PPM-91-754

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(102)

UNISYS

Interoffice Memorandum

To
T. Miccolis
Department
Code 300.1
From
K. Sahu KS
Department
7809
Subject
Radiation Report on SMEX
Common Buy Part No. 54AC521DMQB
Control No. 1661

PPM-91-754
Date
December 27, 1991
Location
Lanham
Telephone
731-8954
Location
Lanham
cc
B. Fafaul/311
A. Sharma/311
D. Krus
J. Stubblefield
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Library/311

A radiation evaluation was performed on the 54AC521 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 24 and 168 hours, and then irradiation was continued to 200 and 300 krads (cumulative). The parts were finally annealed at +100°C for 168 hours. The dose rate was between 0.5 and 5.2 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 at +25°C according to the test conditions and the specification limits listed in Table III. These tests included a two functional tests (at 1 MHz) after each radiation and annealing step.

All eight parts passed both functional tests and all parametric tests, except ICCH and ICCL, throughout the radiation testing to 300 krads, and subsequent high temperature annealing for 168 hours. After the first radiation exposure to 10 krads, six of eight parts exceeded the maximum specification limit of 8uA for ICCH and five parts exceeded the same limit for ICCL. Maximum readings for these parameters were 280uA and 105uA, respectively. At 20 krads, all parts exceeded the specification limit for ICCH and ICCL. Readings for these parameters continued to increase with total doses to 100 krads. A slight decrease in ICCH/L was observed after 24 and 168 hours of annealing at 25°C, but average readings were still approximately 10mA. At 200 and 300 krads, average ICCH/L values increased to 20mA and 40mA, respectively.

On annealing the parts for 168 hours at 100°C, the parts showed significant recovery as the average ICCH/L readings dropped to approximately 4mA. 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 the functional test results at these steps in the testing.

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:	54AC521
SMEX Common Buy Part Number:	54AC521DMQB (HA124210)
SMEX Common Buy Control Number:	1661
Charge Number:	C90366
Manufacturer:	National Semiconductor Corp.
Quantity Procured:	118
Lot Date Code:	9038A
Quantity Tested:	10
Serial Numbers of Radiation Samples:	162, 163, 164, 165, 166, 167, 168, 169
Serial Numbers of Control Samples:	160, 161
Part Function:	8-Bit Identity Comparator
Part Technology:	CMOS
Package Style:	20-pin DIP
Test Engineer:	A. Karygiannis

TABLE II. Radiation Schedule for 54AC521

EVENTS	DATE
1) Initial (Pre-Irradiation) Electrical Measurements	07/16/91
2) 10- KRAD IRRADIATION (0.5 krads/hour)	11/18/91
POST-10-KRAD ELECTRICAL MEASUREMENT	11/19/91
3) 20-KRAD IRRADIATION (0.5 krads/hour)	11/19/91
POST-20-KRAD ELECTRICAL MEASUREMENT	11/20/91
4) 30-KRAD IRRADIATION (0.5 krads/hour)	11/20/91
POST-30-KRAD ELECTRICAL MEASUREMENT	11/21/91
5) 50-KRAD IRRADIATION (1.0 krads/hour)	11/21/91
POST-50-KRAD ELECTRICAL MEASUREMENT	11/22/91
6) 75-KRAD IRRADIATION (1.4 krads/hour)	11/22/91
POST-75-KRAD ELECTRICAL MEASUREMENT	11/23/91
7) 100-KRAD IRRADIATION (0.6 KRADS/HOUR)	11/23/91
POST-100-KRAD ELECTRICAL MEASUREMENT	11/25/91
8) 24 HOURS ANNEALING AT +25°C	11/25/91
POST-24-HOURS ELECTRICAL MEASUREMENT	11/26/91
9) 168 HOURS ANNEALING AT +25°C	11/25/91
POST-168-HOURS ELECTRICAL MEASUREMENT	12/02/91
10) 200-KRAD IRRADIATION (5.2 KRADS/HOUR)	12/02/91
POST-200-KRAD ELECTRICAL MEASUREMENTS	12/03/91
11) 300-KRAD IRRADIATION (5.0 KRADS/HOUR)	12/03/91
POST-300-KRAD ELECTRICAL MEASUREMENTS	12/04/91
12) 168 HOURS ANNEALING AT +100°C	12/04/91
POST-168 HOURS AT +100°C ELECTRICAL MEASUREMENTS	12/13/91

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 54AC521

FUNCTIONAL TESTS

PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS AT +25C,-55C,+125C
FUNCT # 1	4.5V	0.00V	4.50V	FREQ = 1 MHz	ALL I/O	VOL<1.5V , VOH>1.5V
FUNCT # 2	5.5V	0.00V	5.50V	FREQ = 1 MHz	ALL I/O	VOL<1.5V , VOH>1.5V

