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UNISYS

Interoffice Memorandum

To
T. Miccolis
Department
Code 300.1
From
K. Sahu K<<
Department
7809
Subject
Radiation Report on 54ACT374LMQB
SMEX Common Buy
Part No. 5962-87631012A
Control Number 1756

PPM-92-003
Date
January 10, 1992
Location
Lanham
Telephone
731-8954
Location
Lanham
cc
B. Fafaul/311
A. Sharma/311
J. Stubblefield
D. Krus
A. Moor

A radiation evaluation was performed on the 54ACT374 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 krads. Parts were finally annealed at 100°C for 168 hours. The dose rate was between 0.2 and 5.0 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 total of four functional tests (three at 1MHz and one at 40MHz) after each radiation and annealing step.

All eight parts passed initial electrical measurements. After the first radiation exposure to 10 krads, two parts, SNs 805 & 807, exceeded the maximum specification limit of 160uA for ICCL with readings of 275uA and 196uA, respectively. At 20 krads, all parts were exceeding the specification limits for ICCH and ICCL, and seven parts were exceeding the specification limit for ICCZ. On continued exposure to 30 and 50 krads, parts showed continued degradation on ICC tests, as average readings were above 1mA, and most parts were also exceeding the specification limits for the ICCMAX tests; however, parts continued to pass all other tests.

At 75 krads, the first functional failures occurred. Six parts failed functional test #3 and one part failed functional test #4. Also, two parts (SNs 806 & 807) exceeded the specification limit for TPZL. At 100 krads, all parts failed functional test #4 and some parts exceeded the 16mA limit of the test equipment for the ICC tests. There were also additional AC failures observed.

Some recovery was observed after annealing the parts for 24 and 168 hours at 25°C, but all parts still failed one or more functional tests.

After the final radiation exposure to 200 krads, parts were annealed for 168 hours at 100°C. The parts showed a substantial decrease in ICC readings, but none of the parts recovered to pass all parametric tests. All parts passed functional tests #1 and #2, seven parts passed functional test #4 and two parts recovered to pass all of the functional tests. Table IV provides the mean and standard deviation values for each parameter after different radiation exposures and annealing treatments. Table IV 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 I. Part Information

Generic Part Number:	54ACT374LMQB
SMEX Common Buy Part Number:	5962-87631012A (HA124252)
SMEX Common Buy Control Number:	1756
Charge Number:	C90361
Manufacturer:	National Semiconductor Corp.
Quantity Procured:	100
Lot Date Code:	9040A
Quantity Tested:	10
Serial Numbers of Radiation Samples:	802, 803, 804, 805, 806, 807, 808, 809
Serial Numbers of Control Samples:	800, 801
Part Function:	Octal D Flip-flop with Tri-state
Part Technology:	CMOS
Package Style:	20-pin LCC
Test Engineer:	Tom Karygiannis

Table II. Radiation Schedule

EVENTS	DATE
1) Initial Electrical Measurements	07/16/91
2) 10 krads irradiation @ 540 rads/hr Post 10 krads Electrical Measurements	11/26/91 11/27/91
3) 20 krads irradiation @ 230 rads/hr Post 20 krads Electrical Measurements	11/27/91 11/29/91
4) 30 krads irradiation @ 530 rads/hr Post 30 krads Electrical Measurements	11/29/91 11/30/91
5) 50 krads irradiation @ 450 rads/hr Post 50 krads Electrical Measurements	11/30/91 12/02/91
6) 75 krads irradiation @ 1320 rads/hr Post 75 krads Electrical Measurements	12/02/91 12/03/91
7) 100 krads irradiation @ 1250 rads/hr Post 100 krads Electrical Measurements	12/03/91 12/04/91
8) 24 hrs annealing at 25°C Post 24 hr Electrical Measurements	12/04/91 12/05/91
9) 168 hrs annealing at 25°C Post 168 hr Electrical Measurements	12/04/91 12/11/91
10) 200 krads irradiation @ 5000 rads/hr Post 200 krads Electrical Measurements	12/11/91 12/12/91
11) 168 hrs annealing at 100°C Post 168 hr Electrical Measurements	12/12/91 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 annealing performed under bias.

