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UNISYS

Interoffice Memorandum

To
T. Miccolis

Department
Code 300.1

From
K. Sahu KS

Department
7809

Subject
Radiation Report on 54AC74DMQB
SMEX Common Buy Part No. 5962-8852001CA
Control No. 1649

PPM-91-746

Date
Dec. 13, 1991

Location
Lanham

Telephone
731-8954

Location
Lanham

cc
B. Fafaul/311
A. Sharma/311
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A radiation evaluation was performed on 54AC74DMQB 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 krads*. After 100 krads, parts were annealed at 25°C for 168 hours with measurements taken at 96 and 168 hours, and then irradiation was continued to 200 and 300 krads (cumulative). Finally, parts were annealed under bias at 100°C for 168 hours. The dose rate was between 0.5 and 5 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. These tests included three functional tests at 1MHz and 40MHz.

All eight parts passed the three functional tests throughout the testing to 300 krads. However, after the first radiation exposure to 10 krads, parts began to exceed the specification limits for ICCH and ICCL. Seven parts exceeded the maximum specification limit of 80uA for ICCH and six parts exceeded the same limit for ICCL. On continued exposure to 20, 30 and 50 krads, ICC readings continued to degrade. At 75 krads, ICCH and ICCL readings were well above the specified limit, with typical readings of 25mA. Also, six parts did not meet the minimum specification limit of 3.85V for VOH7. At 100 krads, VOH7 readings approached 1.5V.

After annealing the parts for 168 hours at 25°C, parts showed partial recovery in VOH7. On continued exposure to 300 krads, ICCH and ICCL continued to degrade, with typical readings of 70mA, and parts continued to fail VOH7. Slight recovery in these

parameters was observed after annealing the parts for 168 hours at 100°C, but not enough to bring them within the specification limits. Table IV provides 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.

*In this report, the term "rads" is used as an abbreviation for rads (Si).

TABLE I. Part Information

Generic Part Number:	54AC74DMQB
SMEX Common Buy Part Number:	5962-8852001CA
SMEX Common Buy Control Number:	1649
Charge Number:	C90356
Manufacturer:	National Semiconductor
Lot Date Code:	9039A
Quantity Tested:	10
Serial Numbers of Radiation Samples:	22, 23, 24, 25, 26, 27, 28, 29
Serial Number of Control Samples:	20, 21
Part Function:	Dual D-Type Pos. Edge trig. Flip-Flop
Part Technology:	CMOS
Package Style:	14 pin DIP
Test Engineer:	A. Karygiannis

TABLE II. Radiation Schedule for 54AC74DMQB

EVENTS	DATE
1) Initial (Pre-Irradiation) Electrical Measurements	07/10/91
2) 10-KRAD IRRADIATION (525 rads/hour)	10/29/91
POST 10-KRAD ELECTRICAL MEASUREMENT	10/30/91
3) 20-KRAD IRRADIATION (525 rads/hour)	10/30/91
POST 20-KRAD ELECTRICAL MEASUREMENT	11/04/91
4) 30-KRAD IRRADIATION (500 rads/hour)	11/05/91
POST 30-KRAD ELECTRICAL MEASUREMENT	11/06/91
5) 50-KRAD IRRADIATION (1000 rads/hour)	11/06/91
POST 50-KRAD ELECTRICAL MEASUREMENT	11/07/91
6) 75-KRAD IRRADIATION (1300 rads/hour)	11/07/91
POST 75-KRAD ELECTRICAL MEASUREMENT	11/08/91
7) 100-KRAD IRRADIATION (1300 rads/hour)	11/08/91
POST 100-KRAD ELECTRICAL MEASUREMENT	11/09/91
8) 96 HOURS ANNEALING AT +25°C	11/09/91
POST 96-HOURS ELECTRICAL MEASUREMENT	11/13/91
ANNEALING TIME INCREASED DUE TO S-50 PROBLEMS	
9) 168 HOURS ANNEALING AT +25°C	11/09/91
POST 168-HOURS ELECTRICAL MEASUREMENT	11/16/91
10) 200-KRAD IRRADIATION (2300 rads/hour)	11/16/91
POST 200-KRAD ELECTRICAL MEASUREMENTS	11/18/91
11) 300-KRAD IRRADIATION (5000 rads/hour)	11/18/91
POST 300-KRAD ELECTRICAL MEASUREMENTS	11/19/91
12) 168 HOURS ANNEALING AT +100°C UNDER BIAS	11/19/91
POST 168 HOURS AT +100°C ELECTRICAL MEASUREMENTS	11/27/91

All electrical measurements performed at +25°C.

