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To

T. Miccolis
Department

Code 300.1
From

K. Sahu *KS*
Department

7809
Subject

Radiation Report on 54AC20DMQB
SMEX Common Buy Part No. 5962-8761301CA
Control No. 1647

Date PPM-92-057

Feb. 7, 1992
Location

Lanham
Reference

731-8954
Location

Lanham

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A radiation evaluation was performed on 54AC20DMQB 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 after 24 hours and 168 hours. After this annealing, parts were irradiated to 300 krads and, finally, a total accumulated dose of 400 krads, after which they were annealed under bias at +100°C for 168 hours. The dose rate was between 0.5 and 6.25 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 @ +25°C according to the test conditions and the specification limits listed in Table III. These tests included two functional tests at 1 MHz.

All parts passed both functional tests throughout testing to 400 krads. The parts passed all parametric tests and stayed within the specification limits up to 75 krads of irradiation. However, after 100 krads, 2 parts failed to meet the specification limits for ICCH and ICCL. These parts had readings from 90 uA to 255 uA against the maximum specification limit of 80 uA. After 168 hours of annealing, the parts recovered, but one part marginally exceeded the limit for ICCL. Upon further irradiation to 300 krads, all 8 radiation parts exceeded the limits for ICCH and ICCL. Readings were as high as 2.1 mA for ICCH and 3.5 mA for ICCL. ICCH and ICCL continued to increase for all 8 irradiated parts after 400 krads. After the 168 hour annealing under bias at 100°C, 4 parts recovered within the limits for ICCH and ICCL. The other 4 parts also recovered, but remained above the specified upper limits. These parts had readings from 90 uA to 325 uA.

Table IV provides the mean and standard deviation values for each parameter after different irradiation exposures and annealing steps. It also provides a summary of functional test results after these radiation/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:	54AC20DMQB
SMEX Common Buy Part Number:	5962-8761301CA (HA124255)
SMEX Common Buy Control Number:	1647
Charge Number:	C90354
Manufacturer:	National Semiconductor
Lot Date Code:	9049A
Quantity Tested:	10
Serial Numbers of Radiation Samples:	202 - 209
Serial Numbers of Control Samples:	200, 201
Part Function:	DUAL 4 INPUT NAND GATE
Part Technology:	CMOS
Package Style:	14 pin DIP
Test Engineer:	R. Tosh

TABLE II. Radiation Schedule for 54AC20DMQB

EVENTS	DATE
1) Initial (Pre-Irradiation) Electrical Measurements	11/08/91
2) 10-KRAD IRRADIATION (500 rads/hour) POST 10-KRAD ELECTRICAL MEASUREMENT	12/09/91 12/10/91
3) 20-KRAD IRRADIATION (500 rads/hour) POST 20-KRAD ELECTRICAL MEASUREMENT	12/10/91 12/11/91
4) 30-KRAD IRRADIATION (525 rads/hour) POST 30-KRAD ELECTRICAL MEASUREMENT	12/11/91 12/12/91
5) 50-KRAD IRRADIATION (1000 rads/hour) POST 50-KRAD ELECTRICAL MEASUREMENT	12/13/91 12/16/91
6) 75-KRAD IRRADIATION (1550 rads/hour) POST 75-KRAD ELECTRICAL MEASUREMENT	12/16/91 12/17/91
7) 100-KRAD IRRADIATION (1315 rads/hour) POST 100-KRAD ELECTRICAL MEASUREMENT	12/17/91 12/18/91
8) 24 HOURS ANNEALING AT +25°C POST 24-HOURS ELECTRICAL MEASUREMENT	12/18/91 12/19/91
9) 168 HOURS ANNEALING AT +25°C POST 168-HOURS ELECTRICAL MEASUREMENT	12/19/91 12/27/91
10) 300-KRAD IRRADIATION (5000 rads/hour) POST 300-KRAD ELECTRICAL MEASUREMENTS	12/27/91 12/30/91
11) 400-KRAD IRRADIATION (6250 rads/hour) POST 400-KRAD ELECTRICAL MEASUREMENTS	12/30/91 12/31/91
12) 168 HOURS ANNEALING AT +100°C POST 168 HOURS AT +100°C ELECTRICAL MEASUREMENTS	12/31/91 01/07/92

- Notes:
- All electrical measurements were performed off-site at +25°C.
 - All parts were radiated under bias at the cobalt-60 gamma ray facility at GSFC.
 - Annealing was performed under bias.

