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PPM-91-706

To
T. Miccolis
 Department
Code 300.1
 From
K. Sahu KS
 Department
7809
 Subject
Radiation Report on 54AC157DMQB
SMEX Common Buy Part No. 5962-8953901EA
Control Number : 1654C

Date
December 02, 1991

Location
Lanham

Telephone
731-8954

Location
Lanham

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A radiation evaluation was performed on 54AC157DMQB 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 2.5, 5, 10, 20, 50, 75 and 100 krads. After 100 krads, parts were annealed at +25°C for 24 and 168 hours, and then irradiation was continued to 200 and 300 krads (cumulative) after which they were annealed at +100°C for 168 hours. The dose rate was between 0.06 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 a total of two functional tests (at 1 MHz) after each radiation and annealing step.

All of the Parts passed all tests on irradiation up to 20 krads without any significant degradation in any of the electrical parameters. On continued irradiation to 50 krads, one part (SN 57) marginally exceeded the specification limits on ICCL (reading was 407.3uA against the specification limit of 160uA). The ICCL continued to degrade during the next two irradiation steps (75 krads and 100 krads). After 100 krads, all eight irradiated parts failed ICC (worst reading was (on SN 57) 1.154 mA). After annealing at +25°C for 168 hours, the parts showed very little recovery on the ICC readings. On continued irradiation to 200 krads, all parts failed the ICC and VOH4 (voltage level high at VCC = 3.0V, Load = -4.0mA). The VOH4 readings were between 0.6 to 1V. The ICC readings continued to degrade. At 300 krads, the average ICC reading was 5 mA. The worst ICC reading at this irradiation step was 12 mA. After annealing at +100°C for 168 hours, only three parts (SN's 55, 56 and 57) failed the ICC and VOH4. The worst ICC reading at this step was 2.8 mA. However, all parts passed all functional tests at all steps of irradiation.

Summary(continued)

Tables IV provides the mean and standard deviation values for each parameter after different irradiation 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:	54AC157DMQB
SMEX Common Buy Part Number:	5962-8953901EA
SMEX Common Buy Control Number:	1654C
Charge Number:	C90418
Manufacturer:	National Semiconductor Corp.
Lot Date Code:	9041
Quantity Tested:	10
Serial Numbers of Radiation Samples:	52, 53, 54, 55, 56, 57, 58, 59
Serial Number of Control Sample:	50, 51
Part Function:	Quad 2-input MUX
Part Technology:	CMOS
Package Style:	16-pin DIP

TABLE II. Radiation Schedule for 54AC157DMQB

EVENTS	DATE
1) Initial (Pre-Irradiation) Electrical Measurements	10/04/91
2) 2.5-KRAD IRRADIATION (0.13 krads/hour)	10/07/91
POST-2.5-KRAD ELECTRICAL MEASUREMENT	10/09/91
3) 5-KRAD IRRADIATION (0.13 krads/hour)	10/10/91
POST-5-KRAD ELECTRICAL MEASUREMENT	10/11/91
4) 10- KRAD IRRADIATION (0.06 krads/hour)	10/11/91
POST-10-KRAD ELECTRICAL MEASUREMENT	10/15/91
5) 20-KRAD IRRADIATION (0.5 krads/hour)	10/15/91
POST-20-KRAD ELECTRICAL MEASUREMENT	10/16/91
6) 50-KRAD IRRADIATION (1.5 krads/hour)	10/16/91
POST-50-KRAD ELECTRICAL MEASUREMENT	10/21/91
7) 75-KRAD IRRADIATION (1.4 krads/hour)	10/21/91
POST-75-KRAD ELECTRICAL MEASUREMENT	10/23/91
8) 100-KRAD IRRADIATION (1.25 KRADS/HOUR)	10/23/91
POST-100-KRAD ELECTRICAL MEASUREMENT	10/24/91
9) 24 HOURS ANNEALING AT +25°C	10/24/91
POST-24-HOURS ELECTRICAL MEASUREMENT	10/25/91
10) 168 HOURS ANNEALING AT +25°C	10/25/91
POST-168-HOURS ELECTRICAL MEASUREMENT	11/05/91
11) 200-KRAD IRRADIATION (5.0 KRADS/HOUR)	11/05/91
POST-200-KRAD ELECTRICAL MEASUREMENTS	11/07/91
12) 300-KRAD IRRADIATION (5.3 KRADS/HOUR)	11/07/91
POST-300-KRAD ELECTRICAL MEASUREMENTS	11/08/91
13) 168 HOURS ANNEALING AT +100°C	11/08/91
POST-168 HOURS AT +100°C ELECTRICAL MEASUREMENTS	11/16/91

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.
- All Annealings were performed under bias.

