PPM - 91 - 412

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UNISYS

(46)

Interoffice Memorandum

To
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Department
Code 300.1
From
K. Sahu KS
Department
7809
Subject
Radiation Report on ISTP
Non-Common Buy Part No. 54HC85A

PPM-91-412
Date
June 13, 1991
Location
Lanham
Telephone
731-8954
Location
Lanham

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A radiation evaluation was performed on 54HC85A 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, four parts were irradiated under bias (see Figure 1 for bias configuration), and one part was used as a control sample. The total dose radiation steps were 2.5, 5, 7.5, 10, 15, 20, and 50 krads. After 50 krads, parts were annealed at 25°C for 144 hours (cumulative). The dose rate was between 0.125 - 1.6 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 according to the test conditions and the specification limits listed in Table III.

All (4) parts passed the initial electrical measurements. All parts continued to pass all tests on irradiation up to 10 krads. At 15 krads, all parts except one (SN 53) passed all tests. The failures on SN 53 included: functional test #3, V_{OH}, and ICCH. While the V_{OH} failure was marginal, the ICCH reading on the part was way above the specification limit (79 mA against the specification limits of 8 μA). On further irradiation to 20 krads, SN 53 continued to show the same failures as at the previous radiation step. Additionally, SN 54 also exceeded the specification limit on I_{CCH} (reading was 39 mA). However, SN 54 passed all functional tests. The remaining two parts (SN 51 and SN 52) passed all tests up to 20 krads. However, at the next radiation step of 50 krads, all parts failed functional test #1. Also, all parts failed to meet the specification limit on a number of parameters including I_{CC}, V_{OH}, V_{OL}, and AC timing parameters. On annealing the parts for 168 hours, no recovery (or change) was observed in the functional or DC parameters. However, it was found that the AC parameters showed increased

degradation on annealing, indicating that parts were experiencing "rebound" due to the large number of interface states. 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 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:	54HC85A
ISTP Non-Common Buy Part Number:	54HC85A
ISTP Non-Common Buy Control Number:	2061B
Charge Number:	C14200
Manufacturer:	Texas Instruments
Quantity Procured:	50
Lot Date Codes:	8817Y
Quantity Tested:	5
Serial Numbers of Radiation Samples:	51, 52, 53, 54
Serial Number of Control Sample:	50
Part Function:	4-Bit Magnitude Comparator
Part Technology:	CMOS
Package Style:	16 Pin DIP

TABLE II. Radiation Schedule

EVENTS	DATE
1) Initial Electrical Measurements	05/16/91
2) 2.5 krads irradiation @ 138.9 rads/hr	05/16/91
Post 2.5 krads Electrical Measurements	05/17/91
3) 5.0 krads irradiation @ 138.9 rads/hr	05/17/91
Post 5.0 krads Electrical Measurements	05/18/91
4) 7.5 krads irradiation @ 125 rads/hr	05/18/91
Post 7.5 krads Electrical Measurements	05/19/91
5) 10 krads irradiation @ 131.5 rads/hr	05/19/91
Post 10 krads Electrical Measurements	05/20/91
6) 15 krads irradiation @ 270 rads/hr	05/20/91
Post 15 krads Electrical Measurements	05/21/91
7) 20 krads irradiation @ 270 rads/hr	05/21/91
Post 20 krads Electrical Measurements	05/22/91
8) 50 krads irradiation @ 1622 rads/hr	05/22/91
Post 50 krads Electrical Measurements	05/23/91
9) 144 hour annealing	05/23/91
Post 144 hr Electrical Measurements	05/29/91

Notes:

1) All parts were radiated under bias at the cobalt-60 gamma ray facility at GSFC.

2) All electrical measurements were performed off-site at 25°C.

3) Annealing performed at 25°C under bias.

