05 KRADS/HOUR)	10/01/92
POST-100 KRAD ELECTRICAL MEASUREMENT	10/02/92
9) 168 HOUR ANNEALING @100°C*	10/02/92
POST-168 HOUR ANNEAL ELECTRICAL MEASUREMENT	10/09/92

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 54AC153

PART NO : M38510/76202BEA (54AC153) | PART TYPE : DUAL 4 INPUT MULTIPLEXER (16-PIN DIP).

LOCATION	TEST SPECIFICATIONS
PGM NUMBER : SI10576A DISK LABEL : LI8.25 DIRECTORY : DOAT:[PROGRAMS.576J]	MIL-M-38510/762 DATE : 08/28/90

TESTS PERFORMED

PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS @ +25C only
FUNCT #1	3.0V	.45V	2.5V	FREQ = 1MHz IOH =-50uA Load <= VREF= 1.5V IOL = 50uA	ALL I/O	VOL<1.50V , VOH>1.50V
FUNCT #2	4.5V	0.0V	3.7V	FREQ = 1Mhz IOH =-4.0mA Load <= VREF= 2.25V IOL = 4.0mA	ALL I/O	VOL<2.25V , VOH>2.25V

DC PARAMETRIC TESTS PERFORMED

PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS @ +25C only
VOH1	3.0V	0.90V	2.10V	LOAD = -50UA	OUTS	>2.90V , <3.00V
VOH2	4.5V	1.35V	3.15V	LOAD = -50UA	OUTS	>4.40V , <4.50V
VOH3	5.5V	1.65V	3.85V	LOAD = -50UA	OUTS	>5.40V , <5.50V
VOH4	3.0V	0.90V	2.10V	LOAD = -4MA	OUTS	>2.40V , <3.00V
VOH5	4.5V	1.35V	3.15V	LOAD = -24MA	OUTS	>3.70V , <4.50V
VOH6	5.5V	1.65V	3.85V	LOAD = -24MA	OUTS	>4.70V , <5.50V
VOH7	5.5V	1.65V	3.85V	LOAD = -50MA	OUTS	>3.85V , <5.50V

PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS @ +25C only
VOL1	3.0V	0.90V	2.10V	LOAD = +50UA	OUTS	>0.00V , <0.10V
VOL2	4.5V	1.35V	3.15V	LOAD = +50UA	OUTS	>0.00V , <0.10V
VOL3	5.5V	1.65V	3.85V	LOAD = +50UA	OUTS	>0.00V , <0.10V
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	5.5V	1.65V	3.85V	LOAD = +24MA	OUTS	>0.00V , <0.40V
VOL7	5.5V	1.65V	3.85V	LOAD = +50MA	OUTS	>0.00V , <1.65V

PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS @ +25C only
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 @ +25C only
IIH	5.5V	0.00V	5.50V	VIN = 5.5V	INS	> 0.00A , <+0.1UA
IIL	5.5V	0.00V	5.50V	VIN = 0.0V	INS	> -0.1UA , < 0.00A

PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS @ +25C only
ICCH	5.5V	0.00V	5.50V		VCC	> 0.00A , < 2.0UA
ICCL	5.5V	ALL INPUTS AT 0.00V			VCC	> 0.00A , < 2.0UA

Table III. Electrical Characteristics of 54AC153 (cont.)

AC PARAMETRIC TESTS PERFORMED

PARAMETER	VCC	VIL	VIH	FREQUENCY	PINS	LIMITS AT +25C ONLY
TPLH1	4.5V	0.0V	4.5V	1.0 MHz	Sn TO OUTS	> 1.0nS , < 11.0nS
TPHL1	4.5V	0.0V	4.5V	1.0 MHz	Sn TO OUTS	> 1.0nS , < 11.0nS
TPLH2	4.5V	0.0V	4.5V	1.0 MHz	In TO OUTS	> 1.0nS , < 9.0nS
TPHL2	4.5V	0.0V	4.5V	1.0 MHz	In TO OUTS	> 1.0nS , < 9.0nS
TPLH3	4.5V	0.0V	4.5V	1.0 MHz	$\bar{E}$_ TO OUTS	> 1.0nS , < 10.0nS
TPHL3	4.5V	0.0V	4.5V	1.0 MHz	$\bar{E}$_ TO OUTS	> 1.0nS , < 10.0nS

COMMENTS/EXCEPTIONS

(1) Cin, Co, Cpd, Vgbl, Icc(o/v1), Icc(o/v2), Icc(o/i1+) and Icc(o/i1-) tests are NOT performed.

