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UNISYS

Interoffice Memorandum

To
T. Miccolis
Department
Code 300.1
From
K. Sahu *K-S*
Department
7809
Subject
Radiation Report on 54ACT157DMQB
SMEX Common Buy Part No. 5962-8968801EA
Control Number: 1654B

PPM-92-001
Date
January 15, 1992
Location
Lanham
Telephone
731-8954
Location
Lanham
cc
B. Fafaul/311
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A radiation evaluation was performed on 54ACT157 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, the parts were allowed to anneal under bias at +25°C for 96 and 168 hours, and then the parts were further irradiated to 200 and 300 krads (cumulative). The parts were finally annealed under bias at +100°C for 168 hours. 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 two functional tests at 1MHz (performed at VCC levels of 4.5V and 5.5V) after each radiation and annealing step.

All eight parts passed initial (pre-irradiation) electrical measurements. After the first radiation exposure to 10 krads, three parts exceeded the maximum specification limit of 160uA for ICCL. Failed readings ranged from 176uA to 530uA. On continued exposure to 20 krads, six parts exceeded the specification limit for ICCL and five parts exceeded the specification limits for dICC and ICCH. ICC readings continued to degrade on continued exposure to 30 and 50 krads, and at 75 krads, six of the eight parts had ICC readings greater than 32mA, the upper measurement limit of the test equipment. However, two parts (SNs 142 and 145) continued to pass all tests. The same failures were observed after 100 krads and no significant recovery occurred after annealing the parts for 96 and 168 hours.

At 200 krads, three parts failed functional test #1. Also, six of the eight parts continued to fail the ICC tests and three parts did not meet the minimum specification limit for VOH1. At 300 krads, six parts failed functional test #1 and SN 142 marginally exceeded the specification limit for ICCL with a reading of 171uA. ICC readings decreased significantly after annealing the parts for 168 hours at 100°C. Three parts passed all ICC tests and average ICCH and ICCL readings fell from above 32mA to 4mA and 6mA, respectively. However, all parts failed functional test #1 after this final annealing treatment. Table IV provides the mean and standard deviation values for each parameter after each radiation exposure and annealing treatment. It also provides a summary of the 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.

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

TABLE II. Radiation Schedule

EVENTS	DATE
1) Initial Electrical Measurements	07/31/91
2) 10 krads irradiation @ 500 rads/hr	12/05/91
Post 10 krads Electrical Measurements	12/06/91
3) 20 krads irradiation @ 500 rads/hr	12/06/91
Post 20 krads Electrical Measurements	12/07/91
4) 30 krads irradiation @ 480 rads/hr	12/09/91
Post 30 krads Electrical Measurements	12/10/91
5) 50 krads irradiation @ 980 rads/hr	12/10/91
Post 50 krads Electrical Measurements	12/11/91
6) 75 krads irradiation @ 1250 rads/hr	12/11/91
Post 75 krads Electrical Measurements	12/12/91
7) 100 krads irradiation @ 1250 rads/hr	12/12/91
Post 100 krads Electrical Measurements	12/13/91
8) 96 hrs annealing at 25°C	12/13/91
Post 96 hr Electrical Measurements	12/17/91
9) 168 hrs annealing at 25°C	12/13/91
Post 168 hr Electrical Measurements	12/20/91
10) 200 krads irradiation @ 1600 rads/hr	12/20/91
Post 200 krads Electrical Measurements	12/23/91
11) 300 krads irradiation @ 4900 rads/hr	12/23/91
Post 300 krads Electrical Measurements	12/24/91
12) 168 hrs annealing at 100°C	12/24/91
Post 168 hr Electrical Measurements	12/31/91

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 annealing performed under bias.

