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Interoffice Memorandum

To
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 From **Code 300.1**
 Department **K. Sahu** KS
 Subject **7809**
Radiation Report on 54AC20LMQB
SMEX Common Buy Part No. 5962-87613012A

Date **PPM-91-0692**
 Location **Nov. 22, 1991**
 Telephone **Lanham**
 Location **731-8954**
 cc **Lanham**
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A radiation evaluation was performed on 54AC20LMQB 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 216 hours with measurements taken at 72 and 216 hours. After this annealing, parts were irradiated to 200 krads and, finally, a total accumulated dose of 300 krads, after which they were annealed under bias at +100°C for 336 hours. The dose rate was between 0.147 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 @ +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 300 krads. Parts passed all parametric tests and stayed within the specified limits up to 100 krads of irradiation. After 200 krads, 4 parts failed electrical measurements. Two parts failed VOH3, one failed VOH1, and one failed ICCH. After 300 krads of irradiation, 3 parts failed ICCH and ICCL measurements. After annealing under bias at +100°C for 336 hours, all parts recovered and passed the final electrical measurements.

Table IV provides a summary of the 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.

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

TABLE I. Part Information

Generic Part Number:	54AC20IMQB
SMEX Common Buy Part Number:	5962-87613012A (HA124256)
SMEX Common Buy Control Number:	2301
Charge Number:	C90364
Manufacturer:	National Semiconductor
Lot Date Code:	9052A
Quantity Tested:	10
Serial Numbers of Radiation Samples:	32 - 39
Serial Number of Control Samples:	30, 31
Part Function:	DUAL 4 INPUT NAND GATE
Part Technology:	CMOS
Package Style:	20 pin LCC
Test Engineer:	R. Tosh

TABLE II. Radiation Schedule for 54AC20LMQB

EVENTS	DATE
1) Initial (Pre-Irradiation) Electrical Measurements	07/31/91
2) 10-KRAD IRRADIATION (0.147 krads/hour) POST 10-KRAD ELECTRICAL MEASUREMENT	09/27/91 09/30/91
3) 20-KRAD IRRADIATION (0.5 krads/hour) POST 20-KRAD ELECTRICAL MEASUREMENT	09/30/91 10/01/91
4) 30-KRAD IRRADIATION (0.5 krads/hour) POST 30-KRAD ELECTRICAL MEASUREMENT	10/01/91 10/02/91
5) 50-KRAD IRRADIATION (930 KRADS/HOUR) POST 50-KRAD ELECTRICAL MEASUREMENT	10/02/91 10/03/91
6) 75-KRAD IRRADIATION (1314.6 KRADS/HOUR) POST 75-KRAD ELECTRICAL MEASUREMENT	10/03/91 10/04/91
7) 100-KRAD IRRADIATION (367.8 KRADS/HOUR) POST 100-KRAD ELECTRICAL MEASUREMENT NOT PERFORMED DUE TO TEST EQUIPMENT (S-50) PROBLEMS	10/04/91
8) 72 HOURS ANNEALING AT +25°C POST 72-HOURS ELECTRICAL MEASUREMENT ANNEALING TIME INCREASED DUE TO S-50 PROBLEMS	10/07/91 10/10/91
9) 216 HOURS ANNEALING AT +25°C POST 216-HOURS ELECTRICAL MEASUREMENT ANNEALING TIME INCREASED DUE TO S-50 PROBLEMS	10/07/91 10/16/91
10) 200-KRAD IRRADIATION (5.0 KRADS/HOUR) POST 200-KRAD ELECTRICAL MEASUREMENTS	10/16/91 10/23/91
11) 300-KRAD IRRADIATION (5.0KRADS/HOUR) POST 300-KRAD ELECTRICAL MEASUREMENTS	10/23/91 10/24/91
12) 336 HOURS ANNEALING AT +100°C UNDER BIAS POST 336 HOURS AT +100°C ELECTRICAL MEASUREMENTS All electrical measurements performed at +25°C.	10/25/91 11/08/91

Table III. Electrical Characteristics of 54AC20LMQB

PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS @ +25C
FUNCTION #1	5.0V	0.0V	3.0V	FREQ = 1MHZ	ALL I/O	VOL < 1.50V / VOH > 1.50V
FUNCTION #2	5.5V	0.0V	3.5V	FREQ = 1MHZ	ALL I/O	VOL < 2.75V / VOH > 2.75V
PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS @ +25C
VOH1	5.0V	0.90V	2.10V	LOAD = -50UA	OUTS	> 2.90V / < 5.50V
VOH2	4.5V	1.35V	3.15V	LOAD = -50UA	OUTS	> 4.40V / < 5.50V
VOH3	5.5V	1.65V	3.85V	LOAD = -50UA	OUTS	> 5.40V / < 5.50V
VOH4	5.0V	0.90V	2.10V	LOAD = -4mA	OUTS	> 2.90V / < 5.50V
VOH5	4.5V	1.35V	3.15V	LOAD = -4mA	OUTS	> 4.40V / < 5.50V
VOH6	5.5V	1.65V	3.85V	LOAD = -24mA	OUTS	> 5.70V / < 5.50V
VOH7	5.5V	1.65V	3.85V	LOAD = -30mA	OUTS	> 4.70V / < 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	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 = +30mA	OUTS	> 0.00V / < 0.50V
VOL7	5.5V	1.65V	3.85V	LOAD = +30mA	OUTS	> 0.00V / < 1.65V
PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS @ +25C
IIn	5.5V	0.00V	3.50V	VIN = 5.5V	INS	> 0.00UA / < +1.00UA
IIL	5.5V	0.00V	3.50V	VIN = 0.0V	INS	> -1.00UA / < 0.00UA
Icch	5.5V	ALL INPUTS AT 0.00V			VCC	> 0.00UA / < 80 UA
Iccl	5.5V	ALL INPUTS AT 5.50V			VCC	> 0.00UA / < 80 UA

