PPM 92-032

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UNISYS

Interoffice Memorandum

To
T. Miccolis T.M.
Department
Code 300.1
From
K. Sahu KS
Department
7809
Subject
Radiation Report on 54AC373DMQB
SMEX Common Buy Part No. 5962-8755501RA
Control Number: 1659

PPM-92-032
Date
January 31, 1992
Location
Lanham
Phone
731-8954
Location
Lanham

B. Fafaul/311
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A radiation evaluation was performed on 54AC373 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 48 and 168 hours. The parts were further irradiated to 200 and 300 krads (cumulative), and then allowed to anneal under bias for 168 hours at 100°C. The dose rate was between 0.5 and 5.0 krads/hour depending on the total dose level (see Table II for the radiation schedule). After each radiation exposure and annealing treatment, the 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 (at VCC levels of 2.0V and 5.5V) after each radiation and annealing step.

All eight parts passed all functional tests throughout the radiation testing and all parametric tests on irradiation to 10 krads. At 20 krads, all parts exceeded the maximum specification limit of 160uA for ICCH, ICCL and ICCZ (maximum readings were 1.8mA, 2.2mA and 1.4mA, respectively) and 10uA for IOZH (maximum reading was 30uA). At 30 krads, all parts failed to meet the minimum specification limit of -10uA for IOZL. ICC and IOZH/L readings continued to increase way beyond the specification limits on continued exposures to 50, 75 and 100 krads. No significant recovery was observed after annealing the parts for 168 hours at 25°C.

At 200 and 300 krads, all parts failed TPZL, as some outputs did not make the transition within the 1ms limit of the test equipment. After annealing the parts for 168 hours at 100°C, one

part (SN 214) recovered to pass TPZL and average ICC readings dropped significantly; however, average ICC readings (17mA) were still way above the specification limit of 160uA. Table IV provides the mean and standard deviation values for each parameter after each radiation exposure and annealing treatment. It also provides the functional test results after each radiation exposure and annealing treatment.

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:	54AC373
SMEX Common Buy Part Number:	5962-8755501RA (HA124217)
SMEX Common Buy Control Number:	1659
Charge Number:	C90359
Manufacturer:	National Semiconductor Corp.
Quantity Procured:	195
Lot Date Code:	9035A
Quantity Tested:	10
Serial Numbers of Radiation Samples:	212, 213, 214, 215 216, 217, 218, 219
Serial Numbers of Control Samples:	210, 211
Part Function:	Octal Transparent Latch
Part Technology:	CMOS
Package Style:	20-pin DIP
Test Engineer:	C. Nguyen

TABLE II. Radiation Schedule

EVENTS	DATE
1) Initial Electrical Measurements	10/15/91
2) 10 krads irradiation @ 500 rads/hr	11/20/91
Post 10 krads Electrical Measurements	11/21/91
3) 20 krads irradiation @ 500 rads/hr	11/21/91
Post 20 krads Electrical Measurements	11/22/91
4) 30 krads irradiation @ 570 rads/hr	11/22/91
Post 30 krads Electrical Measurements	11/23/91
5) 50 krads irradiation @ 450 rads/hr	11/23/91
Post 50 krads Electrical Measurements	11/25/91
6) 75 krads irradiation @ 1300 rads/hr	11/25/91
Post 75 krads Electrical Measurements	11/26/91
7) 100 krads irradiation @ 1350 rads/hr	11/26/91
Post 100 krads Electrical Measurements	11/27/91
8) 48 hrs annealing at 25°C	11/27/91
Post 48 hr Electrical Measurements	11/29/91
9) 168 hrs annealing at 25°C	11/27/91
Post 168 hr Electrical Measurements	12/04/91
10) 200 krads irradiation @ 5000 rads/hr	12/04/91
Post 200 krads Electrical Measurements	12/05/91
11) 300 krads irradiation @ 5000 rads/hr	12/05/91
Post 300 krads Electrical Measurements	12/06/91
12) 168 hrs annealing at 100°C	12/06/91
Post 168 hr Electrical Measurements	12/26/91

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.
- Annealing was performed under bias.