Table III. Electrical Characteristics of 54ACT157

TESTS PERFORMED						
PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS @ -55C TO +125C
FUNCT #1	4.5V	0.0V	4.5V	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
VOM1	4.5V	0.80V	2.00V	LOAD = -50UA	OUTS	> 4.40V / < 4.50V
VOH2	5.5V	0.80V	2.00V	LOAD = -50UA	OUTS	> 5.40V / < 5.50V
VOH3	4.5V	0.80V	2.00V	LOAD = -24MA	OUTS	> 3.70V / < 4.50V
VOH4	5.5V	0.80V	2.00V	LOAD = -24MA	OUTS	> 4.70V / < 5.50V
VOH5	5.5V	0.80V	2.00V	LOAD = -50MA	OUTS	> 3.85V / < 5.50V
PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS @ -55C TO +125C
VOL1	4.5V	0.80V	2.00V	LOAD = +50UA	OUTS	> 0.00V / < 0.10V
VOL2	5.5V	0.80V	2.00V	LOAD = +50UA	OUTS	> 0.00V / < 0.10V
VOL3	4.5V	0.80V	2.00V	LOAD = +24MA	OUTS	> 0.00V / < 0.50V
VOL4	5.5V	0.80V	2.00V	LOAD = +24MA	OUTS	> 0.00V / < 0.50V
VOL5	5.5V	0.80V	2.00V	LOAD = +50MA	OUTS	> 0.00V / < 1.65V
PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS @ -55C TO +125C
IIN	5.5V	0.00V	5.50V	VIN = 5.5V	INS	> 0.00A / < +1.00A
IIL	5.5V	0.00V	5.50V	VIN = 0.0V	INS	> -1.00A / < 0.00A
dICC	5.5V	0.00V	3.40V	dICC/INPUT	VCC	> -1.6MA / < 1.6 MA
ICCH	5.5V	0.00V	5.50V		VCC	> 0.00A / < 160 UA
ICCL	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
TPLM1	4.5V	0.0V	4.5V	1.0 MHZ	S TO OUTS	> 1.0ns / < 9.00ns
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 / < 8.50ns
TPLH3	4.5V	0.0V	4.5V	1.0 MHZ	IN TO OUTS	> 1.0ns / < 7.50ns
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
TPLM1	4.5V	0.0V	4.5V	1.0 MHZ	S TO OUTS	> 1.0ns / < 11.5ns
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 / < 10.0ns
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 / < 8.50ns
COMMENTS/EXCEPTIONS						
(1) FUNCTIONAL TESTS #1 AND #2 ARE PERFORMED W/ IOH = -24.0mA AND IOL = 24mA						
(2) VIL & VIH WERE TESTED DURING THE VOL & VOH TESTS AS GO/NO GO						
(3) dICC TEST TESTED PER INPUT PINS						
(4) CIn and Cpd TESTS NOT PERFORMED						
(5) THIS PROGRAM CHECKS FOR OUT ORIENTATION.						

TABLE IV: Summary of Electrical Measurements
after Total Dose Exposures and Annealing for 54ACT157

1/, 2/, 3/

Parameters	Spec. Limits min max		Total Dose Exposure (krads)														
			Pre-Rad		10		20		30		50		75		100		
			mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	
Func1 @VCC=4.5V			Pass		Pass		Pass		Pass		Pass		Pass		Pass		
Func2 @VCC=5.5V			Pass		Pass		Pass		Pass		Pass		Pass		Pass		
VOH1	V	4.4	4.5	4.49	0	4.49	0	4.49	0	4.49	0	4.49	0	4.48	.01	4.47	.01
VOH2	V	5.4	5.5	5.49	.01	*		5.49	0	5.49	0	5.49	.01	5.48	.01	5.47	.01
VOH3	V	3.7	4.5	*		*		4.18	.01	4.17	.01	4.17	.01	4.15	.01	4.14	.01
VOH4	V	4.7	5.5	*		*		5.22	.01	5.22	0	5.21	.01	5.20	.01	5.19	.01
VOH5	V	3.85	5.5	*		*		4.90	.01	4.89	.01	4.88	.01	4.87	.01	4.85	.02
VOL1	mV	0	100	0	0	0	0	0	0	1.3	2.9	6.9	5.6	13	9	18	12
VOL2	mV	0	100	0	0	0	0	0	0	2.3	3.6	7.4	6.1	14	10	19	12
VOL3	mV	0	500	208	10	206	8	208	9	212	9	214	11	217	13	223	15
VOL4	mV	0	500	180	10	178	8	181	9	184	10	187	11	191	14	198	16
VOL5	mV	0	1650	387	21	384	18	389	19	393	20	394	21	395	21	404	23
I IH	uA	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
I IL	uA	-1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
dICC	mA	-1.6	1.6	0.5	.02	0.7	0.2	2.3	1.4	5.4	3.9	13.2	8.7	22	13	>32	-
ICCH	uA	0	160	0	0	28	33	367	305	1.7E3	1.4E3	7E3	5E3	15E3	10E3	>3E4	-
ICCL	uA	0	160	0	0	170	187	1.9E3	1.6E3	5.3E3	4.2E3	1E4	9E3	>3E4	-	>3E4	-
TPLH1	ns	1	9.0	6.1	0.2	6.9	0.4	7.1	0.1	7.1	0.1	7.1	0.1	7.1	0.1	7.1	0.1
TPHL1	ns	1	9.5	6.4	0.2	7.7	0.4	8.0	.08	8.0	0.1	8.0	.09	8.0	.09	8.1	.09
TPLH2	ns	1	10.0	7.7	0.2	7.7	0.3	7.9	0.1	7.9	0.1	8.0	0.1	8.0	0.1	8.1	0.1
TPHL2	ns	1	8.5	4.5	0.2	5.4	0.3	5.6	.06	5.6	.07	5.6	.06	5.5	.07	5.5	.06
TPLH3	ns	1	7.5	4.7	0.4	4.6	0.4	4.8	0.3	4.8	0.2	4.8	0.3	4.8	0.3	4.8	0.3