Table III. Electrical Characteristics of 54ACT374

FUNCTIONAL TESTS PERFORMED						
PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS AT +25C ONLY
FUNCT 1	4.5V	0.0V	4.5V	FREQ=1.000MHZ	ALL I/O	VOL<1.5V / VOH>1.5V
FUNCT 2	5.5V	0.0V	5.5V	FREQ=1.000MHZ	ALL I/O	VOL<2.5V / VOH>2.5V
FUNCT 3 *	4.5V	0.0V	4.5V	FREQ=1.000MHZ	ALL I/O	VOL<2.5V / VOH>2.5V
FUNCT 4	4.5V	0.0V	4.5V	FREQ=40.000MHZ	ALL I/O	VOL<2.5V / VOH>2.5V
LOAD USED <= C IOH = -6.0mA C IOL = +6.0mA C VREF = 1.5V C IGL = +6.0mA						
DC PARAMETRIC TESTS PERFORMED						
PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS @ +125C, +25C, -55C
VOH1	4.5V	0.8V	2.0V	LOAD=-50UA	OUTS	>+4.4V / <+4.5V
VOH2	5.5V	0.8V	2.0V	LOAD=-50UA	OUTS	>+5.4V / <+5.5V
VOH3	4.5V	0.8V	2.0V	LOAD=-24MA	OUTS	>+3.7V / <+4.5V
VOH4	5.5V	0.8V	2.0V	LOAD=-24MA	OUTS	>+4.7V / <+5.5V
VOH5	5.5V	0.8V	2.0V	LOAD=-50MA	OUTS	>+3.85V / <+5.5V
VOL1	4.5V	0.8V	2.0V	LOAD=+50UA	OUTS	>+0.0V / <+0.1V
VOL2	5.5V	0.8V	2.0V	LOAD=+50UA	OUTS	>+0.0V / <+0.1V
VOL3	4.5V	0.8V	2.0V	LOAD=+24MA	OUTS	>+0.0V / <+0.5V
VOL4	5.5V	0.8V	2.0V	LOAD=+24MA	OUTS	>+0.0V / <+0.5V
VOL5	5.5V	0.8V	2.0V	LOAD=+50MA	OUTS	>+0.0V / <+1.65V
IIH	5.5V	0.0V	5.5V	INPUTS HIGH	INS	>+0.0UA / <+1.0UA
IIL	5.5V	0.0V	5.5V	INPUTS LOW	INS	>-1.0UA / <+0.0UA
IOZH	5.5V	0.0V	5.5V	VTST= 5.5V	INS	>+0.0UA / <+10UA
IOZL	5.5V	0.0V	5.5V	VTST= 0.0V	INS	>-10UA / <+0UA
ICCH	5.5V	0.0V	5.5V	VIN = 5.5V	VCC	>+0.0UA / <+160UA
ICCL	5.5V	0.0V	5.5V	VIN = 0.0V	VCC	>+0.0UA / <+160UA
ICCZ	5.5V	0.0V	5.5V	VIN = 0.0V	VCC	>+0.0UA / <+160UA
ICCMAX	5.5V	0.0V	3.4V	VIN = 3.4V	VCC	>+0.0UA / <+1.6MA
ICCHMAX	5.5V	0.0V	3.4V	VIN = 3.4V	VCC	>+0.0UA / <+3.0MA
ICCLMAX	5.5V	0.0V	3.4V	VIN = 3.4V	VCC	>+0.0UA / <+1.6MA
AC PARAMETRIC TESTS						
PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS @ +25C
TPLH	5.0V	0.0V	4.0V	F=1 MHz,	OUTPUTS	> 1.0ns / <10.0ns
TPHL	5.0V	0.0V	4.0V	F=1 MHz,	OUTPUTS	> 1.0ns / <10.0ns
TPLZ	5.0V	0.0V	4.0V	F=1 MHz,	OUTPUTS	> 1.0ns / <11.0ns
TPHZ	5.0V	0.0V	4.0V	F=1 MHz,	OUTPUTS	> 1.0ns / <11.0ns
TPZL	5.0V	0.0V	4.0V	F=1 MHz,	OUTPUTS	> 1.0ns / <10.7ns
TPZH	5.0V	0.0V	4.0V	F=1 MHz,	OUTPUTS	> 1.0ns / <10.7ns
COMMENTS/EXCEPTIONS						
(1) VIL & VIH were tested during VOL & VOH tests as Go/No/Go. (2) Setup and Hold times are tested as Go/NoGo in Functional tests at 25°C. * (3) Minimum pulse width CP Tw high tested as Go/NoGo in Functional Test 3 only. This is a very stringent AC parametric test for the parts. (4) Functional Test 4 tests device at 40MHz not 92MHz, the maximum frequency at which the device is specified to operate.						

