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Memorandum

PARAMAX
A Unisys Company

DATE: October 7, 1992
TO: B. Fafaul/311.1
FROM: K. Sahu/7809 ks
SUBJECT: Radiation Report on FAST/MUE Project
Part No. M38510/75601BRA (control no.6003)

PPM-92-244

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

A radiation evaluation was performed on the M38510/75601BRA (54AC273) Octal D-Type Flip-Flop 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. The total dose radiation steps were 5, 10, 20, 40, 60 and 100 krads (the term rad as used here means rad(Si)). The parts were kept under bias during irradiation and annealing (see Figure 1 for bias configuration). Two parts were used as control samples. After the 60-krad exposure, the parts were annealed at +25°C for 168 hours. After this annealing step, the parts were irradiated to a total accumulated dose of 100 krads. After this exposure, the parts were annealed for 168 hours at +100°C. The dose rate was between 0.11 and 2.1 krads/hour, depending on the total dose level (see Table II for radiation schedule). After each radiation exposure and annealing treatment, the parts were electrically tested at +25°C according to the test conditions and the specification limits listed in Table III. These tests included three functional tests at 1 MHz, with Vcc = 3.0V, 4.5V and 5.5V.

All parts passed the initial electrical tests as well as all electrical tests up to the 40 krad exposure. After the 40-krad irradiation, two parts marginally exceeded the maximum specification limit of 2uA for ICCH and ICCL, with a maximum reading of 2.6uA. After the 60-krad exposure, only one of these two parts exceeded the maximum specification limits.

After 168 hours of annealing at 25°C, all parts passed all electrical tests. After the subsequent 100-krad exposure, all parts exceeded the maximum specification limits for ICCH and ICCL, with a maximum reading of 6.57uA and a typical reading of 5.0uA. After annealing for 168 hours at +100°C, all parts passed all electrical tests.

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

Table IV gives 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:	54AC273
FAST/MUE Part Number:	JM38510/75601BRA
Control Number:	6003
Charge Number:	C23972
Manufacturer:	National Semiconductor
Lot Date Code:	9212A
Quantity Tested:	10
Serial Number of Radiation Samples:	92, 93, 94, 95, 96, 97, 98, 99
Serial Number of Control Sample:	90, 91
Part Function:	Octal D-Type Flip-Flop
Part Technology:	CMOS
Package Style:	10-pin DIP
Test Engineer:	A. Karygiannis

TABLE II. Radiation Schedule for 54AC273

EVENTS	DATE
1) INITIAL (PRE-IRRADIATION) ELECTRICAL MEASUREMENT	09/01/92
2) 5- KRAD IRRADIATION (0.25 krads/hour) POST-5-KRAD ELECTRICAL MEASUREMENT	09/02/92 09/03/92
3) 10-KRAD IRRADIATION (0.21 krads/hour) POST-10-KRAD ELECTRICAL MEASUREMENT	09/04/92 09/04/92
4) 20-KRAD IRRADIATION (0.11 krads/hour) POST-20-KRAD ELECTRICAL MEASUREMENT	09/08/92 09/08/92
5) 40-KRAD IRRADIATION (1.0 krads/hour) POST-40-KRAD ELECTRICAL MEASUREMENT	09/09/92 09/09/92
6) 60-KRAD IRRADIATION (1.03 krads/hour) POST-60-KRAD ELECTRICAL MEASUREMENT	09/10/92 09/11/92
7) 168 HOURS ANNEALING AT +25°C POST-168-HOUR ELECTRICAL MEASUREMENTS	09/11/92 09/21/92
8) 100-KRAD IRRADIATION (2.1 krads/hour) POST-100-KRAD ELECTRICAL MEASUREMENT	09/22/92 09/22/92
9) 168 HOURS ANNEALING AT +100°C POST-168-HOUR ELECTRICAL MEASUREMENT	09/22/92 09/30/92

ALL ELECTRICAL MEASUREMENTS WERE PERFORMED AT +25°C.