Table III. Electrical Characteristics of 54HC85A

FUNCTIONAL TESTS PERFORMED						
PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS AT -55C TO 125C
FUNCT 1	2.0V	0.00V	2.00V	FREQ=1.000MHz { IOH =-20 UA STD Load <= { VREF= 1.0V { IOL = 20 UA	ALL I/O	VOL<1.0V , VOH>1.0V
FUNCT 2	4.5V	0.00V	4.5V	FREQ=1.000MHz { IOH =-4 mA STD Load <= { VREF= 1.5V { IOL = 4 mA	ALL I/O	VOL<1.5V , VOH>1.5V
FUNCT 3	6.0V	0.00V	6.00V	FREQ=1.000MHz { IOH =-5.2 mA STD Load <= { VREF= 1.5V { IOL = 4 mA	ALL I/O	VOL<2.5V , VOH>2.5V

DC PARAMETRIC TESTS PERFORMED						
PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS AT +25C
VOH1	2.0V	0.3V	1.50V	LOAD=-20 UA	OUTS	>+1.9V , <+2.0V
VOH2	4.5V	0.9V	3.15V	LOAD=-20 UA	OUTS	>+4.4V , <+4.5V
VOH3	6.0V	1.2V	4.20V	LOAD=-20 UA	OUTS	>+5.9V , <+6.0V
VOH4	4.5V	0.9V	3.15V	LOAD=-4.0 MA	OUTS	>+3.98V , <+4.5V
VOH5	6.0V	1.2V	4.20V	LOAD=-5.2 MA	OUTS	>+5.48V , <+6.0V
VOL1	2.0V	0.3V	1.50V	LOAD= 20 UA	OUTS	>+0.0V , <+0.1V
VOL2	4.5V	0.9V	3.15V	LOAD= 20 UA	OUTS	>+0.0V , <+0.1V
VOL3	6.0V	1.2V	4.20V	LOAD= 20 UA	OUTS	>+0.0V , <+0.1V
VOL4	4.5V	0.9V	3.15V	LOAD= 4.0 MA	OUTS	>+0.0V , <+0.4V
VOL5	6.0V	1.2V	4.20V	LOAD= 5.2 MA	OUTS	>+0.0V , <+0.4V
IIH	6.0V	0.0V	6.0V	VIN = 6.0V	INS	>-0.1UA , <+0.1UA
IIL	6.0V	0.0V	6.0V	VIN = 0.0V	INS	>-0.1UA , <+0.1UA
ICCH	6.0V	0.0V	6.0V	2 OUTPUTS HIGH	VCC	>+0.0A , <+8.0UA
ICCL	6.0V	0.0V	6.0V	3 OUTPUTS LOW	VCC	>+0.0A , <+8.0UA

Table III (cont'd): Electrical Characteristics of 54HC85A

AC PARAMETRIC TESTS PERFORMED

PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS AT 25C ONLY
TPLHP>Q1	4.5V	0.00V	4.5V	FREQ=1.000MHz	OUT	46NS MAX
TPLHP=Q1	4.5V	0.00V	4.5V	FREQ=1.000MHz	OUT	40NS MAX
TPLHP<Q1	4.5V	0.00V	4.5V	FREQ=1.000MHz	OUT	46NS MAX
TPHLP>Q1	4.5V	0.00V	4.5V	FREQ=1.000MHz	OUT	46NS MAX
TPHLP=Q1	4.5V	0.00V	4.5V	FREQ=1.000MHz	OUT	40NS MAX
TPHLP<Q1	4.5V	0.00V	4.5V	FREQ=1.000MHz	OUT	46NS MAX
TPLHP>Q2	4.5V	0.00V	4.5V	FREQ=1.000MHz	OUT	41NS MAX
TPLHP=Q2	4.5V	0.00V	4.5V	FREQ=1.000MHz	OUT	29NS MAX
TPLHP<Q2	4.5V	0.00V	4.5V	FREQ=1.000MHz	OUT	41NS MAX
TPLHP>Q2	4.5V	0.00V	4.5V	FREQ=1.000MHz	OUT	41NS MAX
TPLHP=Q2	4.5V	0.00V	4.5V	FREQ=1.000MHz	OUT	29NS MAX
TPLHP<Q2	4.5V	0.00V	4.5V	FREQ=1.000MHz	OUT	41NS MAX

COMMENTS/EXCEPTIONS

(1) VIL & VIH were also tested during VOL & VOH tests as Go/NoGo.

(2) This Program detects improper Device insertion.

