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Interoffice Memorandum

To
T. Miccolis
Department
Code 300.1
From
K. Sahu KS
Department
7809
Subject
Radiation Report on 54AC109DMQB
SMEX Common Buy Part No. 5962-8955101EA

Date
PPM-91-437
July 8, 1991
Location
Lanham
Telephone
731-8954
Location
Lanham
cc
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A radiation evaluation was performed on 54AC109 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 85 krads. After 85 krads, parts were annealed at 25°C for 24 and 168 hours, and then irradiation was continued to 185 and 285 krads (cumulative). The dose rate was between 0.5 - 5.7 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 a total of three functional tests (at 1MHz) after each radiation and annealing step.

All (8) parts passed all functional tests and parametric tests, except ICCH/L, up to 285 krads. All parts exceeded the maximum specification limit of 80uA for ICCH and ICCL after the first radiation step of 10 krads. ICCH readings ranged from 332uA to 1mA and ICCL readings ranged from 151uA to 435uA. ICCH/L continued to degrade throughout the radiation testing to 95 krads, showed very slight recovery after 24 and 168 hours annealing, and showed continued degradation after 185 and 285 krad exposures. Table IV provides the mean and standard deviation values for each parameter after different radiation exposures and annealing treatments. It also provides a summary of functional test results after each radiation/annealing step.

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:	54AC109
SMEX Common Buy Part Number:	5962-8955101EA (HA124247)
SMEX Common Buy Control Number:	1651
Charge Number:	C90101
Manufacturer:	National Semiconductor Corporation
Quantity Procured:	100
Lot Date Code:	9036A
Quantity Tested:	10
Serial Numbers of Radiation Samples:	3, 4, 5, 6, 7, 8, 9, 10
Serial Numbers of Control Samples:	1,2
Part Function:	Dual JK Flip-Flop
Part Technology:	CMOS
Package Style:	16-Pin DIP

TABLE II. Radiation Schedule

EVENTS	DATE
1) Initial Electrical Measurements	04/22/91
2) 10 krads irradiation @ 555 rads/hr Post 10 krads Electrical Measurements	04/22/91 04/23/91
3) 20 krads irradiation @ 525 rads/hr Post 20 krads Electrical Measurements	04/23/91 04/24/91
4) 30 krads irradiation @ 555 rads/hr Post 30 krads Electrical Measurements	04/24/91 04/25/91
5) 50 krads irradiation @ 1100 rads/hr Post 50 krads Electrical Measurements	04/25/91 04/26/91
6) 75 krads irradiation @ 1400 rads/hr Post 75 krads Electrical Measurements	04/26/91 04/27/91
7) 85 krads irradiation @ 580 rads/hr* Post 85 krads Electrical Measurements	04/27/91 04/29/91
8) 24 hrs annealing Post 24 hr Electrical Measurements	04/29/91 04/30/91
9) 168 hrs annealing Post 168 hr Electrical Measurements	04/29/91 05/06/91
10) 185 krads irradiation @ 5550 rads/hr Post 185 krads Electrical Measurements	05/06/91 05/07/91
11) 285 krads irradiation @ 5700 rads/hr Post 285 krads Electrical Measurements	05/07/91 05/08/91

Notes:

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

* Anomalous Event: Parts were scheduled to receive a net dose of 25 krads (cumulative dose of 100 krads) at this radiation step; however, the timer at the radiation facility was inadvertently set for 16 hours, instead of 43 hours, and the parts received a net dose of 10 krads at this radiation step.

