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Interoffice Memorandum

To
T. Miccolis
Department
Code 300.1
From
K. Sahu KS
Department
7809
Subject
Radiation Report on 54AC32DMQB
SMEX Common Buy Part No. 5962-8761401CA

PPM-91-645
Date
October 19, 1991
Location
Lanham
Telephone
731-8954
Location
Lanham
cc
B. Fafaul/311
A. Sharma/311
D. Krus
J. Stubblefield
A. Moor

A radiation evaluation was performed on 54AC32 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. After 100 krad, parts were annealed at 25°C for 24 and 168 hours, and then irradiation was continued to 200 and 300 krad (cumulative). Parts were then annealed at high temperature (100°C) for 168 hours. The dose rate was between 0.5 - 5.0 krad/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 three functional tests (10MHz, at VCC voltages of 2.0V, 3.0V and 5.5V) after each radiation and annealing step.

All (8) parts passed all functional and parametric tests up to 300 krad. Some slight degradation was observed in some of the VOL and VOH tests as the total dose exposure reached 300 krad; however, all parts remained well within the specification limits for all parameters. 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.

TABLE I. Part Information

Generic Part Number:	54AC32
SMEX Common Buy Part Number:	5962-8761401CA (HA124225)
SMEX Common Buy Control Number:	1648
Charge Number:	C90355
Manufacturer:	National Semiconductor Corp.
Quantity Procured:	107
Lot Date Code:	9036A
Quantity Tested:	10
Serial Numbers of Radiation Samples:	802, 803, 804, 805 806, 807, 808, 809
Serial Numbers of Control Samples:	801, 802
Part Function:	Quad 2-Input OR Gate
Part Technology:	CMOS
Package Style:	14-Pin DIP
Test Engineer:	R. Tosh

REMARKS

Urgent
 For your review
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From: Nora Cline

Phone: _____
Fax Phone: _____
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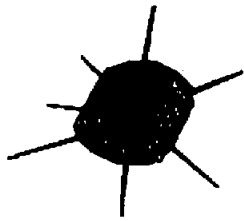
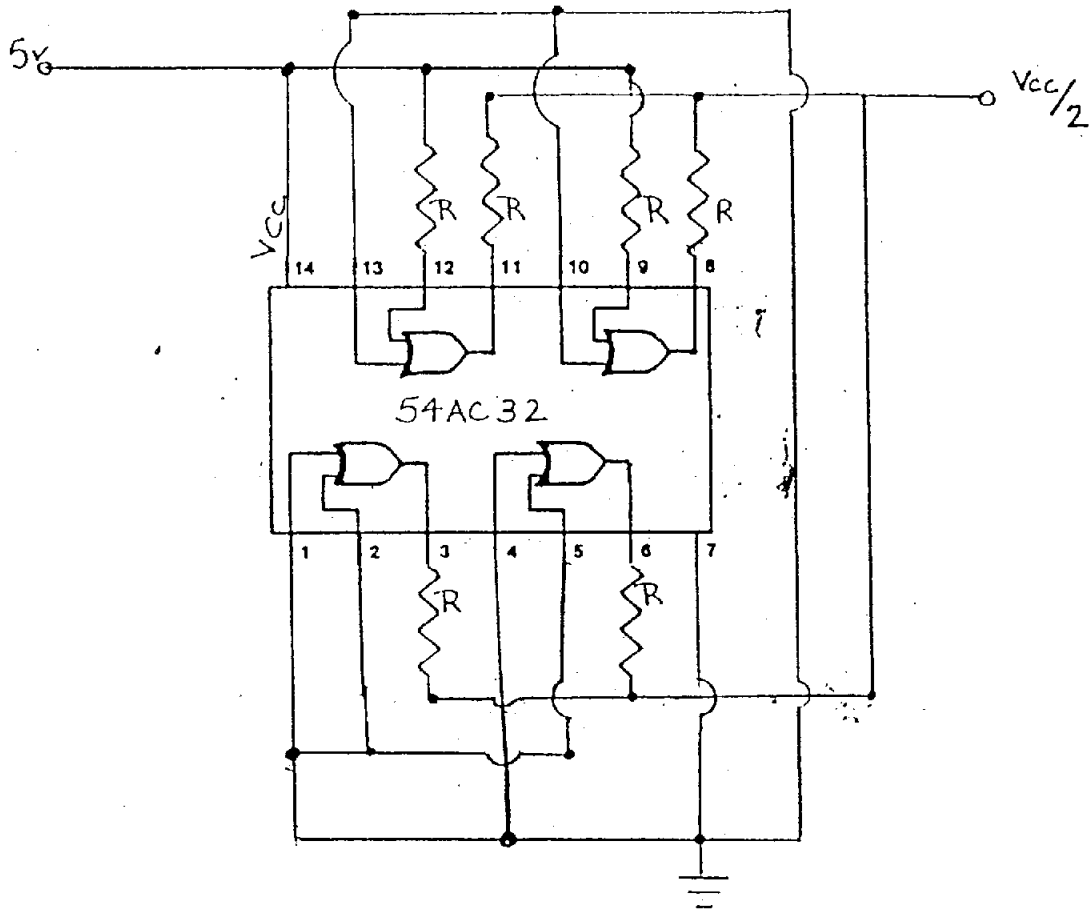