Table III. Electrical Characteristics of 54AC157DMQB

TESTS PERFORMED

PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS @ -55C TO +125C
FUNCT #1	3.0V	0.0V	3.0V	FREQ = 1MHz	ALL I/O	VOL < 1.50V / VOH > 1.50V
FUNCT #2	5.5V	0.0V	5.5V	FREQ = 1MHz	ALL I/O	VOL < 1.50V / VOH > 1.50V

PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS @ -55C TO +125C
VOH1	3.0V	0.90V	2.10V	LOAD = -50UA	OUTS	> 2.90V / < 3.00V
VOH2	4.5V	1.35V	3.15V	LOAD = -50UA	OUTS	> 4.40V / < 4.50V
VOH3	5.5V	1.65V	3.85V	LOAD = -50UA	OUTS	> 5.40V / < 5.50V
VOH4	3.0V	0.90V	2.10V	LOAD = -4mA	OUTS	> 2.40V / < 3.00V
VOH5	4.5V	1.35V	3.15V	LOAD = -24mA	OUTS	> 3.70V / < 4.50V
VOH6	5.5V	1.65V	3.85V	LOAD = -24mA	OUTS	> 4.70V / < 5.50V
VOH7	5.5V	1.65V	3.85V	LOAD = -50mA	OUTS	> 3.85V / < 5.50V

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	V _{IN} = 5.5V	INS	> 0.00A / < +1.00A
I _{IL}	5.5V	0.00V	5.50V	V _{IN} = 0.0V	INS	> -1.00A / < 0.00A
I _{CC1}	5.5V	ALL INPUTS AT 5.50V			VCC	> 0.00A / < 160 UA
I _{CC2}	5.5V	ALL INPUTS AT 0.00V			VCC	> 0.00A / < 160 UA

AC PARAMETRIC TESTS PERFORMED

PARAMETER	VCC	VIL	VIH	FREQUENCY	PINS	LIMITS AT +25C ONLY
TPLH1	4.5V	0.0V	4.5V	1.0 MHz	S TO OUTS	> 1.0ns / < 10.0ns
TPHL1	4.5V	0.0V	4.5V	1.0 MHz	S TO OUTS	> 1.0ns / < 9.50ns
TPLH2	4.5V	0.0V	4.5V	1.0 MHz	E ₋ TO OUTS	> 1.0ns / < 10.0ns
TPHL2	4.5V	0.0V	4.5V	1.0 MHz	E ₋ TO OUTS	> 1.0ns / < 9.50ns
TPLH3	4.5V	0.0V	4.5V	1.0 MHz	IN TO OUTS	> 1.0ns / < 7.00ns
TPHL3	4.5V	0.0V	4.5V	1.0 MHz	IN TO OUTS	> 1.0ns / < 7.00ns

PARAMETER	VCC	VIL	VIH	FREQUENCY	PINS	LIMITS AT -55C TO +125C
TPLH1	4.5V	0.0V	4.5V	1.0 MHz	S TO OUTS	> 1.0ns / < 12.0ns
TPHL1	4.5V	0.0V	4.5V	1.0 MHz	S TO OUTS	> 1.0ns / < 11.5ns
TPLH2	4.5V	0.0V	4.5V	1.0 MHz	E ₋ TO OUTS	> 1.0ns / < 12.0ns
TPHL2	4.5V	0.0V	4.5V	1.0 MHz	E ₋ TO OUTS	> 1.0ns / < 11.5ns
TPLH3	4.5V	0.0V	4.5V	1.0 MHz	IN TO OUTS	> 1.0ns / < 9.00ns
TPHL3	4.5V	0.0V	4.5V	1.0 MHz	IN TO OUTS	> 1.0ns / < 9.00ns

COMMENTS/EXCEPTIONS

- (1) FUNCTIONAL TESTS #1 AND #2 ARE PERFORMED W/ I_{OH} = -24.0mA AND I_{OL} = 24mA
- (2) VIL & VIH WERE TESTED DURING THE VOL & VOH TESTS AS GO/NO GO
- (3) C_{in} and C_{pd} TESTS NOT PERFORMED
- (4) THIS PROGRAM CHECKS FOR OUT ORIENTATION.