(2) AC parametric tests at VCC = 3.0V is NOT performed.

(3) This program detects improper DUT insertion.

HARDWARE REQUIREMENTS	TEST TEMPERATURES		
DEVICE CONFIGURATION : 16-PIN DIP S-50 LOAD BOARD # 17 : DUT pin#5 jumped to GND.	+25 DEG. C. -55 DEG. C. +125 DEG. C.	x	only
PROGRAMMER : K. Kim	DATE : 09-10-92		

TABLE IV: Summary of Electrical Measurements After Total Dose Exposures and Annealing for 54AC153 1/

Parameters	Spec. Lim./2 min	max	Total Dose Exposure (TDE) (krads) Initial mean	sd	5 mean	sd	10 mean	sd	20 mean	sd	40 mean	sd	60 mean	sd	Anneal 168 hrs @25°C mean	sd	TDE 100 krads mean	sd	Anneal 168 hrs @100°C 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	2.98	.03	2.97	.04	2.99	0	2.99	0	2.99	.01	2.99	.01	2.99	.01	2.99	0
VOH3 V	5.4	5.5	5.49	0	5.48	.03	5.48	.02	5.49	.01	5.48	.01	5.49	.01	5.49	.01	5.49	.01	5.49	0
VOH5 V	3.7	4.5	4.19	.01	4.18	.02	4.19	.04	4.18	.01	4.18	.01	4.18	.01	4.18	.01	4.18	.01	4.18	.01
VOH7 V	3.85	5.5	4.91	.02	4.92	.04	4.87	.09	4.90	.02	4.89	.03	4.89	.02	4.90	.01	4.89	.02	4.89	.02
VOL1 mV	0	100	0	0	0	0	0	0	0.38	1.5	1.88	5.9	2.31	7.5	4.81	13	3.0	9.7	0.94	3.6
VOL7 mV	0	1650	388	14	371	5.4	421	87	389	7.7	402	10	387	14	461	21	376	14	389	11
VIC+ mV	400	1500	786	6.3	787	31	772	59	783	5.3	782	5.2	778	9.8	779	4.5	778	4.4	781	5.3
VIC- mV	-1.5K	-400	-740	1.5	-739	1.6	-742	2.1	-740	1.5	-741	2.1	-737	1.1	-738	1.6	-739	1.8	-735	2.2
IIH nA	-100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
IIL nA	0	100	-0.1	0	-0.1	0	-0.1	0	-0.1	0	-0.1	0	-0.1	0	-0.1	0	-0.1	0	-0.1	0
ICCH uA	0	2.0	0	0	8.44	22	217	569	12.4	5.6	0	0	0	0	0	0	0	0	2200	6000
ICCL uA	0	2.0	0	0	12.6	33	264	692	14.0	6.3	0	0	0	0	0	0	0	0	2500	6000
TPLH1 ns	1.0	11.0	9.05	.17	9.01	.16	8.96	.18	8.95	.19	8.88	.18	8.95	.17	8.99	.17	8.92	.16	8.73	.22
TPHL1 ns	1.0	11.0	7.57	.30	7.57	.30	7.48	.36	7.48	.33	7.45	.34	7.52	.36	7.55	.36	7.51	.39	7.91	.25
TPLH2 ns	1.0	9.0	7.91	.15	7.86	.14	7.82	.14	7.79	.13	7.73	.12	7.77	.13	7.80	.13	7.72	.11	7.63	.18
TPHL2 ns	1.0	9.0	6.54	.11	6.51	.13	6.46	.10	6.41	.12	6.39	.11	6.43	.11	6.46	.10	6.39	.10	6.75	.21
TPLH3 ns	1.0	10.0	7.87	.13	7.85	.14	63.6	.22	7.84	.14	7.85	.13	7.93	.13	7.98	.13	8.00	.12	8.56	.18
TPHL3 ns	1.0	10.0	6.91	.09	6.86	.07	6.79	0.1	6.75	.09	6.71	.08	6.68	.10	6.74	.10	6.60	.11	6.35	.16