AC PARAMETRIC TESTS PROPAGATION DELAY TIMING

PARAMETER	VCC	VIL	VIH	PINS	LIMITS @25C	
TPHL-Q0	4.5V	0.0V	4.5V	JUT	MIN	MAX
TPHL-Q1	4.5V	0.0V	4.5V	JUT	1.0NS	6.0NS
TPHL-Q0	4.5V	0.0V	4.5V	OUT	1.0NS	6.0NS
TPHL-Q1	4.5V	0.0V	4.5V	OUT	1.0NS	7.0NS

COMMENTS/EXCEPTIONS

- (1) FUNCTIONAL TEST #1 WAS PERFORMED WITH IOH = -4.0mA AND IOL = 12mA
- (2) FUNCTIONAL TEST #2 WAS PERFORMED WITH IOH = -24.0mA AND IOL = 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.

TABLE IV: Summary of Electrical Measurements After
Total Dose Exposures and Annealing for 54AC20LMQB 1/2/

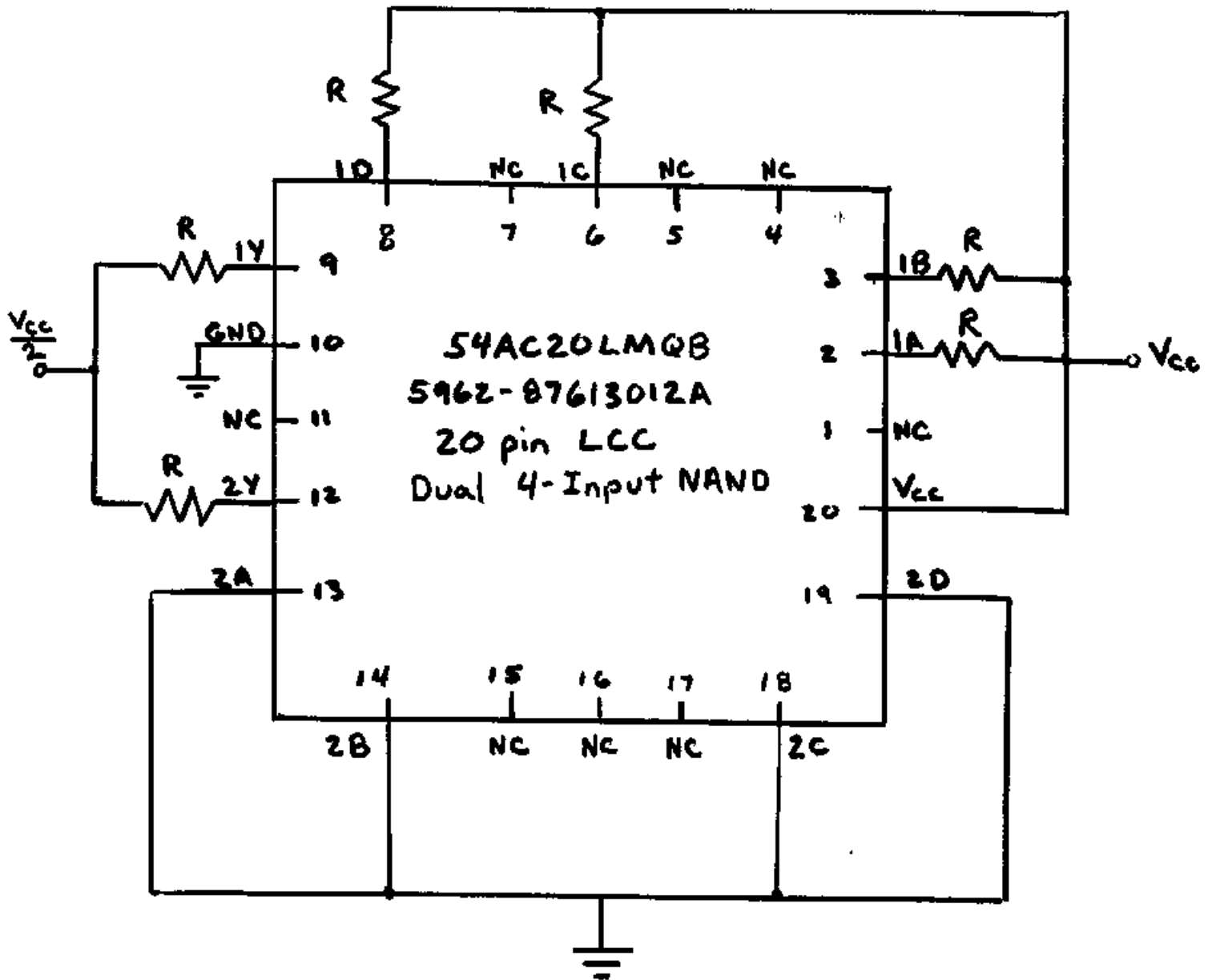
Parameters	Spec Limits min max		Total Dose Exposure (TDE) (krads)										Anneal		Total Dose (krads)		Anneal						
			0 (Pre-Rad)		10		20		30		50		75		216 hrs	200		300		336 hrs			
			mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd			
FUNC1 @ 1 MHz			P		P		P		P		P		P		P		P		P				
FUNC2 @ 1 MHz			P		P		P		P		P		P		P		P		P				
VOH1_3.0V V	2.9	5.5	2.99	0	2.99	0	2.99	0	2.99	0	2.99	0	2.99	0	2.99	0	3.02	.10	3.00	.01	3.00	0	
VOH2_4.5V V	4.4	5.5	4.49	0	4.49	0	4.49	0	4.49	0	4.49	0	4.49	0	4.49	0	4.56	.06	4.49	0	4.49	0	
VOH3_5.5V V	5.4	5.5	5.49	-	5.49	-	5.49	-	5.49	-	5.49	-	5.49	-	5.49	-	5.46	.07	5.49	-	5.49	0	
VOH4_3.0V V	2.4	5.5	2.92	0	2.92	0	2.92	0	2.92	0	2.92	0	2.92	0	2.92	0	2.93	.08	2.92	0	2.92	0	
VOH5_4.5V V	3.7	5.5	4.19	0	4.18	0	4.17	.01	4.18	.01	4.17	.01	4.17	.01	4.17	.01	4.19	.08	4.15	.01	4.15	.01	
VOH6_5.5V V	4.7	5.5	5.22	0	5.22	0	5.21	0	5.22	.01	5.21	.01	5.21	.01	5.21	.01	5.14	.08	5.20	0	5.20	.01	
VOH7_5.5V V	3.85	5.5	4.89	0	4.89	.01	4.89	.01	4.89	.01	4.88	.01	4.88	.01	4.88	.01	4.87	.10	4.86	.01	4.86	.01	