Table III. Electrical Characteristics of 54AC373

FUNCTIONAL TESTS PERFORMED

PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS AT +25C ONLY
FUNCT 1	2.0V	0.0V	3.0V	FREQ=1.000MHz	ALL I/O	VOL<1.0V , VOH>1.0V
FUNCT 2	5.5V	0.0V	5.5V	FREQ=1.000MHz	ALL I/O	VOL<2.7V , VOH>2.7V
				(IOH =-6.0mA		
		LOAD USED <=		(VREF= 1.5V		
				(IOL =+6.0mA		

DC PARAMETRIC TESTS PERFORMED

PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS AT +25C ONLY
VOH1	3.0V	0.9V	2.1V	LOAD=-50UA	OUTS	>+2.9V , <+3.0V
VOH2	3.0V	0.9V	2.1V	LOAD=-04MA	OUTS	>+2.4V , <+3.0V
VOH3	4.5V	1.35V	3.15V	LOAD=-50UA	OUTS	>+4.4V , <+4.5V
VOH4	4.5V	1.35V	3.15V	LOAD=-24MA	OUTS	>+3.7V , <+4.5V
VOH5	5.5V	1.65V	3.85V	LOAD=-50UA	OUTS	>+5.4V , <+5.5V
VOH6	5.5V	1.65V	3.85V	LOAD=-24MA	OUTS	>+4.7V , <+5.5V
VOH7	5.5V	1.65V	3.85V	LOAD=-50MA	OUTS	>+3.85V , <+5.5V
VOL1	3.0V	0.9V	2.1V	LOAD=+50UA	OUTS	>+0.0V , <+0.1V
VOL2	3.0V	0.9V	2.1V	LOAD=+12MA	OUTS	>+0.0V , <+0.5V
VOL3	4.5V	1.35V	3.15V	LOAD=+50UA	OUTS	>+0.0V , <+0.1V
VOL4	4.5V	1.35V	3.15V	LOAD=+24MA	OUTS	>+0.0V , <+0.5V
VOL5	5.5V	1.65V	3.85V	LOAD=+50UA	OUTS	>+0.0V , <+0.1V
VOL6	5.5V	1.65V	3.85V	LOAD=+24MA	OUTS	>+0.0V , <+0.5V
VOL7	5.5V	1.65V	3.85V	LOAD=+50MA	OUTS	>+0.0V , <+1.65V
IIH	5.5V	0.0V	5.5V	VIN = 5.5V	INS	>+0.0UA , <+1.0UA
IIL	5.5V	0.0V	5.5V	VIN = 0.0V	INS	>-1.0UA , <+0.0UA
IOZH	5.5V	0.0V	5.5V	VIN = 5.5V	INS	>+0.0UA , <+10UA
IOZL	5.5V	0.0V	5.5V	VIN = 5.5V	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

AC PARAMETRIC TESTS PERFORMED

PARAMETER	VCC	VIL	VIH	PINS	LIMITS AT +25C ONLY
TPHL1_DQ	4.5V	0.0V	4.5V	DN TO QN	> 1.0NS < 9.5NS
TPLH1_DQ	4.5V	0.0V	4.5V	DN TO QN	> 1.0NS < 9.5NS
TPHL2_LQ	4.5V	0.0V	4.5V	LE TO QN	> 1.0NS < 9.5NS
TPLH2_LQ	4.5V	0.0V	4.5V	LE TO QN	> 1.0NS < 10.0NS
TPHZ_OQ	4.5V	0.0V	4.5V	OE TO QN	> 1.0NS < 11.5NS
TPLZ_OQ	4.5V	0.0V	4.5V	OE TO QN	> 1.0NS < 9.5NS
TPZH_OQ	4.5V	0.0V	4.5V	OE TO QN	> 1.0NS < 9.0NS
TPZL_OQ	4.5V	0.0V	4.5V	OE TO QN	> 1.0NS < 8.5NS