Figure 1. Radiation Bias Circuit for 54AC32



NOTE :

- 1) $V_{CC} = 5V \pm 10\%$
- 2) $R = 1.0K\Omega, \pm 5\%, \frac{1}{4}$ WATT.
- 3) $T_A = 25^\circ C$

TABLE IV: Summary of Electrical Measurements

after Total Dose Exposures and Annealing for 54AC32

1/, 2/, 3/

Parameters	Spec. Limits	min	max	Initials			Total Dose Exposure (krads)						Annealing @ 25°C			Total Dose (krads)			Annealing @ 100°C						
				mean	sd	Pass	20	50	100	200	300	mean	sd	Pass	200	300	mean	sd	Pass	168 hrs	mean	sd	Pass		
							mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	
Func1 VCC=2.0V				Pass			Pass			Pass			Pass			Pass			Pass			Pass			
Func2 VCC=3.0V				Pass			Pass			Pass			Pass			Pass			Pass			Pass			
Func3 VCC=5.5V				Pass			Pass			Pass			Pass			Pass			Pass			Pass			
VOH1	V	2.9	5.5	3.00	0	3.00	0	3.00	0	3.00	0	3.00	0	3.00	0	3.00	0	3.00	0	3.00	0	3.00	0	3.00	0
VOH2	V	4.4	5.5	4.49	.01	4.50	0	5.50	0	4.50	0	4.49	0	4.49	0	4.49	0	4.49	0	4.49	0	4.49	0	4.50	0
VOH3	V	5.4	5.5	5.49	0	5.49	.01	5.49	0	5.49	0	5.49	0	5.49	0	5.49	0	5.49	0	5.49	0	5.49	0	5.49	0
VOH4	V	2.4	5.5	2.94	0	2.94	0	2.94	0	2.94	0	2.94	0	2.94	0	2.94	0	2.94	0	2.94	0	2.94	0	2.94	.01
VOH5	V	3.7	5.5	4.23	.01	4.22	.01	4.20	.01	4.19	.03	4.20	.02	4.18	.02	4.14	.08	4.15	.04	4.15	.04	4.15	.04	4.15	.04
VOH6	V	4.7	5.5	5.26	.01	5.25	.01	5.24	.02	5.22	.03	5.23	.01	5.21	.02	5.19	.08	5.20	.04	5.20	.04	5.20	.04	5.20	.04
VOH7	V	3.85	5.5	4.99	.01	4.97	.02	4.95	.03	4.91	.06	4.94	.03	4.89	.06	4.85	.12	4.85	.08	4.85	.08	4.85	.08	4.85	.08
VOL1	mV	0	100	0	0	0	0	0	0	0	0	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	0	0	0	0	0	0	0	0
VOL3	mV	0	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VOL4	mV	0	500	133	4	143	8	140	8	152	14	146	7	156	15	161	22	203	47	203	47	203	47	203	47
VOL5	mV	0	500	185	4	204	14	199	16	223	27	209	12	231	30	241	38	272	49	272	49	272	49	272	49
VOL6	mV	0	500	157	3	177	14	172	16	197	26	181	12	203	30	214	40	232	41	232	41	232	41	232	41
VOL7	mV	0	1650	338	7	381	31	370	34	425	63	389	25	436	61	473	116	505	93	505	93	505	93	505	93
IIL	nA	-1000	0	-1	4	0	0	0	0	-2	1.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
IIH	nA	0	1000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ICCH	uA	0	80	<16	N/A	<16	N/A	<16	N/A	<16	N/A	<16	N/A	<16	N/A	<16	N/A	<16	N/A	<16	N/A	<16	N/A	<16	N/A
ICCL	uA	0	80	<16	N/A	<16	N/A	<16	N/A	<16	N/A	<16	N/A	<16	N/A	<16	N/A	<16	N/A	<16	N/A	<16	N/A	<16	N/A
TPHL1	ns	1	10	5.3	.2	6.4	.2	6.4	.2	6.4	.2	6.5	.2	6.6	.2	6.7	.3	7.2	.7	7.2	.7	7.2	.7	7.2	.7
TPHL1	ns	1	9.5	4.6	.2	6.6	.2	6.6	.2	6.7	.3	6.7	.3	6.9	.4	7.1	.5	7.6	.4	7.6	.4	7.6	.4	7.6	.4
TPHL2	ns	1	7.5	5.0	.2	6.1	.2	6.0	.2	6.0	.2	6.1	.2	6.1	.2	6.1	.2	6.4	.4	6.4	.4	6.4	.4	6.4	.4
TPHL2	ns	1	7.5	4.1	.2	5.1	.2	6.1	.2	6.2	.2	6.2	.2	6.3	.3	6.4	.4	6.5	.2	6.5	.2	6.5	.2	6.5	.2

