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PPM-91-747

To
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December 13, 1991Department
Code 300.1Location
LanhamFrom
K. Sahu k->Telephone
731-8954Department
7809Location
LanhamSubject -
Radiation Report on 54ACT240LMQB
SMEX Common Buy
Part No. 5962-87759012A
Control No. 2302cc
B. Fafaul/311
A. Sharma/311
D. Krus
J. Stubblefield
A. Moor
Library/311

A radiation evaluation was performed on 54ACT240 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 krad^s. After 100 krad^s, parts were annealed at 25°C for 24 and 168 hours, and then irradiation was continued to 200 and 300 krad^s (cumulative). Parts were then annealed at high temperature (100°C) for 312 hours. The dose rate was between 0.4 - 5.0 krad^s/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 two functional tests (1MHz, at VCC voltages of 4.5V and 5.5V) after each radiation and annealing step.

All eight parts passed both functional tests to 200 krad^s and all parametric tests to 10 krad^s. At 20 krad^s, one part (SN 229) exceeded the maximum specification limit of 160uA for ICCH with a reading of 678uA. At 30 krad^s, the same part exceeded the specification limit for ICCH, ICCL and ICCZ, and at 50 krad^s, three parts (SNs 223, 227 & 229) failed these ICC tests. However, after 75 krad^s, the only failure observed was from SN 229 in ICCH. Four parts failed ICC tests at 100 krad^s. After 168 hours of annealing at 25°C, all parts showed partial recovery while one part (SN 230) recovered to pass all tests. After 200 krad^s, six parts failed ICC tests and one part (SN 229) exceeded the maximum specification limit of 8.5ns for TPLH (the reading was 78.8ns). Also, VOH failures were observed in three parts.

At 300 krads, the first functional failures were observed in three parts (SNs 223, 228 & 229). In addition, two more parts failed AC timing tests. Upon annealing the parts for 312 hours at 100°C, all parts passed all functional and parametric testing. 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 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:	54ACT240
SMEX Common Buy Part Number:	5962-87759012A
SMEX Common Buy Control Number:	2302
Charge Number:	C90274
Manufacturer:	National Semiconductor Corp.
Quantity Procured:	100
Lot Date Codes:	9012A & 9040A
Quantity Tested:	10
Serial Numbers of Radiation Samples:	223, 224, 225, 230 (LDC 9040A) 226, 227, 228, 229 (LDC 9012A)
Serial Numbers of Control Samples:	- 221, 222 (LDC 9012A)
Part Function:	Octal, Tri-state Inverting Buffer/Driver
Part Technology:	CMOS
Package Style:	20-Pin LCC
Test Engineer:	R. Tosh

TABLE II. Radiation Schedule

EVENTS	DATE
1) Initial Electrical Measurements	09/03/91
2) 10 krads irradiation @ 525 rads/hr Post 10 krads Electrical Measurements	10/28/91 10/29/91
3) 20 krads irradiation @ 525 rads/hr Post 20 krads Electrical Measurements	10/29/91 10/30/91
4) 30 krads irradiation @ 525 rads/hr Post 30 krads Electrical Measurements*	10/30/91 11/07/91
5) 50 krads irradiation @ 1050 rads/hr Post 50 krads Electrical Measurements	11/07/91 11/08/91
6) 75 krads irradiation @ 1320 rads/hr Post 75 krads Electrical Measurements	11/08/91 11/09/91
7) 100 krads irradiation @ 1250 rads/hr Post 100 krads Electrical Measurements	11/09/91 11/13/91
8) 24 hrs annealing at 25°C Post 24 hr Electrical Measurements	11/13/91 11/14/91
9) 168 hrs annealing at 25°C Post 168 hr Electrical Measurements	11/13/91 11/20/91
10) 200 krads irradiation @ 5000 rads/hr Post 200 krads Electrical Measurements	11/20/91 11/21/91
11) 300 krads irradiation @ 5000 rads/hr Post 300 krads Electrical Measurements	11/21/91 11/22/91
12) 312 hrs annealing at 100°C Post 312 hr Electrical Measurements	11/22/91 12/05/91

*Due to problems with the test equipment, parts received an unscheduled eight day annealing treatment at 25°C.