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 54AC373 1/,2/,3/

Parameters		Spec. Limits min	Spec. Limits max	Pre-Rad mean	Pre-Rad sd	Total Dose Exposure (krads) 10 mean	10 sd	20 mean	20 sd	30 mean	30 sd	50 mean	50 sd	75 mean	75 sd	100 mean	100 sd
Func1 @VCC=2.0V				Pass		Pass		Pass		Pass		Pass		Pass		Pass	
Func2 @VCC=5.5V				Pass		Pass		Pass		Pass		Pass		Pass		Pass	
VOH1	V	2.9	3.0	2.99	0	3.00	0	3.00	0	2.99	0	2.99	0	2.99	.01	2.99	.01
VOH2	V	2.4	3.0	2.92	0	2.92	0	2.92	0	2.92	0	2.92	0	2.91	.01	2.91	.01
VOH3	V	4.4	4.5	4.49	0	4.49	0	4.49	0	4.49	0	4.49	0	4.49	0	4.49	.01
VOH4	V	3.7	4.5	4.15	.02	4.15	.01	4.15	.01	4.15	.01	4.14	.01	4.14	.01	4.13	.01
VOH5	V	5.4	5.5	5.49	0	5.49	0	5.49	0	5.49	0	5.49	0	5.49	0	5.48	.01
VOH6	V	4.7	5.5	5.19	.01	5.19	.01	5.19	.01	5.19	.01	5.18	.01	5.18	.01	5.18	.01
VOH7	V	3.85	5.5	4.83	.02	4.85	.01	4.84	.02	4.84	.01	4.83	.02	4.82	.01	4.81	.01
VOL1	mV	0	100	0	0	0	0	0	0	0	0	0	0	0.7	1.5	2.8	2.7
VOL2	mV	0	500	145	6	143	5	144	5	143	5	142	8	142	5	142	5.6
VOL3	mV	0	100	0	0	0	0	0	0	0	0	0	0	3.5	2.4	6.5	2.8
VOL4	mV	0	500	211	10	206	7	208	8	207	8	208	14	209	8	210	9
VOL5	mV	0	100	0.3	1.0	0	0	0	0	1.4	1.9	2.0	2.0	6.5	2.6	9.2	2.7
VOL6	mV	0	500	185	9	181	7	183	7	183	7	185	13	187	8	189	8
VOL7	mV	0	1650	396	18	386	15	391	15	389	15	393	28	393	16	394	16
IIH	nA	0	1000	3.6	7	0.4	1.7	0	0	.08	0.7	0	0	0	0	0	0
IIL	nA	-1000	0	-1.5	5.0	0	0	0	0	0	0	0	0	0	0	0	0
IOZH	uA	0	10	0	.01	0	.01	5.2	9.3	43	75	63	109	227	393	365	633
IOZL	uA	-10	0	0	0	0	0	-0.7	1.4	-4.5	8.3	-7.0	13.2	-38	67	-65	114
ICCH	mA	0	.16	0	0	.03	.01	1.5	0.3	4.8	0.7	5.6	0.8	17.4	1.5	26.2	1.9
ICCL	mA	0	.16	0	0	.05	.02	1.8	0.4	5.2	0.8	5.6	0.9	17.5	1.7	25.6	2.2
ICCZ	mA	0	.16	0	0	.02	.01	1.2	0.3	4.2	0.7	4.8	0.8	16.3	1.6	25.6	2.0
TPHL1_DQ	2/ ns	1	9.5	8.0	0.5	7.9	0.4	7.9	0.4	7.9	0.4	7.9	0.4	8.0	0.6	7.9	0.4
TPLH1_DQ	2/ ns	1	9.5	8.7	0.4	*		9.0	0.6	9.0	0.7	8.9	0.7	9.1	0.7	8.9	0.7
TPHL2_LQ	2/ ns	1	9.5	8.0	0.5	7.9	0.4	7.9	0.4	7.9	0.4	8.0	0.4	8.1	0.6	7.9	0.4
TPLH2_LQ	2/ ns	1	10.0	8.7	0.4	9.0	0.6	9.0	0.6	9.0	0.7	8.9	0.7	9.1	0.7	8.9	0.7
TPHZ_OQ	2/ ns	1	11.5	7.0	0.4	7.1	0.3	7.0	0.3	7.0	0.3	7.0	0.3	6.9	0.4	6.7	0.4
TPLZ_OQ	2/ ns	1	9.5	8.7	0.4	9.1	0.6	9.1	0.6	9.1	0.6	9.1	0.6	9.2	0.6	9.1	0.5
TPZH_OQ	2/ ns	1	9.0	5.5	0.4	5.4	0.4	5.6	0.4	5.9	0.5	6.0	0.5	6.2	0.5	6.0	0.5
TPZL_OQ	2/ ns	1	8.5	7.1	0.3	7.2	0.3	7.2	0.3	7.2	0.3	7.2	0.3	7.3	0.3	6.9	0.5