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

Table III. Electrical Characteristics of LF147

DEVICE	PART TYPE : JCIAL J-TYPE FLIP-FLOP WITH RESET		PCN : SI10501A			
	PART NO. : N33510/75A018RA (54AC273)					
TEST PROGRAM LOCATION			TEST SPECIFICATIONS			
DISK LABEL : LID 22			MIL-R-38510/756 18 AUG 1990			
DIRRECTORY : \QAAT\PROGRAMS.5011						
FUNCTIONAL TESTS						
PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS AT +25C ONLY
FUNCT 1	3.0V	0.0V	3.0V	FREQ=1.00MHZ	ALL I/O	VOL<1.5V / VOH>1.5V
FUNCT 2	4.5V	0.0V	4.5V	FREQ=1.00MHZ	ALL I/O	VOL<2.0V / VOH>2.0V
FUNCT 3	5.5V	0.0V	5.5V	FREQ=1.00MHZ	ALL I/O	VOL<2.5V / VOH>2.5V
DC PARAMETRIC TESTS						
PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS AT +25C ONLY
V _{OH1}	3.00V	0.90V	2.10V	LOAD=-50uA	OUTS	>+2.90V / <+3.00V
V _{OH2}	4.50V	1.35V	3.15V	LOAD=-50uA	OUTS	>+4.40V / <+4.50V
V _{OH3}	5.50V	1.65V	3.85V	LOAD=-50uA	OUTS	>+5.40V / <+5.50V
V _{OH4}	3.00V	0.90V	2.10V	LOAD=-4mA	OUTS	>+2.40V / <+3.00V
V _{OH5}	4.50V	1.35V	3.15V	LOAD=-24mA	OUTS	>+3.70V / <+4.50V
V _{OH6}	5.50V	1.65V	3.85V	LOAD=-24mA	OUTS	>+4.70V / <+5.50V
V _{OH7}	5.50V	1.65V	3.85V	LOAD=-50mA	OUTS	>+3.85V / <+5.50V
PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS AT +25C ONLY
V _{OL1}	3.00V	0.90V	2.10V	LOAD=+50uA	OUTS	>+0.00V / <+0.10V
V _{OL2}	4.50V	1.35V	3.15V	LOAD=+50uA	OUTS	>+0.00V / <+0.10V
V _{OL3}	5.50V	1.65V	3.85V	LOAD=+50uA	OUTS	>+0.00V / <+0.10V
V _{OL4}	3.00V	0.90V	2.10V	LOAD=+12mA	OUTS	>+0.00V / <+0.40V
V _{OL5}	4.50V	1.35V	3.15V	LOAD=+24mA	OUTS	>+0.00V / <+0.40V
V _{OL6}	5.50V	1.65V	3.85V	LOAD=+24mA	OUTS	>+0.00V / <+0.40V
V _{OL7}	5.50V	1.65V	3.85V	LOAD=+50mA	OUTS	>+0.00V / <+1.65V
PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS AT +25C ONLY
V _{IC+}	0.00V	N/A	N/A	I _{IN} = +1mA	INS	>+0.4V / <+1.5V
V _{IC-}	OPEN	N/A	N/A	I _{IN} = -1mA	INS	>-1.5V / <-0.4V
I _{IH}	5.50V	0.00V	5.50V	V _{IN} = 5.5V	INS	>+0.0uA / <+0.1uA
I _{IL}	5.50V	0.00V	5.50V	V _{IN} = 0.0V	INS	>-0.1uA / <+0.0uA
I _{CC1}	5.50V	0.00V	5.50V	V _{IN} = 5.5V	VCC	>+0.0uA / <+2.0uA
I _{CC2}	5.50V	0.00V	5.50V	V _{IN} = 0.0V	VCC	>+0.0uA / <+2.0uA
HARDWARE REQUIREMENTS			TEMPERATURE TESTING CAPABILITY			
DEVICE CONFIGURATION : 20-PIN DIP			+25 DEG. C. x Only			
LOAD GUARD # 2 OR 17 : JUMP/SWITCH GND TO PIN # 10						
PROGRAMMER : JUAN R. LANDER			DATE : 10 FEB 92			

TABLE IV: Summary of Electrical Measurements After
Total Dose Exposures and Annealing for 54AC273 1/

Parameters	Spec. Lim. min max	Total Dose Exposure (TDE) (krads)										Anneal		TDE		Anneal			
		Initial		5		10		20		40		60		168 hour @+25°C		100 krads		168 hour @+100°C	
		mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd
FUNC1 @1 MHz, Vcc=3.0V*		PASS		PASS		PASS		PASS		PASS		PASS		PASS		PASS		PASS	
FUNC2 @1 MHz, Vcc=4.5V		PASS		PASS		PASS		PASS		PASS		PASS		PASS		PASS		PASS	
FUNC3 @1 MHz, Vcc=5.5V		PASS		PASS		PASS		PASS		PASS		PASS		PASS		PASS		PASS	
VOH1	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
VOH2	V	4.4	4.5	4.49	0	4.49	0	4.49	0	4.49	0	4.49	0	4.49	0	4.49	0	4.49	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
VOH4	V	2.4	3.0	2.91	.01	2.92	.01	2.91	.01	2.91	.01	2.90	.01	2.91	.01	2.91	0	2.91	0
VOH5	V	3.7	4.5	4.11	.05	4.12	.01	4.10	.04	4.13	.01	4.11	.03	4.07	.06	4.11	.03	4.11	.01
VOH6	V	4.7	5.5	5.15	.06	5.17	.01	5.15	.04	5.17	.01	5.15	.03	5.18	.06	5.15	.04	5.16	.01
VOH7	V	3.85	5.5	4.76	0.1	4.79	.03	4.75	.07	4.79	.02	4.77	.06	4.70	0.1	4.75	.08	4.77	.03
VOL1	mV	0	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VOL2	mV	0	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VOL3	mV	0	100	0	0	1.06	2.4	0	0	0	0	0	0	0	0	0	0	0	0
VOL4	mV	0	400	170	13	167	9.3	170	13	162	3.5	170	13	177	14	170	13	164	5.2
VOL5	mV	0	400	240	27	233	18	240	26	222	5.7	237	25	251	29	237	25	226	11
VOL6	mV	0	400	207	29	201	19	207	26	239	5.4	203	25	218	29	202	24	192	11
VOL7	mV	0	1650	452	77	432	39	449	65	409	12	440	56	475	76	442	82	416	27
VIC+	V	0.4	1.5	1.29	0	1.30	0	1.10	.01	1.11	.02	1.11	.01	1.11	0.1	1.13	.01	1.16	0
VIC-	V	-1.5	-0.4	-0.7	0	-0.7	0	-0.7	0	-0.7	.02	-0.7	.01	-0.7	.01	-0.7	0	-0.7	0
IIB	nA	0	100	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
ICCH	uA	0	2	0	0	0.30	.04	0.49	0.2	0.94	0.4	1.28	0.3	2.22	0.3	1.11	0.1	5.9	.05
ICCL	uA	0	2	0	0	0.21	.04	0.23	0.2	0.55	0.3	0.50	0.2	1.76	0.2	0.76	.07	5.5	.05

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.

*"PASS" means that all parts passed this functional test. "FAIL" means that all parts failed the test. If N parts passed and M parts failed, this is represented by "NP/MF".

Figure 1. Radiation Bias Circuit for 54AC273