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 54ACT240

TESTS PERFORMED						
PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS
FUNC1 01	4.5V	0.0V	4.5V	FREQ= 1.0MHz IOH = -12.0mA IOL = +12.0mA	ALL I/O	VOH>2.0V , VOL<1.0V
FUNC1 01	5.5V	0.0V	5.5V	FREQ= 1.0MHz IOH = -12.0mA IOL = +12.0mA	ALL I/O	VOH>2.0V , VOL<1.0V
PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS
VOL1	4.5V	0.8V	2.0V	LOAD= -50.0mA	OUTPUTS	>4.40V <4.50V
VOL2	5.5V	0.8V	2.0V	LOAD= -50.0mA	OUTPUTS	>5.40V <5.50V
VOL3	4.5V	0.8V	2.0V	LOAD= -24.0mA	OUTPUTS	>3.70V <4.50V
VOL4	5.5V	0.8V	2.0V	LOAD= -24.0mA	OUTPUTS	>4.70V <5.50V
VOL5	5.5V	0.8V	2.0V	LOAD= -50.0mA	OUTPUTS	>3.85V <5.50V
VOL1	4.5V	0.8V	2.0V	LOAD= +50.0mA	OUTPUTS	>0.00V <0.10V
VOL2	5.5V	0.8V	2.0V	LOAD= +50.0mA	OUTPUTS	>0.00V <0.10V
VOL3	4.5V	0.8V	2.0V	LOAD= +24.0mA	OUTPUTS	>0.00V <0.50V
VOL4	5.5V	0.8V	2.0V	LOAD= +24.0mA	OUTPUTS	>0.00V <0.50V
VOL5	5.5V	0.8V	2.0V	LOAD= +50.0mA	OUTPUTS	>0.00V <1.65V
IOZH	5.5V	0.0V	5.5V	VTEST=3.3V	OUTPUTS	> 0.0A <100A
IOZL	5.5V	0.0V	5.5V	VTEST=0.0V	OUTPUTS	> -100A <0.0A
IIH	5.5V	0.0V	5.5V	VTEST=5.5V	INPUTS	> 0mA <10A
IIL	5.5V	0.0V	5.5V	VTEST=0.0V	INPUTS	> -10A <00A
IOCH	5.5V	0.0V	5.5V	OUTPUTS HIGH	VCC	>+0.0mA <1600A
ICCL	5.5V	0.0V	5.5V	OUTPUTS LOW	VCC	>+0.0mA <1600A
IOCX	5.5V	0.0V	5.5V	OUTPUTS DISABLED	VCC	>+0.0mA <1600A
DICC	5.5V	0.0V	VCC=2.1-3.4V		VCC	>+0.0mA <1.6mA
AC PARAMETRIC TESTS PROPAGATION DELAY TIMING						
PARAMETER	VCC	VIL	VIH	PINS	LIMITS @25C	
					MIN	MAX
TPHL	4.5V	0.0V	3.0V	OUT	1.0NS	0.5NS
TPLH	4.5V	0.0V	3.0V	OUT	1.0NS	0.5NS
TPLZ	4.5V	0.0V	3.0V	OUT	1.0NS	0.5NS
TPZL	4.5V	0.0V	3.0V	OUT	1.0NS	9.5NS
TPHZ	4.5V	0.0V	3.0V	OUT	1.0NS	9.5NS
TPZH	4.5V	0.0V	3.0V	OUT	1.0NS	9.5NS
EXCEPTIONS/COMMENTS/REMARKS						
1) FUNCTIONAL TEST PERFORMED AT -12MA AND 12MA.						
2) VIL AND VIH WERE TESTED DRIVING VOL AND VOH AS GO/NOGO						