Table III. Electrical Characteristics of 54AC20DMQB

TESTS PERFORMED						
PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS @ +25C
FUNCT #1	3.0V	0.0V	3.0V	FREQ = 1MHz	ALL I/O	VOL < 1.50V / VOH > 1.50V
FUNCT #2	3.5V	0.0V	3.5V	FREQ = 1MHz	ALL I/O	VGL < 2.75V / VOH > 2.75V
PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS @ +25C
VOH1	3.0V	0.70V	2.10V	LOAD = -50uA	OUTS	> 2.90V / < 5.50V
VOH2	4.5V	1.35V	3.15V	LOAD = -50uA	OUTS	> 4.40V / < 5.50V
VOH3	3.5V	1.05V	3.85V	LOAD = -50uA	OUTS	> 3.40V / < 5.50V
VOH4	3.0V	0.90V	2.10V	LOAD = -4mA	OUTS	> 2.40V / < 5.50V
VOH5	4.5V	1.35V	3.15V	LOAD = -24mA	OUTS	> 3.70V / < 5.50V
VOH6	3.5V	1.05V	3.85V	LOAD = -24mA	OUTS	> 4.70V / < 5.50V
VOH7	3.5V	1.05V	3.85V	LOAD = -50mA	OUTS	> 3.35V / < 5.50V
PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS @ +25C
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	3.5V	1.05V	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	3.5V	1.05V	3.85V	LOAD = +24mA	OUTS	> 0.00V / < 0.50V
VOL7	3.5V	1.05V	3.85V	LOAD = +50uA	OUTS	> 0.00V / < 1.65V
PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS @ +25C
I _{IH}	3.5V	0.00V	3.50V	V _{IN} = 3.5V	INS	> 0.00A / < +1.00A
I _{IL}	3.5V	0.00V	3.50V	V _{IN} = 0.0V	INS	> -1.00A / < 0.00A
I _{CC1}	3.5V	ALL INPUTS AT 0.00V			VCC	> 0.00A / < 80 uA
I _{CC2}	3.5V	ALL INPUTS AT 3.50V			VCC	> 0.00A / < 80 uA
AC PARAMETRIC TESTS PROPAGATION DELAY TIMING						
PARAMETER	VCC	VIL	VIH	PINS	LIMITS @25C	
					MIN	MAX
T _{PHL-Q0}	4.5V	0.0V	4.5V	OUT	1.0NS	6.0NS
T _{PHL-Q1}	4.5V	0.0V	4.5V	OUT	1.0NS	6.0NS
T _{PLH-Q0}	4.5V	0.0V	4.5V	OUT	1.0NS	7.0NS
T _{PLH-Q1}	4.5V	0.0V	4.5V	OUT	1.0NS	7.0NS
COMMENTS/EXCEPTIONS						
(1) FUNCTIONAL TEST #1 WAS PERFORMED WITH I _{OH} = -4.0mA AND I _{OL} = 12mA						
(2) FUNCTIONAL TEST #2 WAS PERFORMED WITH I _{OH} = -24.0mA AND I _{CL} = 24mA						
(3) VIL & VIH WERE TESTED DURING THE VOL & VOH TESTS AS GO/NO GO						
(4) AC PARAMETERS WERE TESTED AT VCC = 4.5V, NOT VCC = 3.0V.						
(5) THIS PROGRAM CHECKS FOR OUT ORIENTATION.						