DC PARAMETRIC TESTS

PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS AT +25C
VOH1	3.0V	0.90V	2.10V	LOAD= -50UA	OUTS	>+2.9V , <+6.0V
VOH2	4.5V	1.35V	3.15V	LOAD= -50UA	OUTS	>+4.4V , <+6.0V
VOH3	5.5V	1.65V	3.85V	LOAD= -50UA	OUTS	>+5.4V , <+6.0V
VOH4	3.0V	0.90V	2.10V	LOAD= -12MA	OUTS	>+2.56V , <+6.0V
VOH5	4.5V	1.35V	3.15V	LOAD= -24MA	OUTS	>+3.86V , <+6.0V
VOH6	5.5V	1.65V	3.85V	LOAD= -24MA	OUTS	>+4.86V , <+6.0V

PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS AT +25C
VOL1	3.0V	0.90V	2.10V	LOAD= +50UA	OUTS	>+0.0V , <+0.1V
VOL2	4.5V	1.35V	3.15V	LOAD= +50UA	OUTS	>+0.0V , <+0.1V
VOL3	5.5V	1.65V	3.85V	LOAD= +50UA	OUTS	>+0.0V , <+0.1V
VOL4	3.0V	0.90V	2.10V	LOAD= +12MA	OUTS	>+0.0V , <+0.36V
VOL5	4.5V	1.35V	3.15V	LOAD= +24MA	OUTS	>+0.0V , <+0.36V
VOL6	5.5V	1.65V	3.85V	LOAD= +24MA	OUTS	>+0.0V , <+0.36V

PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS AT +25C
VIOH	5.5V	1.65V	3.85V	LOAD= -50MA	OUTS	>+3.85V , <+6.0V
VIOL	5.5V	1.65V	3.85V	LOAD= +50MA	OUTS	>+0.0V , <+1.65V

PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS AT +25C
IIH	5.5V	0.0V	5.5V	VIN = 5.5V	INS	>-0.0UA , <+0.1UA
IIL	5.5V	0.0V	5.5V	VIN = 0.0V	INS	>-0.1UA , <+0.0UA

PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS AT +25C
ICCH	5.5V	0.0V	5.5V	VIN = VCC	VCC	>+0.0UA , <+8.0UA
ICCL	5.5V	0.0V	5.5V	VIN = 0.0V	VCC	>+0.0UA , <+8.0UA

AC PARAMETRIC TESTS

PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS AT +25C
TPLH1_A	3.0V	0.0V	3.0V	F=1MHz,VCMP=1.50V	OUTPUTS	> 1.0ns , < 12.5ns
TPHL1_A	3.0V	0.0V	3.0V	F=1MHz,VCMP=1.50V	OUTPUTS	> 1.0ns , < 12.5ns
TPLH1_B	3.0V	0.0V	3.0V	F=1MHz,VCMP=1.50V	OUTPUTS	> 1.0ns , < 12.5ns
TPHL1_B	3.0V	0.0V	3.0V	F=1MHz,VCMP=1.50V	OUTPUTS	> 1.0ns , < 12.5ns
TPLH1_I	3.0V	0.0V	3.0V	F=1MHz,VCMP=1.50V	OUTPUTS	> 1.0ns , < 9.0ns
TPHL1_I	3.0V	0.0V	3.0V	F=1MHz,VCMP=1.50V	OUTPUTS	> 1.0ns , < 9.0ns

PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS AT +25C
TPLH2_A	4.5V	0.0V	4.5V	F=1MHz,VCMP=2.25V	OUTPUTS	> 1.5ns , < 9.0ns
TPHL2_A	4.5V	0.0V	4.5V	F=1MHz,VCMP=2.25V	OUTPUTS	> 1.5ns , < 9.0ns
TPLH2_B	4.5V	0.0V	4.5V	F=1MHz,VCMP=2.25V	OUTPUTS	> 1.5ns , < 9.0ns
TPHL2_B	4.5V	0.0V	4.5V	F=1MHz,VCMP=2.25V	OUTPUTS	> 1.5ns , < 9.0ns
TPLH2_I	4.5V	0.0V	4.5V	F=1MHz,VCMP=2.25V	OUTPUTS	> 1.5ns , < 6.5ns
TPHL2_I	4.5V	0.0V	4.5V	F=1MHz,VCMP=2.25V	OUTPUTS	> 1.5ns , < 6.5ns

COMMENTS/EXCEPTIONS

(1) VIL & VIH WERE TESTED DURING VOL & VOH TESTS AS GO/NOGO.