TABLE IV: Summary of Electrical Measurements After
Total Dose Exposures and Annealing for 54AC157DMQB 1/21

Parameter	Spec. Limits	Total Dose Exposure (TDE) (krads)										Anneal				Total Dose (krads)				Anneal			
		0 (Pre-Rad)		10		20		50		100		24 hours +25°C		168 hours +25°C		200		300		168 hours +100°C			
		min	max	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd		
FUNC1 @1MHz				P		P		P		P		P		P		P		P		P			
FUNC2 @1MHz				P		P		P		P		P		P		P		P		P			
VOH1	V	2.90	3.00	2.99	0.00	2.99	0.00	2.99	0.00	2.99	0.00	2.99	0.00	2.99	0.00	2.99	0.01	2.98	0.01	2.99	0.01		
VOH2	V	4.40	4.50	4.49	0.00	4.49	-	4.49	-	4.49	-	4.49	0.00	4.49	0.00	4.49	0.01	4.48	0.01	4.49	0.00		
VOH3	V	5.40	5.50	5.49	0.01	5.48	0.00	5.49	0.00	5.49	0.00	5.49	0.01	5.49	0.00	5.49	0.01	5.48	0.01	5.49	0.00		
VOH4	V	2.40	5.50	2.93	0.00	2.93	0.00	2.93	0.00	2.93	0.01	2.92	0.01	2.93	0.00	2.93	0.01	0.82	0.13	0.89	0.08	2.41	0.90
VOH5	V	3.70	3.00	4.19	0.03	4.19	0.03	4.19	0.02	4.18	0.04	4.17	0.04	4.19	0.01	4.20	0.01	4.19	0.01	4.18	0.02	2.20	0.01
VOH6	V	4.70	4.50	5.21	0.03	5.22	0.03	5.22	0.02	5.21	0.04	5.20	0.04	5.22	0.01	5.23	0.01	5.23	0.01	5.22	0.02	5.23	0.01
VOH7	V	3.85	5.50	4.90	0.06	4.92	0.07	4.92	0.04	4.88	0.10	4.86	0.08	4.92	0.03	4.94	0.02	4.93	0.03	4.92	0.03	4.93	0.02
VOL1	V	0.00	0.10	0.00	-	0.00	-	0.00	-	0.00	-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	
VOL2	V	0.00	0.10	0.00	0.00	2.69	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.00	0.00
VOL3	V	0.00	0.10	0.01	0.01	0.01	0.01	0.01	0.00	0.01	0.00	0.01	0.00	0.01	0.01	0.01	0.00	0.01	0.00	0.01	0.00	0.01	0.00
VOL4	V	0.00	0.50	0.15	0.02	0.16	0.01	0.15	0.01	0.16	0.02	0.16	0.02	0.15	0.01	0.14	0.01	0.14	0.01	0.14	0.01	0.14	0.00
VOL5	V	0.00	0.50	0.24	0.04	0.23	0.03	0.23	0.02	0.24	0.03	0.24	0.04	0.23	0.02	0.21	0.01	0.21	0.01	0.21	0.01	0.21	0.01
VOL6	V	0.00	0.50	0.23	0.05	0.21	0.03	0.21	0.02	0.22	0.03	0.22	0.04	0.22	0.02	0.19	0.01	0.19	0.01	0.19	0.01	0.19	0.01
VOL7	V	0.00	1.65	0.47	0.09	0.46	0.06	0.45	0.05	0.47	0.10	0.47	0.09	0.45	0.46	0.40	0.02	0.40	0.02	0.40	0.02	0.41	0.03
I _{IH}	uA	0.00	1.00	0.00	-	0.00	-	0.00	-	0.00	-	0.00	-	0.00	-	0.00	-	0.00	-	0.00	-	0.00	-
I _{IL}	uA	-1.00	0.00	0.00	-	0.00	-	0.00	-	0.00	-	0.00	-	0.00	-	0.00	-	0.00	-	0.00	-	0.00	-
IC _{CH}	uA	0.00	160	0.00	-	1.01	0.21	6.04	1.39	20.6	32.4	707	1070	617	1002	450	831	2406	2305	4667	3116	447	892
IC _{CL}	uA	0.00	160	0.00	-	0.15	0.13	6.61	3.20	53.2	134	1156	1189	962	1120	670	945	3062	2143	5071	2603	367	819
TP _{LH1}	ns	0.10	10.0	6.77	0.10	6.41	0.20	6.46	0.20	6.92	0.13	6.08	0.13	6.06	0.14	5.73	0.12	5.52	0.15	5.43	0.14	6.40	0.18
TP _{HL1}	ns	0.10	9.50	6.37	0.12	6.60	0.18	6.70	0.17	7.18	0.15	7.02	0.14	7.01	0.13	5.87	0.08	5.83	0.08	5.89	0.08	6.76	0.09
TP _{LH2}	ns	0.10	10.0	6.59	0.14	6.36	0.16	6.45	0.16	6.70	0.10	6.03	0.10	6.00	0.11	5.37	0.10	5.43	0.15	5.52	0.11	6.10	0.18
TP _{HL2}	ns	0.10	9.50	5.50	0.13	5.57	0.17	5.66	0.16	5.89	0.14	5.79	0.13	5.77	0.11	4.74	0.07	4.56	0.09	4.42	0.07	5.26	0.11
TP _{LH3}	ns	0.10	7.00	5.71	0.16	5.09	0.27	5.12	0.28	5.46	0.29	4.64	0.26	4.61	0.26	4.20	0.24	4.11	0.29	4.06	0.30	4.79	0.32
TP _{HL3}	ns	0.00	7.00	5.86	0.21	5.46	0.31	5.56	0.29	5.97	0.29	5.09	0.21	5.07	0.20	4.54	0.16	4.63	0.12	4.68	0.07	5.45	0.10