TABLE IV: Summary of Electrical Measurements After
Total Dose Exposures and Annealing for 54AC20DMQB 1/ 2/ 3/

Parameters	Spec Limits min max	Total Dose Exposure (TDE) (krads)										Anneal		Total Dose (krads)		Anneal					
		0 (Pre-Rad)		20		30		50		75		100		168 hrs @ 25°C		300		400		168 hrs @ 100°C	
		mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd
FUNC1 @ 1 MHz		Pass		Pass		Pass		Pass		Pass		Pass		Pass		Pass		Pass		Pass	
FUNC2 @ 1 MHz		Pass		Pass		Pass		Pass		Pass		Pass		Pass		Pass		Pass		Pass	
VOH1_3.0V V	2.9 5.5	3.00	0	2.99	0	3.00	0	2.99	0.02	2.99	0	3.00	0	2.99	0	2.99	0	2.99	0	2.99	0
VOH2_4.5V V	4.4 5.5	4.49	0	4.49	0	4.49	0	4.50	0.03	4.49	0	4.49	0	4.49	0	4.49	0	4.49	0	4.49	0
VOH3_5.5V V	5.4 5.5	5.49	0	5.49	0	5.49	0	5.51	0.05	5.49	0	5.49	0	5.49	0	5.49	0	5.49	0	5.49	0
VOH4_3.0V V	2.4 5.5	2.93	0	2.92	0	2.92	0	2.88	0.10	2.92	0	2.92	0	2.92	0	2.92	0	2.91	0	2.91	0
VOH5_4.5V V	3.7 5.5	4.18	0	4.17	0	4.17	0	4.17	0	4.17	0	4.17	0	4.16	0	4.15	0.01	4.14	0.01	4.15	0
VOH6_5.5V V	4.7 5.5	5.21	0	5.21	0	5.21	0	5.21	0	5.21	0	5.21	0	5.21	0	5.19	0	5.19	0	5.19	0
VOH7_5.5V V	3.85 5.5	4.89	0	4.88	0	4.88	0.01	4.88	0.01	4.87	0	4.87	0.01	4.87	0.01	4.84	0.01	4.84	0.01	4.84	0.01
VOL1_3.0V V	0 0.10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VOL2_4.5V V	0 0.10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VOL3_5.5V V	0 0.10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VOL4_3.0V V	0 0.50	0.13	0	0.13	0	0.13	0	0.13	0	0.13	0	0.13	0	0.13	0	0.12	0	0.12	0.01	0.12	0
VOL5_4.5V V	0 0.50	0.19	0	0.19	0	0.19	0	0.19	0	0.19	0	0.19	0	0.19	0	0.18	0	0.18	0.01	0.18	0
VOL6_5.5V V	0 0.50	0.17	0	0.17	0	0.17	0	0.17	0	0.17	0	0.17	0	0.17	0	0.16	0	0.16	0	0.16	0
VOL7_5.5V V	0 1.65	0.37	0	0.36	0	0.36	0	0.36	0	0.36	0	0.36	0	0.36	0	0.35	0.01	0.34	0.01	0.35	0.01
IIR uA	0 1.0	0	0	0	0	0	0	0	0	0	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	0	0	0	0	0	0	0	0	0	0
ICCH uA	0 80.0	0	0	0.46	0.23	0.74	0.38	0.19	0.17	9.84	14.80	43.06	58.02	12.74	19.36	1151	656.0	1900	900.3	100.9	90.1
ICCL uA	0 80.0	0	0	0.45	0.22	0.66	0.34	0.09	0.12	8.73	16.83	49.64	83.20	13.80	27.55	1629	1059	2611	1354	113.6	131.7
TPHL-Q0 nS	1.0 6.0	3.76	0.05	4.59	0	4.72	0.05	5.71	0.05	5.64	0.04	5.53	0.07	5.71	0.05	5.32	0.05	5.25	0.04	5.41	0.07
TPHL-Q1 nS	1.0 6.0	4.55	0.07	5.25	0.05	5.19	0.03	6.13	0.05	6.15	0.05	6.04	0.06	6.36	0.05	6.19	0.05	6.19	0.05	6.13	0.05
TPLH-Q0 nS	1.0 7.0	5.33	0.05	6.42	0.04	6.45	0	7.51	0.03	7.58	0.05	7.58	0.05	7.64	0.04	8.15	0.07	8.36	0.08	8.31	0.06
TPLH-Q1 nS	1.0 7.0	5.81	0.07	6.60	0.05	6.56	0.03	7.53	0.03	7.62	0.05	7.53	0.03	7.89	0.06	7.95	0.05	7.97	0.05	7.97	0.05