<Table IV continued on next page>

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

Table IV. (continued)

Parameters	Spec. Limits min	Spec. Limits max	Pre-Rad mean	Pre-Rad sd	Anneal 168 hrs @25°C mean	Anneal 168 hrs @25°C sd	TDE (krads) 200 mean	TDE (krads) 200 sd	TDE (krads) 300 mean	TDE (krads) 300 sd	Anneal 168 hrs @100°C mean	Anneal 168 hrs @100°C sd
Func1 @VCC=2.0V			Pass		Pass		Pass		Pass		Pass	
Func2 @VCC=5.5V			Pass		Pass		Pass		Pass		Pass	
VOH1 V	2.9	3.0	2.99	0	2.99	.01	2.98	.02	2.97	.03	2.98	.01
VOH2 V	2.4	3.0	2.92	0	2.91	.01	2.90	.02	2.89	.02	2.90	.01
VOH3 V	4.4	4.5	4.49	0	4.49	.01	4.48	.02	4.48	.02	4.48	.01
VOH4 V	3.7	4.5	4.15	.02	4.13	.01	4.11	.02	4.10	.02	4.12	.01
VOH5 V	5.4	5.5	5.49	0	5.48	.01	5.47	.01	5.47	.02	5.48	.01
VOH6 V	4.7	5.5	5.19	.01	5.17	.01	5.16	.02	5.15	.02	5.17	.01
VOH7 V	3.85	5.5	4.83	.02	4.81	.01	4.78	.02	4.77	.02	4.80	.01
VOL1 mV	0	100	0	0	2.4	2.5	7.1	2.9	9	3	0.8	1.8
VOL2 mV	0	500	145	6	143	6	142	6	141	8	133	6.1
VOL3 mV	0	100	0	0	5.7	2.7	11	3	13	4	4.4	2.8
VOL4 mV	0	500	211	10	210	8	214	9	215	10	203	9
VOL5 mV	0	100	0.3	1.0	8.7	2.6	14	4	16	4	7.8	2.8
VOL6 mV	0	500	185	9	189	8	195	9	197	10	183	9
VOL7 mV	0	1650	396	18	395	16	402	17	404	18	384	16
IIH nA	0	1000	3.6	7	0	0	0	0	0	0	0	0
IIL nA	-1000	0	-1.5	5.0	0	0	0	0	0	0	0	0
IOZH uA	0	10	0	.01	347	602	673	1164	837	1428	475	827
IOZL uA	-10	0	0	0	-59	104	-115	195	-131	218	-40	86
ICCH mA	0	.16	0	0	23.8	1.9	42.3	2.7	46.8	2.8	17.9	3.1
ICCL mA	0	.16	0	0	24.2	2.2	43.3	3.0	48.0	3.2	17.0	3.5
ICCZ mA	0	.16	0	0	23.1	2.0	42.2	2.7	47.6	2.9	17.1	3.4
TPHL1_DQ 2/ ns	1	9.5	8.0	0.5	8.1	0.4	7.3	0.5	7.3	0.6	9.2	0.5
TPLH1_DQ 2/ ns	1	9.5	8.7	0.4	9.7	0.7	8.6	0.8	8.4	1.0	10.5	1.0
TPHL2_LQ 2/ ns	1	9.5	8.0	0.5	8.7	0.4	7.9	0.4	7.9	0.6	9.7	0.5
TPLH2_LQ 2/ ns	1	10.0	8.7	0.4	9.0	0.7	7.9	0.8	7.8	1.0	9.9	1.1
TPHZ_OQ 2/ ns	1	11.5	7.0	0.4	7.3	0.4	6.5	0.5	6.5	0.6	8.4	0.5
TPL2_OQ 2/ ns	1	9.5	8.7	0.4	9.3	0.5	8.5	0.6	8.7	0.6	10.3	0.6
TPZH_OQ 2/ ns	1	9.0	5.5	0.4	6.3	0.5	5.6	0.5	5.7	0.5	7.3	0.5
TPZL_OQ 2/ ns	1	8.5	7.1	0.3	7.7	0.5	*		*		*	