TABLE IV: Summary of Electrical Measurements
after Total Dose Exposures and Annealing for 54ACT240

1/

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		Pass		
Func2 @VCC=5.5V			Pass		Pass		Pass		Pass		Pass		Pass		Pass		Pass		
VOH1	V	4.4	4.5	4.50	0	4.50	0	4.50	0	4.50	0	4.49	0	4.49	0	4.49	0	4.49	0
VOH2	V	5.4	5.5	5.50	0	5.50	0	5.50	0	5.50	0	5.49	0	5.49	0	5.49	0	5.49	0
VOH3	V	3.7	4.5	4.21	.03	4.18	.09	4.16	0.1	4.18	.07	4.19	.04	4.19	.03	4.19	.03	4.19	.03
VOH4	V	4.7	5.5	5.24	.02	5.22	.09	5.19	0.1	5.22	.06	5.23	.03	5.23	.03	5.23	.03	5.23	.03
VOH5	V	3.85	5.5	4.94	.05	4.89	.17	4.87	0.2	4.89	.15	4.92	.07	4.92	.06	4.92	.06	4.92	.06
VOL1	mV	0	100	0	0	0.1	0.5	0.2	0.6	.07	0.3	0	0	0	0	0	0	0	0
VOL2	mV	0	100	261	0.5	0.2	0.7	0.3	0.8	.07	0.3	0	0	0	0	0	0	0	0
VOL3	mV	0	500	199	13	220	70	229	90	220	73	204	26	202	21	201	22	201	22
VOL4	mV	0	500	175	12	197	74	206	94	198	77	180	25	179	20	179	21	179	21
VOL5	mV	0	1650	353	19	362	46	361	45	385	47	377	59	383	43	382	44	382	44
IOZH	uA	0	10	0	0	0	0	0	.01	0	.01	0	.02	0	.02	.01	.05	.01	.05
IOZL	uA	-10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
I IH	nA	0	1000	0	0	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	0	0
ICCH	uA	0	160	0.3	0.6	15	21	110	215	126	276	630	1118	25	69	870	1365	870	1365
ICCL	uA	0	160	0	0	1.4	1.4	72	47	40	101	290	570	9	23	469	801	469	801
ICCZ	uA	0	160	0	0	0.7	1.2	19	46	41	104	290	580	9	23	459	791	459	791
DEL_ICC	mA	0	1.6	0.4	.07	0.5	.07	0.5	0.2	0.5	0.2	1.0	1.0	0.4	.08	1.1	1.3	1.1	1.3
TPLH	ns	1	8.5	4.3	0.4	5.4	0.5	5.4	0.5	5.4	0.6	5.3	0.5	5.3	0.5	5.4	0.5	5.4	0.5
TPHL	ns	1	8.5	4.0	0.3	4.5	0.5	4.5	0.5	4.0	0.5	3.9	0.4	3.9	0.4	3.8	0.4	3.8	0.4
TPLZ	ns	1	9.5	6.2	0.4	6.0	0.3	6.0	0.4	6.0	0.5	6.0	0.4	5.9	0.4	5.9	0.4	5.9	0.4
TPZL	ns	1	9.5	4.9	0.5	6.9	0.5	5.8	0.5	6.1	0.6	6.1	0.5	6.1	0.5	6.0	0.5	6.0	0.5
TPHZ	ns	1	9.5	5.0	0.4	6.0	0.4	5.9	0.5	5.2	0.5	4.9	0.5	5.2	0.4	5.2	0.4	5.2	0.4
TPZH	ns	1	9.5	4.6	0.9	5.6	1.0	5.6	1.1	5.4	0.7	5.4	0.6	5.5	0.7	5.5	0.8	5.5	0.8