<Table IV continued on next page>

Table IV. (continued)

Parameters	Spec. Limits min max	Pre-Rad mean sd		Anneal @25°C				TDE (krads)				Anneal 100°C			
				96 hrs		168 hrs		200		300		168 hrs			
				mean	sd	mean	sd	mean	sd	mean	sd	mean	sd		
Func1 @VCC=4.5V		Pass		Pass		Pass		5P/3F		2P/6F		Fail			
Func2 @VCC=5.5V		Pass		Pass		Pass		Pass		Pass		Pass			
VOH1	V	4.4	4.5	4.49	0	4.47	.01	4.47	.01	4.43	.08	4.15	0.9	3.36	1.7
VOH2	V	5.4	5.5	5.49	.01	5.47	.01	5.48	.01	*		5.45	.02	5.49	0
VCH3	V	3.7	4.5	4.14	.08	4.14	.01	4.15	.01	*		4.10	.03	4.15	.01
VCH4	V	4.7	5.5	5.18	.09	5.19	.01	5.19	.01	*		5.16	.03	5.20	.01
VCH5	V	3.85	5.5	4.82	.15	4.85	.01	4.86	.01	*		4.81	.03	4.86	.01
VCL1	mV	0	100	0	0	17	12	16	10	24	15	24	15	3.1	4.8
VOL2	mV	0	100	0	0	18	12	16	11	25	15	25	16	4.4	5.1
VOL3	mV	0	500	208	10	223	15	221	13	229	18	219	17	215	19
VOL4	mV	0	500	180	10	192	15	195	15	201	18	198	13	187	13
VOL5	mV	0	1650	387	21	405	24	401	22	405	27	397	25	396	33
IIF	uA	0	1	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
DIIC	mA	-1.6	1.6	0.5	.02	>32	-	>32	-	>32	-	>32	-	6.4	5.9
ICCH	uA	0	160	0	0	19E3	12E3	18E3	12E3	>3E4	-	>3E4	-	4E3	4E3
ICCL	uA	0	160	0	0	>3E4	-	>3E4	-	>3E4	-	>3E4	-	6E3	6E3
TPLH1	3/ ns	1	9.0	6.1	0.2	7.9	0.2	7.9	0.2	7.9	0.2	7.8	0.2	7.4	0.2
TPHL1	3/ ns	1	9.5	6.4	0.2	9.0	0.2	8.9	0.2	9.0	0.3	9.0	0.2	9.6	0.3
TPLH2	3/ ns	1	10.0	7.7	0.2	9.6	0.2	8.9	0.2	*		9.1	0.2	9.5	0.3
TPHL2	3/ ns	1	8.5	4.5	0.2	6.4	0.2	6.4	0.2	6.3	0.2	6.1	0.2	5.9	0.2
TPLH3	3/ ns	1	7.5	4.7	0.4	5.8	0.3	5.8	0.4	5.7	0.4	5.7	0.4	5.8	0.3