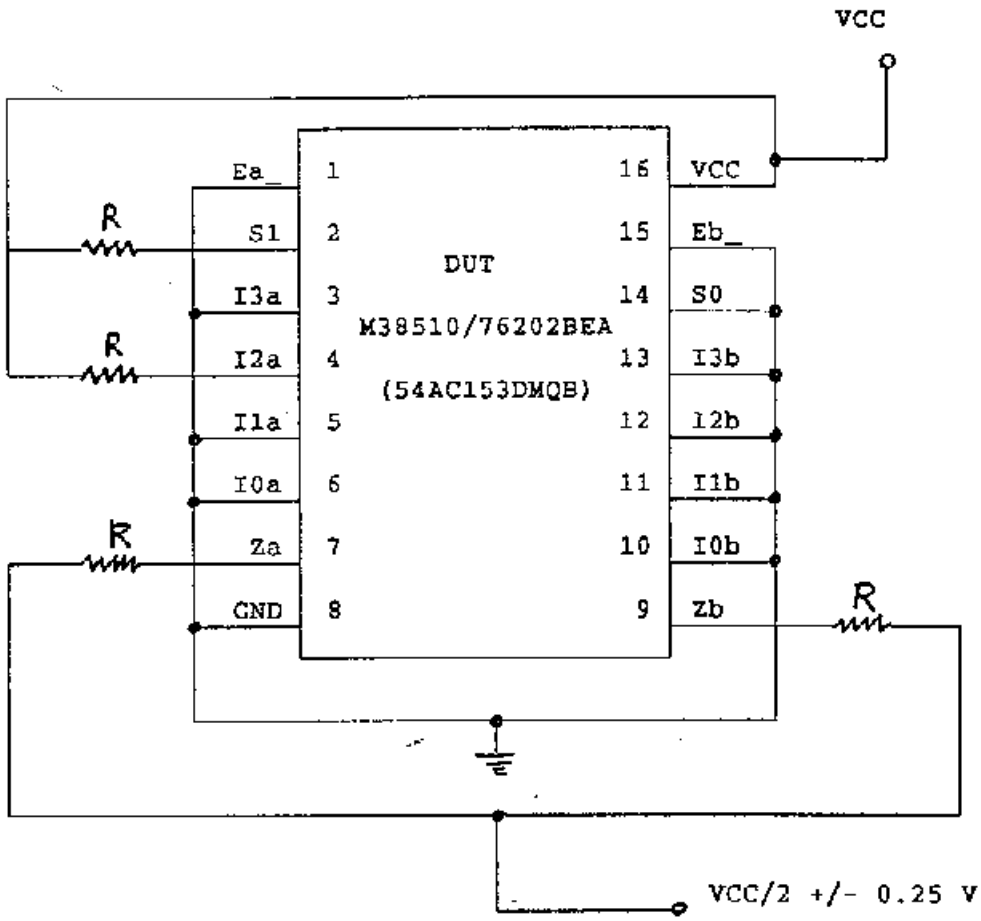
Note:

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 VOH or VOL during irradiation and annealing. Additional data are available on request.

Figure 1. Radiation Bias Circuit for 54AC153



VCC = 5.0 +/- 0.5 V.
R = 2K OHM +/- 10%, 1/4 WATT
Ta = 25 Deg. C except during the final annealing step.
During the final annealing step, Ta = 100 Deg. C.