(3) AC PARAMETRIC TEST PERFORMED AT VCC = 4.5V ONLY

(4) TTLH AND TTHL ARE NOT PERFORMED

TABLE IV: Summary of Electrical Measurements after Total Dose Exposures and Annealing for 54HC85A 1/, 2/

						Total Dose Exposure (krads)												Annealing	
				Initials		5		7.5		10		15		20		50		144 hrs	
		Spec. Limits																	
Parameters		min	max	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd
Test #1				4P/0F		4P/0F		4P/0F		4P/0F		4P/0F		4P/0F		0P/4F		0P/4F	
Test #2				4P/0F		4P/0F		4P/0F		4P/0F		4P/0F		4P/0F		4P/0F		4P/0F	
Test #3				4P/0F		4P/0F		4P/0F		4P/0F		3P/1F		3P/1F		3P/1F		3P/1F	
ICCL	µA	0.0	8.0	0.0	8.0	0.0		0.0		0.0		1.68	1.65	13	17	2800	3600	370	581
ICCH*	µA	0.0	8.0	0.0		0.0		0.0		0.0		20E3	34E3	19E3	34E3	2500	31E3	6.5E3	28E3
VOH1	V	1.9	2.0	1.99	.003	1.99	.003	1.99	0.0	1.99	0.0	1.92	.002	1.92	.002	1.16	1.0	1.22	.9
VOH2	V	4.4	4.5	5	.004	4.49	.005	4.49	.004	4.49	.004	4.25	.008	4.25	.008	4.22	.8	4.24	.8
VOH3	V	5.9	6.0	5.99	.004	5.99	.003	5.99	.004	5.99	.004	5.64	1.18	5.64	1.17	5.62	1.9	5.53	1.2
VOH4	V	3.98	4.5	4.3	.003	4.30	.005	4.30	.006	4.3	.006	4.05	.007	4.04	.007	3.95	.8	3.98	.7
VOH5	V	5.48	6.0	5.8	.003	5.8	.003	5.79	.005	5.79	.006	5.45	1.13	5.44	1.13	5.39	1.13	5.40	1.14
VOL1	V	0.0	.1	0.0		0.0		0.0		0.0		0.0		0.0		1.18	.9	.3	.7
VOL2	mV	0.0	100	0.0		0.0		0.0		0.0		0.0		0.0		.02	.04	0.0	
VOL3	mV	0.0	100	0.0		0.0		0.0		0.0		0.0		0.0		.02	0.4	0.0	
VOL4	mV	0.0	400	129	2.2	130	3	131	4	131	3	136	5	139	7.6	155	13	172	24
VOL5	mV	0.0	400	130	2.8	134	3	134	3	134	4	139	5	141	7	154	11	168	18
IIL	nA	-100	100	0.0		0.0		0.0		0.0		0.0		0.0		0.0			0.0
IIH	nA	-100	100	-1.75	11	-1.80	12	-1.84	12	-1.82	12	-1.86	12	-1.86	12	-1.86	12	-1.82	12

Notes:

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

2/ Post 2.5 krads electrical measurements are not provided in this table. This data is available upon request.

* Conversion: $2E4 \Rightarrow 2 \times 10^4$

TABLE IV (cont'd): Sum of Electrical Measurements after Total Dose Exposures and Annealing for 54HC85A 1/, 2/