TABLE III. Electrical Characteristics of 54AC109

DEVICE		PART TYPE : DUAL JK FLIP-FLOP W/ SET AND CLEAR				PCN : SI10247A	
PART NO. : 54AC109		TEST PROGRAM LOCATION				TEST SPECIFICATIONS	
DISK LABEL : LIB 11		DIRECTORY : DQAT: [PROGRAMS.247]				DESC 5962-89551	
FUNCTIONAL TESTS PERFORMED							
PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS AT +25C ONLY	
FUNCT 1	3.0V	0.0V	3.0V	FREQ=1.000MHZ	ALL I/O	VOL < 1.5V / VOH > 1.5V	
FUNCT 2	5.0V	0.0V	5.0V	FREQ=1.000MHZ	ALL I/O	VOL < 2.5V / VOH > 2.5V	
FUNCT 3	5.5V	0.0V	5.5V	FREQ=1.000MHZ	ALL I/O	VOL < 2.5V / VOH > 1.5V	
LOAD USED <=				I _{OH} = -6.0MA VREF = 1.5V I _{OL} = +6.0MA			
DC PARAMETRIC TESTS PERFORMED							
PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS AT +25C ONLY	
V _{OH1}	3.0V	0.9V	2.1V	LOAD = -50UA	OUTS	> +2.9V / < +3.0V	
V _{OH2}	3.0V	0.9V	2.1V	LOAD = -04MA	OUTS	> +2.4V / < +3.0V	
V _{OH3}	4.5V	1.35V	3.15V	LOAD = -50UA	OUTS	> +4.4V / < +4.5V	
V _{OH4}	4.5V	1.35V	3.15V	LOAD = -24MA	OUTS	> +3.7V / < +4.5V	
V _{OH5}	5.5V	1.65V	3.85V	LOAD = -50UA	OUTS	> +5.4V / < +5.5V	
V _{OH6}	5.5V	1.65V	3.85V	LOAD = -24MA	OUTS	> +4.7V / < +5.5V	
V _{OH7}	5.5V	1.65V	3.85V	LOAD = -50MA	OUTS	> +3.85V / < +5.5V	
V _{OL1}	3.0V	0.9V	2.1V	LOAD = +50UA	OUTS	> +0.0V / < +0.1V	
V _{OL2}	3.0V	0.9V	2.1V	LOAD = +12MA	OUTS	> +0.0V / < +0.5V	
V _{OL3}	4.5V	1.35V	3.15V	LOAD = +50UA	OUTS	> +0.0V / < +0.1V	
V _{OL4}	4.5V	1.35V	3.15V	LOAD = +24MA	OUTS	> +0.0V / < +0.5V	
V _{OL5}	5.5V	1.65V	3.85V	LOAD = +50UA	OUTS	> +0.0V / < +0.1V	
V _{OL6}	5.5V	1.65V	3.85V	LOAD = +24MA	OUTS	> +0.0V / < +0.5V	
V _{OL7}	5.5V	1.65V	3.85V	LOAD = +50MA	OUTS	> +0.0V / < +1.65V	
I _{IH}	5.5V	0.0V	5.5V	V _{IN} = 5.5V	INS	> +0.0UA / < +1.0UA	
I _{IL}	5.5V	0.0V	5.5V	V _{IN} = 0.0V	INS	> -1.0UA / < +0.0UA	
I _{CCH}	5.5V	0.0V	5.5V	V _{IN} = 5.5V	VCC	> +0.0UA / < +80UA	
I _{ACL}	5.5V	0.0V	5.5V	V _{IN} = 0.0V	VCC	> +0.0UA / < +80UA	
COMMENTS/EXCEPTIONS							
(1) VIL & VIH WERE TESTED DURING VOL & VOH TESTS AS GO/NOGO.							
(2) THIS PROGRAM DOES NOT PERFORM ANY AC PARAMETRIC TESTS.							

TABLE IV: Summary of Electrical Measurements
after Total Dose Exposures and Annealing for 54AC109 1/

Parameters	Spec. Limits min max		Initials mean sd		Total Dose Exposure (krads)											
					10		20		30		50		75		85	
					mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd
Func1 @ 1MHz			Pass		Pass		Pass		Pass		Pass		Pass		Pass	
Func2 @ 1MHz			Pass		Pass		Pass		Pass		Pass		Pass		Pass	
Func3 @ 1MHz			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	.01	2.98	.01
VOH2 V	2.4	3.0	2.91	0	2.91	0	2.90	.03	2.91	0	2.90	.01	2.90	.01	2.89	.01
VOH3 V	4.4	4.5	4.49	0	4.49	0	4.49	0	4.49	0	4.49	0	4.48	0	4.48	.01
VOH4 V	3.7	4.5	4.11	.02	4.11	.01	4.09	.03	4.10	.01	4.10	.01	4.09	.01	4.08	.02
VOH5 V	5.4	5.5	5.49	0	5.49	0	5.49	0	5.49	0	5.48	0	5.48	0	5.47	.01
VOH6 V	4.7	5.5	5.16	.02	5.16	.01	5.14	.03	5.15	.01	5.15	.01	5.16	.01	5.13	.03
VOH7 V	3.85	5.5	4.76	.06	4.76	.02	4.74	.04	4.75	.02	4.74	.02	4.73	.02	4.71	.04
VOL1 mV	0	100	0	0	0	0	0	0	0	0	3.7	4.0	6.1	4.3	5.0	1.0
VOL2 mV	0	500	154	18	160	5	162	10	160	4	161	5	161	5	160	5
VOL3 mV	0	100	0	0	0	0	0	0	2.3	2.3	6.5	2.7	8.7	3.1	8.7	1.4
VOL4 mV	0	500	231	31	226	10	232	22	228	7	229	6	231	8	231	8
VOL5 mV	0	100	0	0	0.6	1.4	1.2	1.9	5.7	2.3	8.5	2.5	11	3	10.7	1.1
VOL6 mV	0	500	201	31	197	9	203	21	201	7	201	6	205	8	205	8
VOL7 mV	0	1650	447	148	422	19	433	40	426	13	425	12	429	14	430	17
I IH nA	0	1000	0	0	0	0	0	0	0	0	0	0	0	0	0	0
I IL nA	-1000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ICCH uA	0	80	.01	.02	671	231	93	51	4.7E3	830	15E3	2E3	25E3	2E3	26E3	2E3
ICCL uA	0	80	.01	.02	307	96	43	23	1.8E3	297	8.6E3	1.1E3	16E3	1E3	19E3	2E3