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.
- 3/ The measurement range of the test equipment for ICCH/L was set to 16uA-16nA. ICCH/L of all parts were below this range.

Table III. Electrical Characteristics of 54AC32

TESTS PERFORMED

PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS: -55C TO +125C
FUNC 1	2.0V	0.0V	2.0V	FREQ = 10MHz	ALL I/O	VOH>1.00V, VOL<1.00V
FUNC 2	3.0V	0.0V	3.0V	FREQ = 10MHz	ALL I/O	VOH>1.50V, VOL<1.50V
FUNC 3	5.5V	0.0V	5.5V	FREQ = 10MHz	ALL I/O	VOH>2.75V, VOL<2.75V
VOH1	3.0V; INPUTS AT 0.90V AND 2.10V, EACH OUTPUT AT				-50UA.	2.90V MIN
VOH2	4.5V; INPUTS AT 1.35V AND 3.15V, EACH OUTPUT AT				-50UA.	4.40V MIN
VOH3	5.5V; INPUTS AT 1.65V AND 3.85V, EACH OUTPUT AT				-50UA.	5.40V MIN
VOH4	3.0V; INPUTS AT 0.90V AND 2.10V, EACH OUTPUT AT				-4MA.	2.40V MIN
VOH5	4.5V; INPUTS AT 1.35V AND 3.15V, EACH OUTPUT AT				-24MA.	3.70V MIN
VOH6	5.5V; INPUTS AT 1.65V AND 3.85V, EACH OUTPUT AT				-24MA.	4.70V MIN
VOH7	5.5V; INPUTS AT 1.65V AND 3.85V, EACH OUTPUT AT				-50MA.	3.85V MIN
VOL1 *	3.0V; INPUTS AT 0.00V AND 3.00V, EACH OUTPUT AT				50UA.	0.1V MAX
VOL2 *	4.5V; INPUTS AT 0.00V AND 4.50V, EACH OUTPUT AT				50UA.	0.1V MAX
VOL3 *	5.5V; INPUTS AT 0.00V AND 5.50V, EACH OUTPUT AT				50UA.	0.1V MAX
VOL4 *	3.0V; INPUTS AT 0.00V AND 3.00V, EACH OUTPUT AT				12MA.	0.5V MAX
VOL5 *	4.5V; INPUTS AT 0.00V AND 4.50V, EACH OUTPUT AT				24MA.	0.5V MAX
VOL6 *	5.5V; INPUTS AT 0.00V AND 5.50V, EACH OUTPUT AT				24MA.	0.5V MAX
VOL7 *	5.5V; INPUTS AT 0.00V AND 5.50V, EACH OUTPUT AT				50MA.	1.65V MAX
IIL	5.5V; EACH INPUT TESTED AT VIN=0.0V.					-1UA TO 0.0UA
IIH	5.5V; EACH INPUT TESTED AT VIN=5.5V.					0UA TO 1.0UA
ICCH	5.5V; INPUTS AT 5.5V.					80.0UA MAX
ICCL	5.5V; INPUTS AT 0.0V.					80.0UA MAX