Notes:

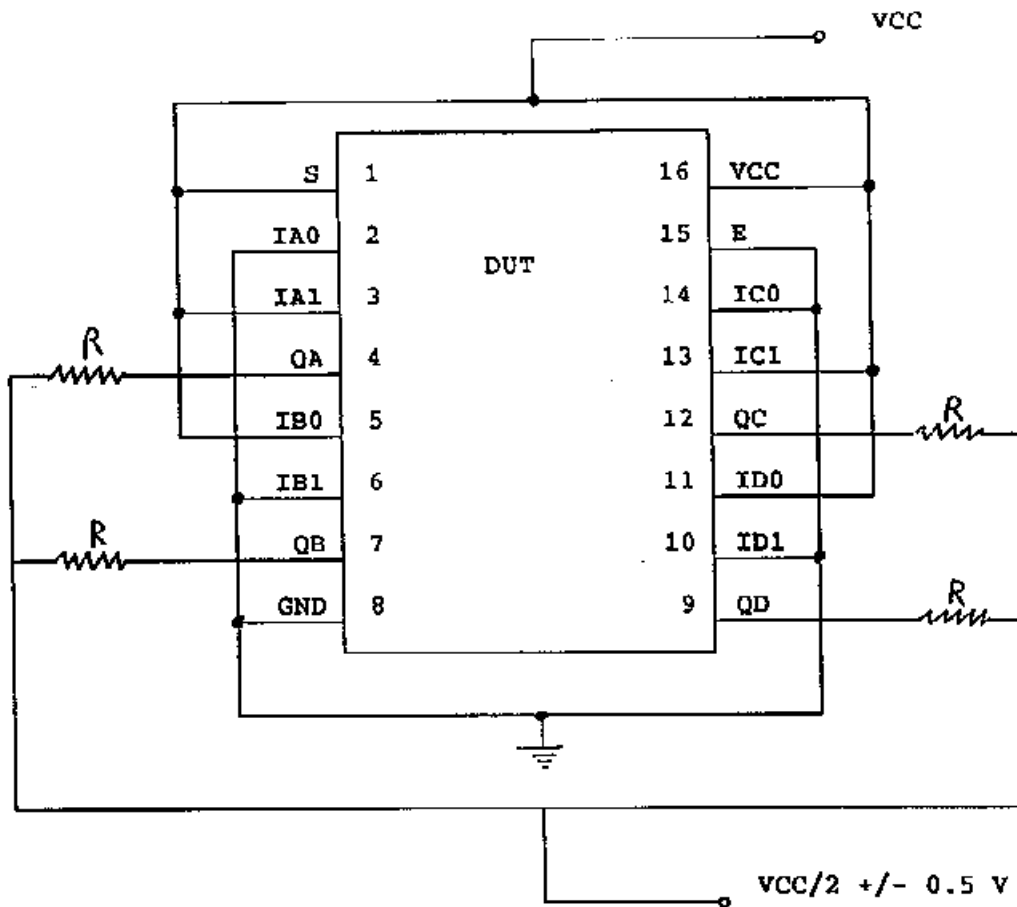
1/ The mean and standard deviation values were calculated over the eight parts irradiated in this testing. The control samples remained constant throughout the testing and are not included in this table.

2/ '>3E4' and '>32' indicate that some of the parts were exceeding 32mA, the upper limit that the test equipment could measure for this parameter.

3/ At all steps at and above 96-hour annealing, AC timing measurements were shifted upward by approximately 1ns due to calibration of the test equipment. The average readings reflect this shift in this table, but are not indicative of AC failures. Also, this table does not include data for TPLH3, since no reliable measurements were made for this parameter.

* No reliable measurements were made for this parameter at the noted radiation level.

Figure 1. Radiation Bias Circuit for 54ACT157



VCC = 5.0 +/- 0.5 V.

R = 2K OHM +/- 10%, 1/4 WATT

Ta = 25 Deg. C except during the final annealing step.

During the final annealing step, Ta = 100 Deg. C.