<Table IV continued on next page>

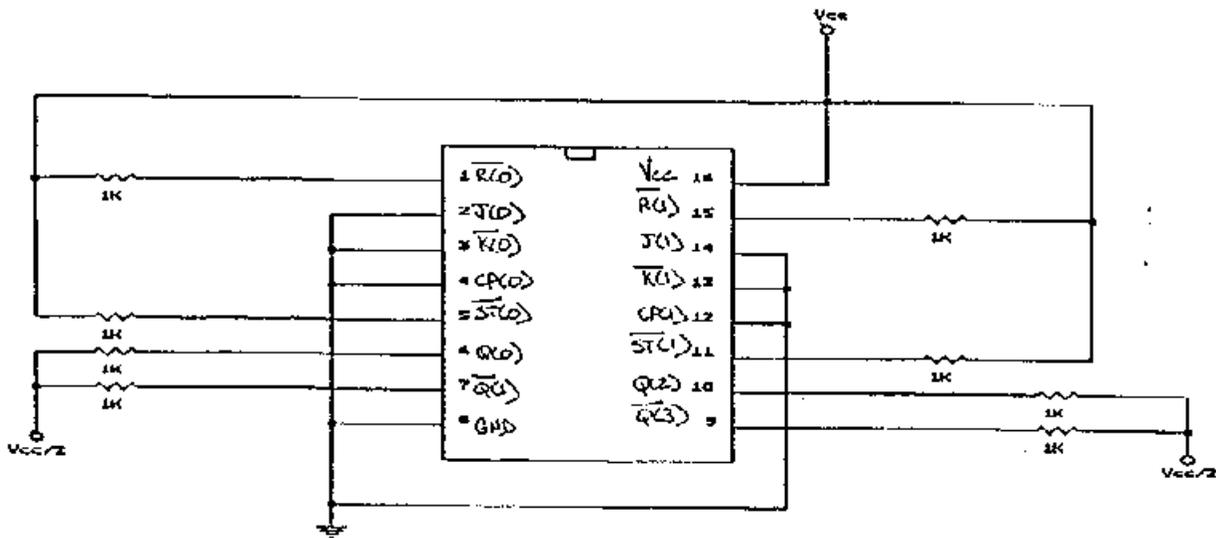
TABLE IV. (continued)

Parameters	Spec. Limits min max		Initials mean sd		Annealing				Total Dose (krads)				
					24 hrs		168 hrs		185		285		
					mean	sd	mean	sd	mean	sd	mean	sd	
Func1 @ 1MHz			Pass		Pass		Pass		Pass		Pass		
Func2 @ 1MHz			Pass		Pass		Pass		Pass		Pass		
Func3 @ 1MHz			Pass		Pass		Pass		Pass		Pass		
VCH1	V	2.9	3.0	2.99	0	2.98	0	2.96	.05	2.97	.02	2.97	.01
VCH2	V	2.4	3.0	2.91	0	2.90	0	2.89	.04	2.88	.02	2.88	.01
VOE3	V	4.4	4.5	4.49	0	4.48	0	4.49	.05	4.47	.01	4.47	.01
VOH4	V	3.7	4.5	4.11	.02	4.08	.01	4.09	.06	4.07	.02	4.06	.01
VOH5	V	5.4	5.5	5.49	0	5.48	0	5.49	.05	5.47	.01	5.47	.01
VOH6	V	4.7	5.5	5.16	.02	5.14	.01	5.15	.05	5.12	.02	5.12	.01
VOH7	V	3.85	5.5	4.76	.06	4.73	.02	4.71	.07	4.70	.03	4.69	.02
VCL1	mV	0	100	0	0	6.0	1.7	5.5	1.5	13	7	12	5
VOL2	mV	0	500	164	18	160	5	102	335	159	6	153	4
VOL3	mV	0	100	0	0	8.6	1.3	8.0	1.4	16	7	15	5
VOL4	mV	0	500	231	31	231	8	234	22	232	9	227	6
VOL5	mV	0	100	0	0	10.7	1.1	10.3	1.0	18	7	17	5
VOL6	mV	0	500	201	31	205	8	208	21	209	10	206	6
VCL7	mV	0	1650	447	148	431	15	443	78	429	15	424	10
IIF	nA	0	1000	0	0	0	0	0	0	0	0	0	0
IIL	nA	-1000	0	0	0	0	0	0	0	0	0	0	0
ICCH	uA	0	80	.01	.02	25E3	2E3	24E3	2E3	37E3	3E3	41E3	3E3
ICCL	uA	0	80	.01	.02	17E3	1E3	17E3	1E3	30E3	2E3	34E3	2E3

Note:

1/ The mean and standard deviation values were calculated over the eight parts irradiated in this. The control samples remained constant throughout the testing and are not included in this table.

Figure 1. Radiation Bias Circuit for 54AC109



Vcc = 5.0 volts +/- .5 volts
 Vcc/2 = 2.5 volts +/- .25 volts
 ALL RESISTORS ARE 1/4 WATT