Table III. Electrical Characteristics of 54AC74DMQB

TESTS PERFORMED						
PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS: -55C TO +125C
FUNCT #1	2.0V	0.0V	2.0V	FREQ = 1MHZ	ALL I/O	VOL < 1.0V / VOH > 1.0V
FUNCT #2	3.0V	0.0V	3.0V	FREQ = 40MHZ	ALL I/O	VOL < 1.5V / VOH > 1.5V
FUNCT #3	5.0V	0.0V	3.0V	FREQ = 40MHZ	ALL I/O	VOL < 2.5V / VOH > 2.5V
PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS: -55C TO +125C
VOH1	3.0V	0.90V	2.10V	LOAD = -50UA	OUTS	> 2.90V / < 6.00V
VOL2	4.5V	1.35V	3.15V	LOAD = -50UA	OUTS	> 4.40V / < 8.00V
VOH3	5.5V	1.65V	3.85V	LOAD = -50UA	OUTS	> 5.40V / < 8.00V
VOH4	3.0V	0.90V	2.10V	LOAD = -4MA	OUTS	> 2.40V / < 6.00V
VOH5	4.5V	1.35V	3.15V	LOAD = -4MA	OUTS	> 3.70V / < 8.00V
VOH6	5.5V	1.65V	3.85V	LOAD = -4MA	OUTS	> 4.70V / < 8.00V
VOH7	3.0V	1.35V	3.85V	LOAD = -50MA	OUTS	> 3.85V / < 8.00V
PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS: -55C TO +125C
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 / < 0.50V
VOL5	4.5V	1.35V	3.15V	LOAD = +24MA	OUTS	> 0.00V / < 0.50V
VOL6	5.5V	1.65V	3.85V	LOAD = +24MA	OUTS	> 0.00V / < 0.50V
VOL7	5.5V	1.65V	3.85V	LOAD = +50MA	OUTS	> 0.00V / < 1.65V
PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS: -55C TO +125C
I _{IH}	5.5V	0.00V	5.50V	VIN = 5.5V	INS	> 0.00A / < +1.00A
I _{IL}	5.5V	0.00V	5.50V	VIN = 0.0V	INS	> -1.00A / < 0.00A
I _{CC1}	5.5V	0.00V	5.50V	VIN = 5.5V	VCC	> 0.00A / < 60.00A
I _{CC2}	5.5V	0.00V	5.50V	VIN = 0.0V	VCC	> 0.00A / < 80.00A
TIMING TESTS PERFORMED						
PARAMETER	VCC	VIL	VIH	CONDITIONS		LIMITS @ +25C
TPLH1 CP	3.0V	0.0V	3.0V	FREQ=1MHZ, RL=500 OHMS		> 1NS / < 13.5NS