Notes:

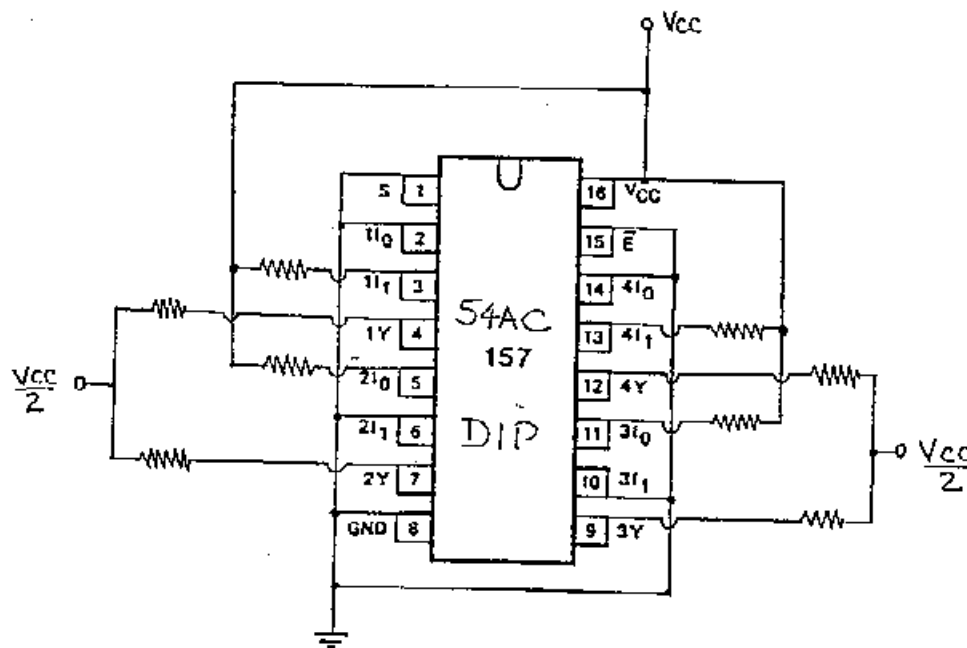
1/ The mean and standard deviation values were calculated over the eight parts irradiated in this testing. The control samples remained constant throughout the testing and are not included in this table.

2/ Table IV provides radiation characteristics of parts at selected total dose exposures and annealing treatments. The data at other radiation exposures and annealing treatments is available and can be obtained upon request.

Figure 1. Radiation Bias Circuit for 54AC157DMQB

Quad 2-Input Multiplexer
54AC157

SMEX



54AC157
16 PIN DIP

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

$$R = 1.0K \text{ OHM}, 5\%, \frac{1}{4}W$$

$$T_A = 25^\circ C$$

RADIATION BIAS CIRCUIT