TABLE IV: Summary of Electrical Measurements
after Total Dose Exposures and Annealing for 54ACT374

1/2/

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 @1MHz		Pass		Pass		Pass		Pass		Pass		Pass		Pass		1P/7F	
Func2 @1MHz		Pass		Pass		Pass		Pass		Pass		Pass		Pass		5P/3F	
Func3 @1MHz		Pass		Pass		Pass		Pass		Pass		Pass		2P/6F		1P/7F	
Func4 @40MHz		Pass		Pass		Pass		Pass		Pass		Pass		7F/1F		Fail	
VOH1 V	4.4 4.5	4.50	0	4.49	0	4.49	0	4.49	0	4.49	0	4.49	0	4.49	0	4.44	.48
VOH2 V	5.4 5.5	5.49	0	5.49	0	5.49	0	5.49	0	5.49	0	5.49	0	5.15	1.3	5.49	.01
VOH3 V	3.7 4.5	4.18	.01	4.17	.03	4.18	.01	4.18	.01	4.18	.01	4.18	.01	4.18	.01	4.17	.01
VOH4 V	4.7 5.5	5.22	0	5.21	.03	5.22	.01	5.22	.01	5.22	.01	5.22	.01	5.22	.01	5.21	.01
VOH5 V	3.85 5.5	4.91	.01	4.89	.06	4.90	.01	4.90	.01	4.90	.01	4.90	.01	4.90	.01	4.88	.02
VOL1 mV	0 100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**	
VOL2 mV	0 100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**	
VOL3 mV	0 500	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**	
VOL4 mV	0 500	176	6	185	27	176	8	176	7	176	7	176	7	177	8	**	
VOL5 mV	0 1650	379	14	398	57	379	17	379	16	378	15	378	17	378	17	**	
IIH nA	0 1000	.08	0.7	0	0	0	0	0	0	0	0	0	0	0	0	0	0
IIIL nA	-1000 0	0	0	0	0	0	0	-0.4	3.2	0	0	0	0	0	0	0	0
IOZH uA	-10 10	0	0	0	0	-0.4	0.3	2.6	13.5	9.7	45	44	177	129	530		
IOZL uA	-10 10	0	0	0	0	0	.01	-0.2	1.1	-0.6	3.3	-3.6	17	-15	66		
ICCH uA	0 160	0	0	33.1	26.6	476	275	1.5E3	704	2.8E3	1.2E3	8E3	3E3	>1E4	-		
ICCL uA	0 160	0	0	113	85.1	494	303	1.7E3	816	3.2E3	1.3E3	9E3	3E3	>1E4	-		
ICCZ uA	0 150	0	0	29.3	24.3	438	278	1.7E3	831	3.2E3	1.4E3	9E3	3E3	>1E4	-		
ICCMAX DE mA	0 1.6	0.5	.01	0.5	.03	1.0	0.3	2.2	0.8	3.7	1.4	9.7	3.4	>16	-		
ICCMAX CP mA	0 3.0	0.6	.01	0.7	.09	1.0	0.3	2.3	0.8	3.7	1.3	9.1	3.0	>16	-		
ICCMAX D mA	0 1.6	.09	0	0.2	.09	0.7	0.3	1.9	0.9	3.3	1.3	8.6	3.0	>16	-		
TPLH ns	1 10	8.2	0.1	7.7	0.2	7.8	0.2	7.7	0.2	7.8	0.1	7.8	0.2	6.9	1.5		
TPHL ns	1 10	6.5	0.2	6.7	0.3	6.8	0.3	6.7	0.2	6.8	0.2	6.8	0.2	*			
TPLZ ns	1 11	7.3	0.1	7.3	0.1	7.3	0.1	7.3	0.2	7.4	.07	7.3	0.1	*			
TPHZ ns	1 11	7.2	0.2	8.4	0.2	8.3	0.2	8.4	0.2	8.4	0.1	8.3	0.1	7.9	0.5		
TPZL ns	1 10.7	6.3	0.7	7.5	0.8	7.4	0.7	7.4	0.7	8.0	0.7	*		*			
TPZH ns	1 10.7	5.9	0.1	6.2	0.2	6.2	0.2	8.3	0.2	6.2	0.1	6.2	0.1	6.3	0.2		

<Table IV continued on next page>

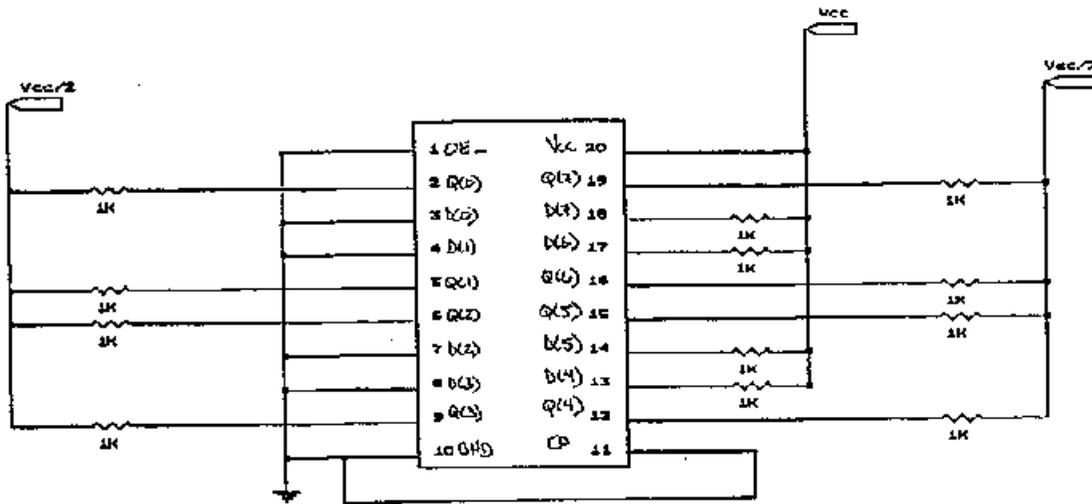
Table IV. (continued)