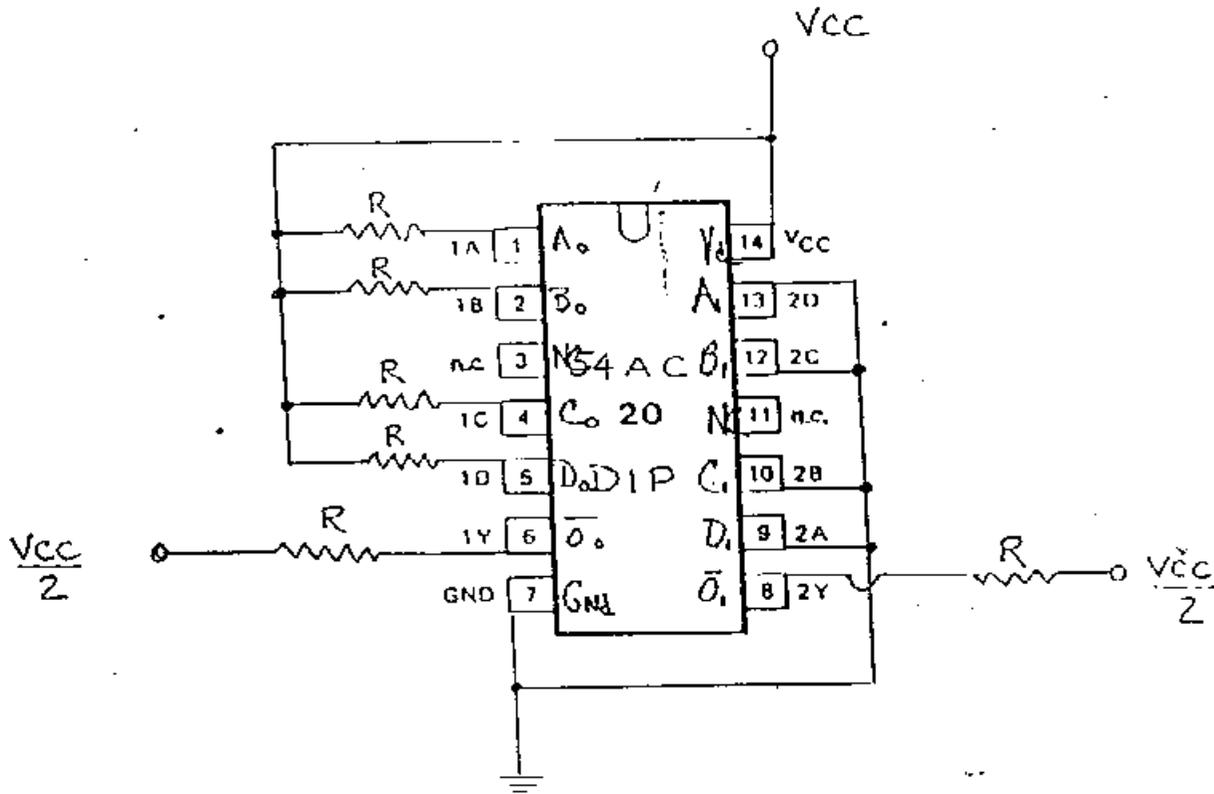
Notes:

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 10 krads and post 24 hour annealing measurements at 25°C are not included in Table IV. This data is available on request.

3/ All parts including the control samples were failing some of the A.C. parameters throughout testing. However, these failures were attributed to shifts in the S-50 Automated Test Equipment (ATE).

Figure 1. Radiation Bias Circuit for 54AC20DMQB



54AC20
14 PIN DIP

$$V_{cc} = 5.0V \pm 10\% , \frac{V_{cc}}{2} = 2.5V \pm 10\%$$

$$R = 1.K \text{ Ohm}, 5\% , \frac{1}{4}W$$

$$T_A = 25^\circ C$$