TPHL1 CP	3.0V	0.0V	3.0V	FREQ=1MHZ, RL=500 OHMS		> 1NS / < 13.5NS
TPLH1 CD	3.0V	0.0V	3.0V	FREQ=1MHZ, RL=500 OHMS		> 1NS / < 12.0NS
TPHL1 CD	3.0V	0.0V	3.0V	FREQ=1MHZ, RL=500 OHMS		> 1NS / < 12.0NS
TPLH1 SD	3.0V	0.0V	3.0V	FREQ=1MHZ, RL=500 OHMS		> 1NS / < 12.0NS
TPHL1 SD	3.0V	0.0V	3.0V	FREQ=1MHZ, RL=500 OHMS		> 1NS / < 12.0NS
PARAMETER	VCC	VIL	VIH	CONDITIONS		LIMITS @ -55C/+125C
TPH1 CP	3.0V	0.0V	3.0V	FREQ=1MHZ, RL=500 OHMS		> 1NS / < 17.5NS
TPH1 CD	3.0V	0.0V	3.0V	FREQ=1MHZ, RL=500 OHMS		> 1NS / < 17.5NS
TPH1 SD	3.0V	0.0V	3.0V	FREQ=1MHZ, RL=500 OHMS		> 1NS / < 14.0NS
TPH1 CP	3.0V	0.0V	3.0V	FREQ=1MHZ, RL=500 OHMS		> 1NS / < 14.0NS
TPH1 CD	3.0V	0.0V	3.0V	FREQ=1MHZ, RL=500 OHMS		> 1NS / < 14.0NS
TPH1 SD	3.0V	0.0V	3.0V	FREQ=1MHZ, RL=500 OHMS		> 1NS / < 14.0NS
PARAMETER	VCC	VIL	VIH	CONDITIONS		LIMITS @ +25C
TPH1 CP	4.5V	0.0V	4.5V	FREQ=1MHZ, RL=500 OHMS		> 1NS / < 10.0NS
TPH1 CD	4.5V	0.0V	4.5V	FREQ=1MHZ, RL=500 OHMS		> 1NS / < 10.0NS
TPH1 SD	4.5V	0.0V	4.5V	FREQ=1MHZ, RL=500 OHMS		> 1NS / < 9.5NS
TPH1 CP	4.5V	0.0V	4.5V	FREQ=1MHZ, RL=500 OHMS		> 1NS / < 9.5NS
TPH1 CD	4.5V	0.0V	4.5V	FREQ=1MHZ, RL=500 OHMS		> 1NS / < 9.5NS
TPH1 SD	4.5V	0.0V	4.5V	FREQ=1MHZ, RL=500 OHMS		> 1NS / < 9.5NS
PARAMETER	VCC	VIL	VIH	CONDITIONS		LIMITS @ -55C/+125C
TPH1 CP	4.5V	0.0V	4.5V	FREQ=1MHZ, RL=500 OHMS		> 1NS / < 12.0NS
TPH1 CD	4.5V	0.0V	4.5V	FREQ=1MHZ, RL=500 OHMS		> 1NS / < 12.0NS
TPH1 SD	4.5V	0.0V	4.5V	FREQ=1MHZ, RL=500 OHMS		> 1NS / < 10.5NS
TPH1 CP	4.5V	0.0V	4.5V	FREQ=1MHZ, RL=500 OHMS		> 1NS / < 10.5NS
TPH1 CD	4.5V	0.0V	4.5V	FREQ=1MHZ, RL=500 OHMS		> 1NS / < 10.5NS
TPH1 SD	4.5V	0.0V	4.5V	FREQ=1MHZ, RL=500 OHMS		> 1NS / < 10.5NS