VOL1_3.0V V	0	0.10	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	-	
VOL3_5.5V V	0	0.10	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	
VOL4_3.0V V	0	0.50	0.129	0	0.130	0	0.130	0	0.129	0	0.129	0	0.127	0	0.129	0	0.124	0	0.121	0	0.138	.01	
VOL5_4.5V V	0	0.50	0.184	0	0.184	0	0.185	0	0.184	0	0.183	0	0.183	0	0.183	0	0.181	0	0.176	0	0.192	.01	
VOL6_5.5V V	0	0.50	0.162	0	0.161	0	0.162	0	0.162	0	0.162	0	0.162	0	0.160	0	0.159	0	0.155	0	0.165	.01	
VOL7_5.5V V	0	1.65	0.345	0	0.345	.01	0.347	.01	0.345	0	0.344	0	0.344	.01	0.344	0	0.338	.01	0.331	.01	0.355	.02	
IIR	uA	0	1.0	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	
ICCH	uA	0	80.0	0	0	0	0.009	.12	0.288	.14	0.662	.28	1.10	.62	0.38	.10	12.99	26.68	112.81	161.07	4.51	11.86	
ICCL	uA	0	80.0	0	0	0	0.138	.14	0.300	.11	0.488	.19	0.700	.29	0.25	.07	8.33	18.12	117.74	178.37	1.52	3.71	
TPHL-Q0	nS	1.0	6.0	3.32	0	3.53	.03	3.43	.03	3.48	.05	3.43	.04	3.34	.04	4.016	.06	4.358	.05	4.199	.08	4.077	.19
TPHL-Q1	nS	1.0	6.0	3.69	.04	4.93	.05	4.90	.03	4.91	.04	4.92	.05	4.60	.06	4.602	.09	4.956	.09	4.883	.10	4.443	.12
TPLH-Q0	nS	1.0	7.0	5.22	.05	5.29	.03	5.31	.05	5.42	.05	5.47	-	5.40	.03	5.864	.04	6.091	.05	6.226	.04	5.635	.11
TPLH-Q1	nS	1.0	7.0	5.60	.05	6.65	.03	6.66	.04	6.69	.05	6.75	.06	6.68	.05	6.409	.05	6.116	.05	6.116	.05	6.189	.12

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 72 hour annealing measurements not included in Table IV. This data is available on request.

Figure 1. Radiation Bias Circuit for 54AC20LMQB



$$V_{cc} = 5.0V \pm 0.5V$$

$$R = 1K\Omega, 5\%, \frac{1}{4}W$$

$$T_A = 25^\circ C$$