Notes:

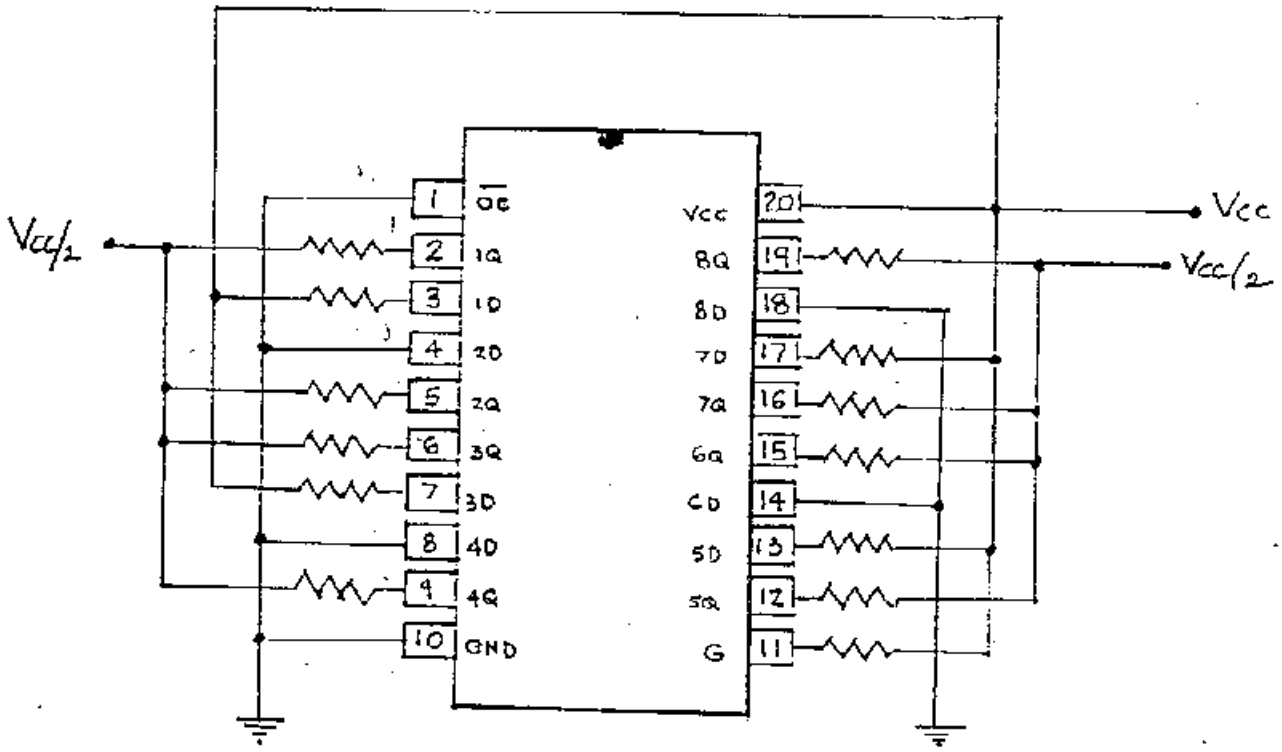
1/ The mean and standard deviation values were calculated over the eight parts irradiated in this testing. The control samples remained constant throughout the testing and are not included in this table.

2/ Due to calibration problems with the S-50, average AC timing measurements were overestimated at some radiation steps by as much as 2ns to 3ns. This upward shift is reflected in the values in Table IV, but is not indicative of AC failures in the parts.

3/ 48-hour annealing data is not provided here, but is available on request.

* Parts did not make the transition within the 1ms testing range of the test equipment.

Figure 1. Radiation Bias Circuit for 54AC373



NOTE: ALL RESISTORS ARE 1KΩ ¼W 5%.
Vcc = 5V ± 10%