COMMENTS/EXCEPTIONS

- (1) FUNCTIONAL TESTS PERFORMED WITH OUTPUT LOADING OF IOH=-2.0mA, IOL=2.0mA
- (2) VIL & VIH WERE TESTED DURING VOL & VOH TESTS AS GO/NOGO.
- (3) I_{IH} TEST WAS PERFORMED WITH OTHER INPUTS AT VIH. (5.5V)
- (4) I_{IL} TEST WAS PERFORMED WITH OTHER INPUTS AT VIL. (0.0V)
- (5) AC TESTS WERE PERFORMED WITH VMEASURE = VCC/2 PER SPECS.

TABLE IV: Summary of Electrical Measurements After Total Dose Exposures and Annealing for 54AC74DMQB

1/, 2/

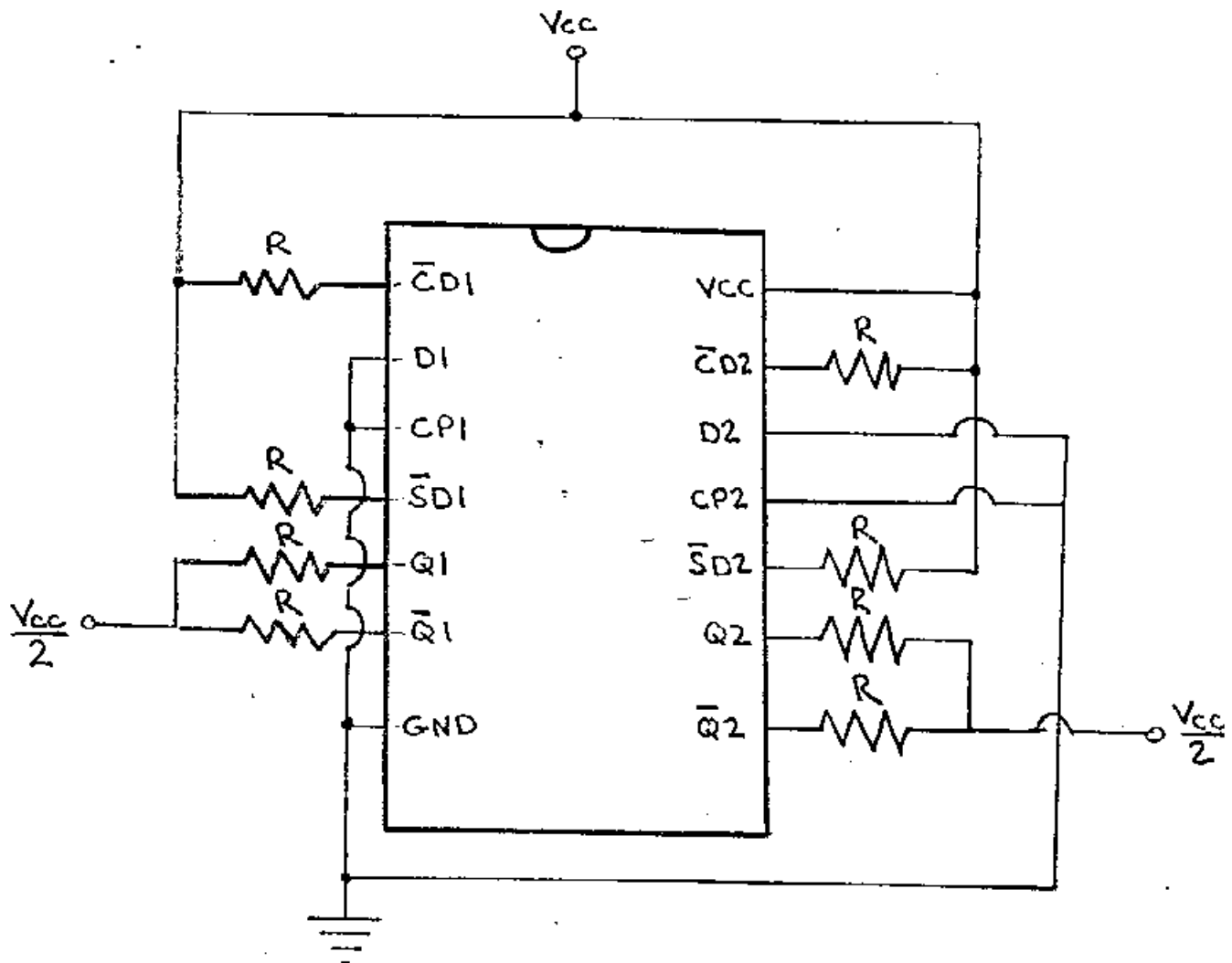
Parameters	Spec Limits min max		Total Dose Exposure (TDE) (krads)												Anneal		Total Dose (krads)		Anneal						
			(Pre-Rad)		0		10		20		30		50		100		168 hrs @25°C		200		300		168 hrs @100°C		
			mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	
FUNC1 @ 1 MHz			P		P		P		P		P		P		P		P		P		P		P		
FUNC2 @ 40 MHz			P		P		P		P		P		P		P		P		P		P		P		
FUNC3 @ 40 MHz			P		P		P		P		P		P		P		P		P		P		P		
VOH1_3.0V V	2.9	6.0	2.99	0	2.99	0	2.99	0	2.99	0	2.99	0	2.99	0.01	2.99	0	2.96	0.03	2.96	0.02	2.98	0.01			
VOH2_4.5V V	4.4	6.0	4.49	0	4.49	-	4.49	-	4.49	-	4.49	0	4.49	0	4.49	0	4.46	0.02	4.46	0.02	4.48	0.01			
VOH3_5.5V V	5.4	6.0	5.49	0	5.49	0	5.49	0	5.49	0	5.49	0	5.48	0	5.48	0.01	5.46	0.02	5.46	0.01	5.48	0.01			
VOH4_3.0V V	2.4	6.0	2.92	0	2.92	0	2.92	0.01	2.92	0	2.91	0	2.91	0.01	2.91	0.01	2.88	0.03	2.87	0.02	2.90	0.01			
VOH5_4.5V V	3.7	6.0	4.15	0.01	4.15	0.01	4.15	0.01	4.15	0.01	4.14	0.01	4.13	0.01	4.13	0.01	4.09	0.02	4.09	0.02	4.11	0.02			
VOH6_5.5V V	4.7	6.0	5.20	0.01	5.20	0.01	5.20	0.01	5.19	0.01	5.18	0.01	5.17	0.01	5.16	0.01	5.14	0.02	5.14	0.02	5.17	0.02			
VOH7_5.5V V	3.85	6.0	4.85	0.02	4.85	0.02	4.85	0.02	4.84	0.02	4.67	0.22	3.25	1.77	3.65	1.40	2.44	2.33	2.35	2.25	2.78	2.13			
VOL1_3.0V mV	0	100	0	-	0	-	0	-	0	-	2.7	3.31	4.5	4.0	3.9	3.9	16.8	9.1	17.9	7.9	7.4	6.6			
VOL2_4.5V mV	0	100	0	-	0	-	0	-	0	-	3.1	3.75	7.3	3.1	7.0	3.0	19.6	8.8	21.6	8.0	10.4	5.0			