PARAMETER	VCC	CONDITIONS	PINS	LIMITS: 25C
TPLH1 A TO Y	3.0V	VIN = 0V TO VCC	COMP = 1.5V	1NS TO 10.0NS
TPLH1 B TO Y	3.0V	VIN = 0V TO VCC	COMP = 1.5V	1NS TO 10.0NS
TPHL1 A TO Y	3.0V	VIN = 0V TO VCC	COMP = 1.5V	1NS TO 9.5NS
TPHL1 B TO Y	3.0V	VIN = 0V TO VCC	COMP = 1.5V	1NS TO 9.5NS
TPLH2 A TO Y	4.5V	VIN = 0V TO VCC	COMP = 2.25V	1NS TO 7.5 NS
TPLH2 B TO Y	4.5V	VIN = 0V TO VCC	COMP = 2.25V	1NS TO 7.5 NS
TPHL2 A TO Y	4.5V	VIN = 0V TO VCC	COMP = 2.25V	1NS TO 7.5 NS
TPHL2 B TO Y	4.5V	VIN = 0V TO VCC	COMP = 2.25V	1NS TO 7.5 NS

COMMENTS/EXCEPTIONS

- * VOL TESTS WERE PERFORMED WITH VIL= 0.0V AND VIH=VCC DUE TO "ATE NOISES".
- ~ IIH TEST WAS PERFORMED WITH OTHER INPUTS AT VCC.
- ~ AC TESTS WERE PERFORMED WITH 10ma OUTPUT LOADING.
- ~ VIL(MAX) AND VIH(MIN) WERE CHECKED GO/NO GO WITHIN THE VOH TESTS.

TABLE II. Radiation Schedule

EVENTS	DATE
1) Initial Electrical Measurements	07/16/91
2) 10 krads irradiation @ 525 rads/hr	09/10/91
Post 10 krads Electrical Measurements	09/11/91
3) 20 krads irradiation @ 525 rads/hr	09/11/91
Post 20 krads Electrical Measurements	09/12/91
4) 30 krads irradiation @ 525 rads/hr	09/12/91
Post 30 krads Electrical Measurements	09/13/91
5) 50 krads irradiation @ 295 rads/hr	09/13/91
Post 50 krads Electrical Measurements	09/16/91
6) 75 krads irradiation @ 1250 rads/hr	09/16/91
Post 75 krads Electrical Measurements	09/17/91
7) 100 krads irradiation @ 1250 rads/hr	09/17/91
Post 100 krads Electrical Measurements	09/18/91
8) 24 hrs annealing at 25°C	09/18/91
Post 24 hr Electrical Measurements	09/19/91
9) 168 hrs annealing at 25°C	09/18/91
Post 168 hr Electrical Measurements	09/25/91
10) 200 krads irradiation @ 5000 rads/hr	09/25/91
Post 200 krads Electrical Measurements	09/26/91
11) 300 krads irradiation @ 5000 rads/hr	09/26/91
Post 300 krads Electrical Measurements	09/27/91
12) 168 hrs annealing at 100°C	09/27/91
Post 168 hr Electrical Measurements	10/04/91

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.
- Post 100 krad annealing was performed at 25°C under bias and post 300 krad high temperature annealing was performed at 100°C under bias.