TABLE IV: Summary of Electrical Measurements After Total Dose Exposures and Annealing for 54AC521DMQB

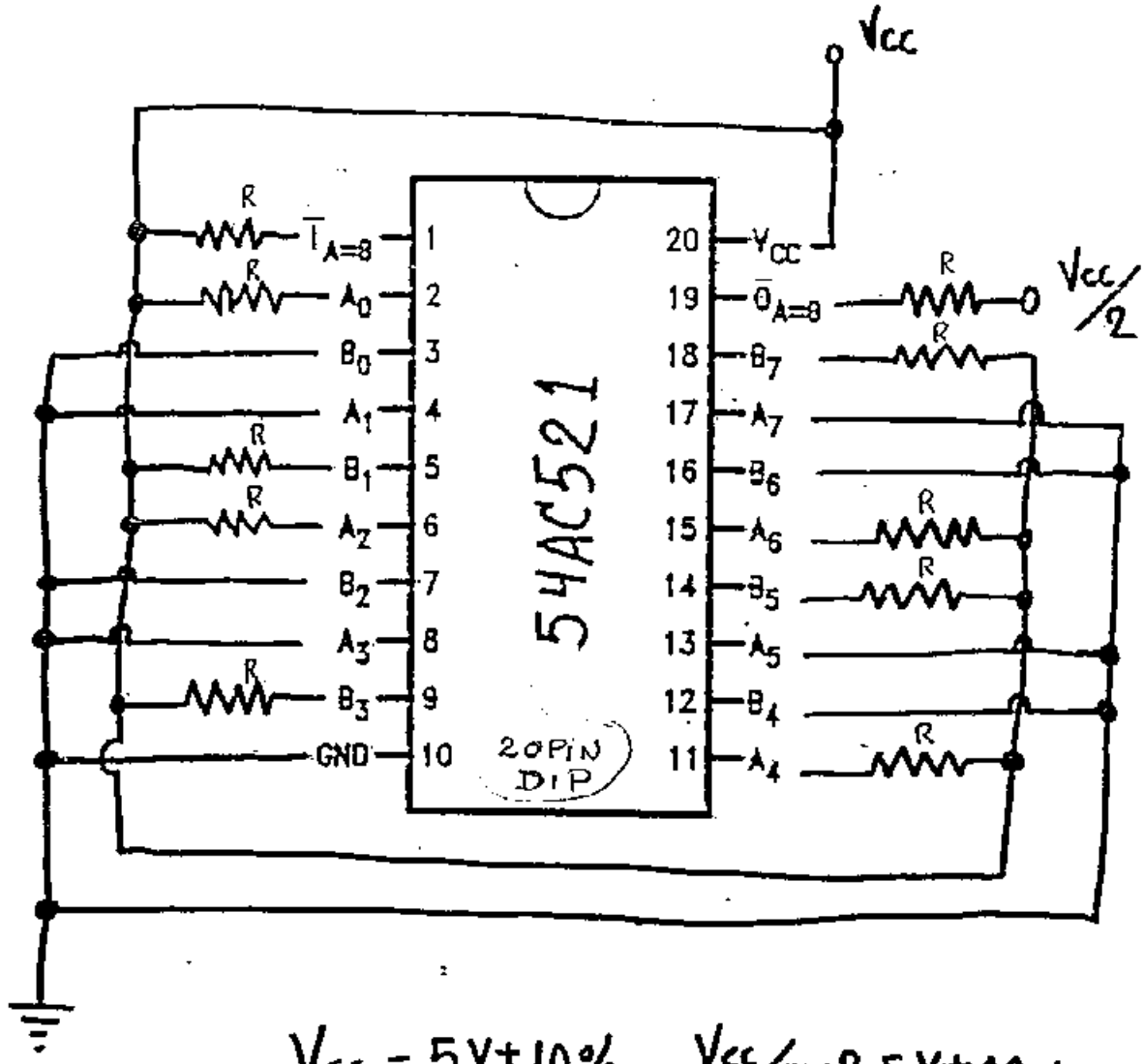
		Spec. Limits		Total Dose Exposure (TDE) (krads)												Anneal		Total Dose (krads)				Anneal	
				0 (Pre-Rad)		10		20		30		50		100		168 hours +25°C		200		300		168 hours +100°C	
Parameter		min	max	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd
FUNC1 VCC = 4.5V				P		P		P		P		P		P		P		P		P		P	
FUNC2 VCC = 5.5V				P		P		P		P		P		P		P		P		P		P	
VOH1	V	2.9	6	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	0.00	2.99	0.00	2.98	0.00	2.99	0.00
VOH2	V	4.4	6	4.49	0.00	4.49	0.00	4.49	0.00	4.49	0.00	4.49	0.00	4.49	0.00	4.48	0.02	4.49	0.00	4.49	0.00	4.49	0.00
VOH3	V	5.4	6	5.49	0.00	5.49	0.00	5.49	0.00	5.49	0.00	5.49	0.00	5.49	0.00	5.47	0.04	5.48	0.00	5.48	0.00	5.49	0.00
VOH4	V	2.56	6	2.79	0.01	2.79	0.01	2.79	0.01	2.79	0.01	2.79	0.00	2.78	0.01	2.76	0.05	2.77	0.01	2.75	0.01	2.77	0.01
VOH5	V	3.86	6	4.20	0.01	4.20	0.01	4.20	0.01	4.20	0.01	4.20	0.01	4.19	0.01	4.18	0.05	4.18	0.01	4.17	0.01	4.19	0.01
VOH6	V	4.86	6	5.24	0.01	5.24	0.01	5.23	0.01	5.24	0.01	5.24	0.01	5.23	0.01	5.22	0.05	5.22	0.01	5.21	0.01	5.23	0.01
VIOH	V	3.85	6	4.95	0.02	4.95	0.02	4.94	0.02	4.95	0.02	4.94	0.02	4.94	0.02	4.92	0.05	4.91	0.02	4.89	0.04	4.93	0.02
VOL1	V	0	0.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VOL2	V	0	0.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VOL3	V	0	0.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VOL4	V	0	0.36	0.13	0.00	0.13	0.00	0.13	0.00	0.13	0.00	0.13	0.00	0.13	0.00	0.12	0.00	0.13	0.00	0.13	0.01	0.12	0.00