VOL3_5.5V mV	0	100	1.44	2.8	0	-	0.8	1.8	1.5	2.4	5.2	4.27	9.3	2.9	9.2	2.7	22.1	8.6	25.0	8.0	12.1	5.1			
VOL4_3.0V mV	0	500	141.7	4.6	139.8	4.4	137.9	4.7	139.4	5.0	141.6	5.11	141.5	5.3	142.7	5.5	152.7	8.7	148.6	6.4	137.9	6.1			
VOL5_4.5V mV	0	500	203.5	6.7	200.8	6.2	197.8	6.7	200.8	7.0	204.7	6.76	205.5	7.1	207.4	6.8	221.7	11.6	218.0	7.7	202.3	7.5			
VOL6_5.5V mV	0	500	179.2	6.9	176.4	5.5	173.4	5.6	176.7	6.1	180.7	5.78	182.9	6.2	184.6	6.0	201.1	11.5	199.1	7.8	181.4	6.6			
VOL7_5.5V mV	0	1650	380.0	14.1	375.2	12.2	368.8	12.9	374.6	13.6	380.4	12.66	381.3	13.8	384.9	13.0	405.8	13.5	398.9	12.0	375.0	12.3			
IIS	uA	0	1.0	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-		
IIL	uA	-1.0	0	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-		
ICCH	uA	0	80.0	0	-	1077	631.5	4170	1752	7331	2038	17878	4090	32432	5215	27652	4530	60179	3836	71691	5437	36048	5462		
ICCL	uA	0	80.0	0	-	371.8	183.8	1840	877	4144	1304	11256	2477	24653	3517	21142	3104	51826	2837	64188	3724	30188	4175		
TPH_3.0V nS	1.0	13.5	6.32	1.76	7.67	1.02	7.46	0.94	7.46	0.90	7.43	0.84	7.35	0.79	7.39	0.82	7.26	0.64	7.95	0.61	8.14	0.79			
TPHL_3.0V nS	1.0	13.5	8.97	1.84	9.99	2.53	8.94	2.12	8.72	1.91	8.35	1.63	8.00	1.47	8.09	1.51	7.69	1.38	8.49	1.43	7.75	1.55			
TPH_4.5V nS	1.0	10.0	7.31	1.25	6.66	0.50	6.48	0.46	6.50	0.42	6.51	0.39	6.46	0.33	6.47	0.34	6.44	0.21	7.07	0.28	7.16	0.47			
TPHL_4.5V nS	1.0	10.0	6.21	1.03	6.71	0.93	5.99	0.84	6.04	0.84	5.99	0.83	5.92	0.85	5.93	0.84	5.86	0.90	6.55	0.96	6.11	0.99			

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.

2/ Post 75 krads and post 86 hour annealing measurements are not included in Table IV. This data is available and can be obtained upon request.

Figure 1. Radiation Bias Circuit for 54AC74DMQB



$V_{cc} = 5V \pm 0.5V$
 $R = 1\text{ Kohm}, \pm 5\%, \frac{1}{4}\text{ W}$
 $T_A = 25^\circ\text{C}$