<Table IV continued on next page>

Table IV. (continued),

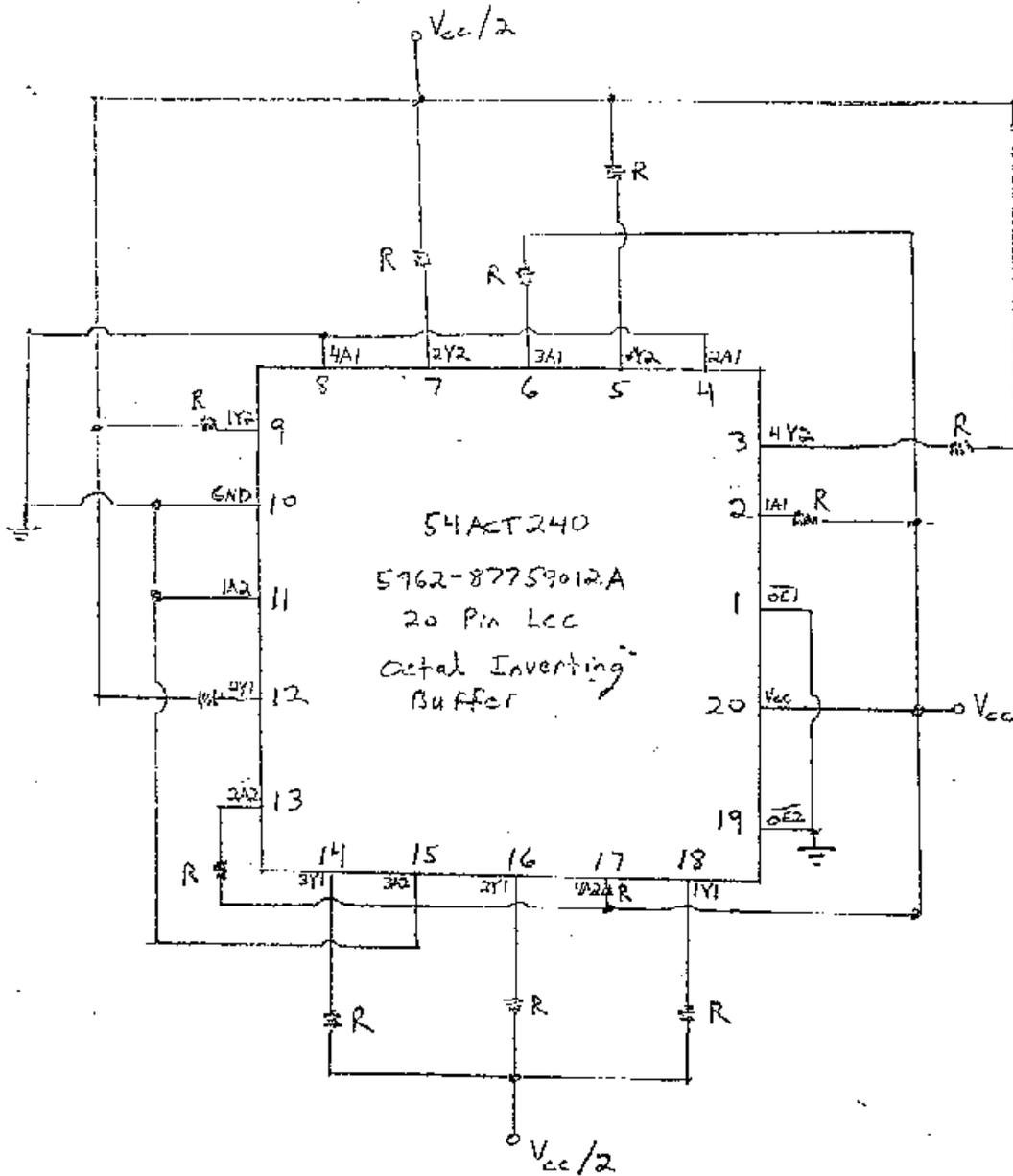
Parameters	Spec. Limits min max		Pre-Rad mean sd		Anneal @25°C				TDE (krads)				Anneal 100°C		
					24 hrs		168 hrs		200		300		312 hrs		
					mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	
Func1 @VCC=4.5V			Pass		Pass		Pass		Pass		6P/2F		Pass		
Func2 @VCC=5.5V			Pass		Pass		Pass		Pass		6P/2F		Pass		
VOH1	V	4.4	4.5	4.50	.0	4.49	0	4.49	0	4.22	0.9	3.64	1.5	4.49	0
VOH2	V	5.4	5.5	5.50	0	5.49	0	5.49	0	5.46	0.2	5.08	1.3	5.49	0
VOH3	V	3.7	4.5	4.21	.03	4.19	.03	4.19	.03	3.94	0.9	3.34	1.5	4.17	.03
VOH4	V	4.7	5.5	5.24	.02	5.23	.03	5.23	.03	5.20	0.2	4.80	1.3	5.22	.03
VOH5	V	3.85	5.5	4.94	.05	4.91	.06	4.92	.06	4.88	0.2	4.45	1.3	4.90	.06
VOL1	mV	0	100	0	0	0	0	0	0	0	0	0	0	0	0
VOL2	mV	0	100	261	0.5	0	0	0	0	0	0.2	0.8	0	0	
VOL3	mV	0	500	199	13	201	22	201	21	199	21	198	19	212	26
VOL4	mV	0	500	175	12	178	21	178	20	177	20	176	17	185	21
VOL5	mV	0	1650	353	19	381	44	381	43	379	43	376	37	396	44
IOZH	uA	0	10	0	0	.01	.05	.01	.04	0.1	0.3	1.4	2.7	.01	.03