VOL5	V	0	0.36	0.18	0.00	0.19	0.00	0.19	0.01	0.18	0.00	0.18	0.00	0.18	0.00	0.19	0.00	0.19	0.00	0.20	0.01	0.18	0.00
VOL6	V	0	0.36	0.16	0.00	0.16	0.00	0.17	0.01	0.16	0.00	0.16	0.00	0.16	0.00	0.16	0.00	0.17	0.00	0.18	0.02	0.16	0.00
VIOL	V	0	1.65	0.34	0.01	0.35	0.01	0.36	0.02	0.35	0.01	0.35	0.01	0.35	0.01	0.35	0.01	0.36	0.01	0.38	0.04	0.34	0.01
IIH	nA	0	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
IIL	nA	-100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ICCH	mA	0	.008	0	0	0.12	0.1	1.2	0.9	3.0	1.8	5.1	3.0	10.1	5.5	10.6	5.3	21.9	7.3	35.6	8.3	4.0	4.6
ICCL	mA	0	.008	0	0	0.04	0.0	0.6	0.5	2.0	1.4	4.3	2.7	12.7	5.5	10.7	5.2	22.8	7.9	38.8	9.0	4.2	5.0
TPLH_A	ns	1	12.5	6.9	0.3	7.7	0.4	6.9	0.4	7.7	0.4	7.6	0.5	7.6	0.4	7.1	0.36	6.9	0.3	6.8	0.3	8.0	0.5
TPHL_A	ns	1	12.5	8.0	0.4	9.7	0.4	9.0	0.4	9.6	0.4	9.7	0.4	9.6	0.5	9.9	0.5	9.9	0.4	9.9	0.5	10.6	0.5
TPLH_B	ns	1	12.5	6.6	0.3	7.4	0.3	6.6	0.3	7.4	0.4	7.4	0.4	7.3	0.4	7.5	0.3	7.4	0.3	7.3	0.3	8.5	0.5
TPHL_B	ns	1	12.5	8.0	0.4	9.1	0.5	8.4	0.4	9.0	0.5	9.0	0.5	8.9	0.5	8.50	0.49	8.5	0.5	8.6	0.5	9.2	0.6
TPLH_I	ns	1	9	5.4	0.3	6.0	0.3	5.3	0.3	6.0	0.3	5.9	0.3	5.8	0.2	5.34	0.25	5.1	0.2	5.0	0.2	6.2	0.3
TPHL_I	ns	1	9	5.1	0.3	5.7	0.3	6.0	0.3	6.8	0.3	6.9	0.3	6.9	0.3	6.93	0.28	7.1	0.3	7.3	0.3	7.2	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/ 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 54AC521



$V_{CC} = 5V \pm 10\%$, $V_{CC}/2 = 2.5V \pm 10\%$

$R = 1K_{OHM} \pm 5\%$, $1/4\,W$

$T_A = +25^{oC}$.