Parameters	Spec. Limits min max	Pre-Rad		Anneal @25°C				Total Dose		Anneal	
		mean	sd	24 hrs		168 hrs		200 krads		168 hrs @100°C	
				mean	sd	mean	sd	mean	sd	mean	sd
Func1 @1MHz		Pass		1P/7F		3P/5F		1P/7F		Pass	
Func2 @1MHz		Pass		6P/2F		7P/1F		2P/6F		Pass	
Func3 @1MHz		Pass		1P/7F		1P/7F		1P/7F		2P/6F	
Func4 @40MHz		Pass		Fail		Fail		Fail		7P/1F	
VOH1	V 4.4 4.5	4.50	0	4.42	.56	4.48	.02	4.47	.03	4.48	.03
VOH2	V 5.4 5.5	5.49	0	5.32	1.0	5.23	1.2	5.40	.68	4.72	1.9
VOH3	V 3.7 4.5	4.18	.01	4.16	.01	4.16	.01	4.11	.30	4.16	.01
VOH4	V 4.7 5.5	5.22	0	5.21	.01	5.21	.01	5.20	.01	5.21	.01
VOH5	V 3.85 5.5	4.91	.01	4.87	.02	4.87	.02	4.85	.02	4.87	.02
VOL1	mV 0 100	0	0	**		**		**		**	
VOL2	mV 0 100	0	0	**		**		**		0	0
VOL3	mV 0 500	0	0	**		**		**		**	
VOL4	mV 0 500	176	6	**		**		**		180	7
VOL5	mV 0 1650	379	14	**		**		**		387	15
I _{IH}	nA 0 1000	.08	0.7	0	0	0	0	0	0	0	0
I _{IL}	nA -1000 0	0	0	0	0	0	0	0	0	0	0
IOZH	uA -10 10	0	0	171	593	161	561	285	923	35	170
IOZL	uA -10 10	0	0	-20	74	-18	69	-38	117	-.05	0.3
ICCH	uA 0 160	0	0	>1E4	-	>1E4	-	>1E4	-	1.5E3	907
ICCL	uA 0 160	0	0	>1E4	-	>1E4	-	>1E4	-	1.3E3	825
IC CZ	uA 0 160	0	0	>1E4	-	>1E4	-	>1E4	-	1.9E3	1.4E3
ICCMAX DE	mA 0 1.6	0.5	.01	>16	-	>16	-	>16	-	2.3	1.4
ICCMAX CP	mA 0 3.0	0.6	.01	>16	-	>16	-	>16	-	1.7	0.8
ICCMAX D	mA 0 1.6	.09	0	>16	-	>16	-	>16	-	1.3	0.8
TPLH	ns 1 10	8.2	0.1	6.8	1.5	7.4	0.9	6.2	1.9	6.9	0.6
TPHL	ns 1 10	6.5	0.2	*		*		*		7.7	0.3
TPLZ	ns 1 11	7.3	0.1	*		*		*		8.3	0.1
TPHZ	ns 1 11	7.2	0.2	7.7	0.4	8.1	0.3	7.7	0.4	9.4	0.2
TPZL	ns 1 10.7	6.3	0.7	*		*		*		9.2	0.7
TPZH	ns 1 10.7	5.9	0.1	6.3	0.2	6.4	0.2	6.4	0.2	7.6	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/ '>1E4' or '>16' means that parts were exceeding the 16mA limit of the test equipment for these parameters.
- * Some parts did not make the transition within the 1000us testing range of the ATE.
- ** No reliable VOL measurements made at the noted radiation step for this parameter.

Figure 1. Radiation Bias Circuit for 54ACT374



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

Table I. Part Information

Generic Part Number:	54ACT157
SMEX Common Buy Part Number:	5962-8968801EA
SMEX Common Buy Control Number:	1654B
Charge Number:	C90397
Manufacturer:	National Semiconductor Corp.
Quantity Procured:	50
Lot Date Code:	9123A
Quantity Tested:	10
Serial Numbers of Radiation Samples:	142, 143, 144, 145, 146, 147, 148, 149
Serial Numbers of Control Samples:	140, 141
Part Function:	Quad 2-input MUX
Part Technology:	CMOS
Package Style:	16-pin DIP
Test Engineer:	Ki Kim