IOZL	uA	-10	0	0	0	0	0	0	0	0	0	-.04	.08	0	0
IIH	nA	0	1000	0	0	0	0	0	0	0	0	0	0	0	0
IIL	nA	-1000	0	0	0	0	0	0	0	0	0	0	0	0	0
ICCH	uA	0	160	0.9	0.6	741	1201	549	932	5191	4994	8171	6461	13.8	36
ICCL	uA	0	160	0	0	393	709	296	567	4046	4055	6792	5632	4.0	11
IC CZ	uA	0	160	0	0	389	697	291	555	3895	3978	6577	5559	2.9	7.6
DEL_ICC	mA	0	1.6	0.4	.07	1.0	1.1	0.8	0.9	5.4	4.9	8.2	6.3	0.3	.05
TPLH	ns	1	8.5	4.3	0.4	5.4	0.5	5.4	0.5	8.4	12.3	*		6.2	0.6
TPHL	ns	1	8.5	4.0	0.3	3.9	0.4	3.9	0.4	3.7	0.5	9.1	14.2	4.5	0.5
TPLZ	ns	1	9.5	6.2	0.4	5.9	0.4	6.0	0.4	5.9	0.4	6.0	0.5	6.7	0.4
TPZL	ns	1	9.5	4.9	0.5	6.1	0.5	6.1	0.5	6.1	0.5	6.1	0.5	7.3	0.5
TPHZ	ns	1	9.5	5.0	0.4	4.1	0.5	4.8	0.6	5.1	0.4	*		5.3	0.4
TPZH	ns	1	9.5	4.6	0.9	5.3	0.7	5.5	0.6	9.3	9.7	*		6.1	0.8

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.

* Some parts did not make the transition within the 1000us testing range of the ATE.

Figure 1. Radiation Bias Circuit for 54ACT240



$$R = 1\text{K}\Omega \pm 5\%, \frac{1}{4}\text{W}$$

$$V_{cc} = 5.0\text{V} \pm 10\%, \quad V_{cc}/2 = 2.5\text{V} \pm 10\%$$

$$T_A = 25^\circ\text{C}$$