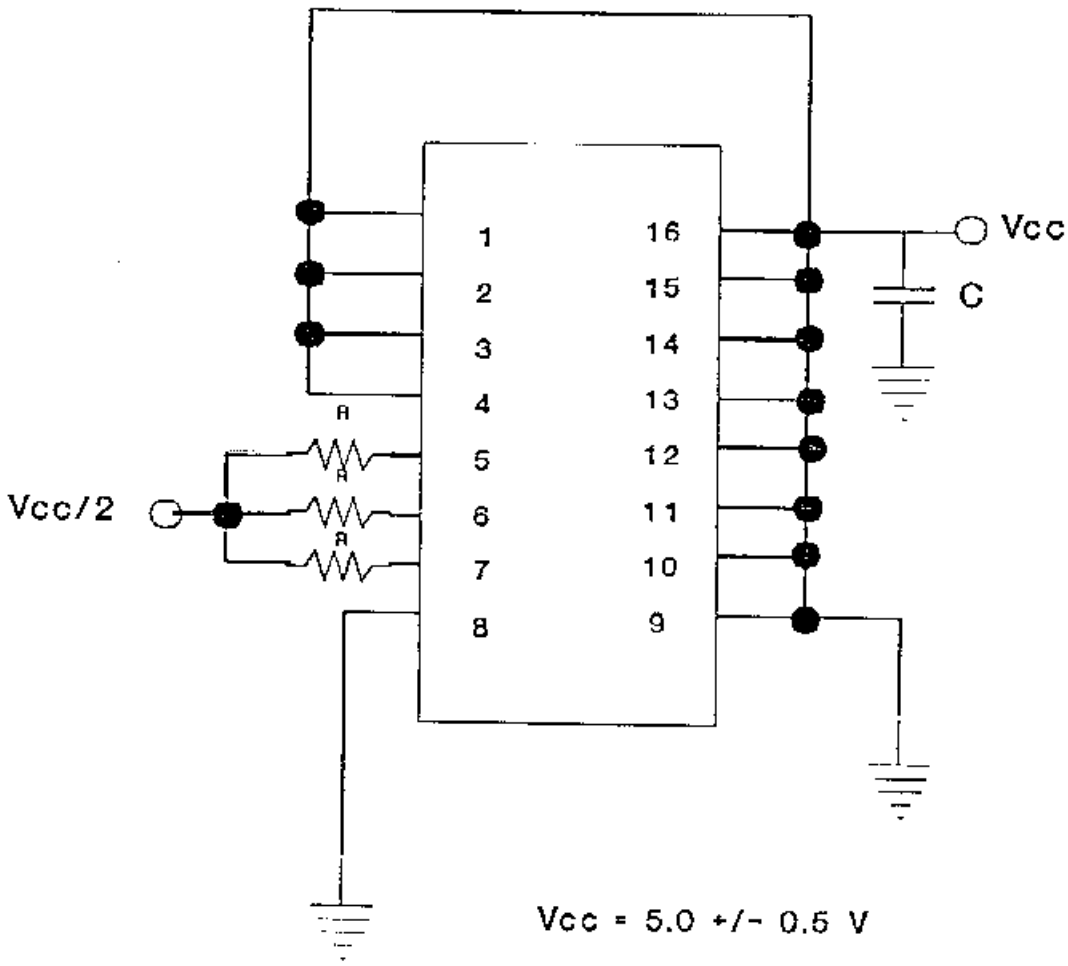
			Initials		Total Dose Exposure (krads)												Annealing	
					5		7.5		10		15		20		50		144 hrs	
Parameters	Spec. Limits min	max	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd
TPLHP>Q1 nS	0	46	26	.3	27	.5	28	.6	28	.7	30	1	31	1	39	6	43	5
TPLHP=Q1 nS	0	40	19	.3	20	.4	20	.5	21	.6	22	.5	23	7	29	1	30	2
TPLHP<Q1 nS	0	46	27	.4	28	.4	29	.6	29	.7	29	2	31	2	38	4	43	4
TPHLP>Q1 nS	0	45	25	.3	25	.4	26	.5	26	.7	27	.8	28	1	36	1	38	3
TPHLP=Q1 nS	0	40	18	.2	18	.3	19	.4	19	.5	19	.7	20	.9	24	4	26	3
TPHLP<Q1 nS	0	46	22	.2	22	.3	23	.4	23	.5	23	1.6	23	2	31	2	31	3
TPLHP>Q2 nS	0	41	27	.1	28	.3	28	.5	29	.6	30	.9	31	2	39	9	44	6
TPLHP=Q2 nS	0	29	15	.2	16	.2	17	.2	17	.2	18	.3	20	.3	27	.4	27	.8
TPLHP<Q2 nS	0	41	30	.4	31	.6	32	.7	32	.8	33	1.6	34	1.5	42	7	45	5
TPHLP>Q2 nS	0	41	24	.2	25	.4	26	.5	27	.6	28	.9	30	1	44	2	44	3
TPHLP=Q2 nS	0	29	16	.2	16	.3	16	.4	16	.5	17	.6	17	.9	19	5	22	3
TPHLP<Q2 nS	0	41	26	.4	28	.5	29	.4	29	.5	30	.8	32	1	48	1	48	2

Notes:

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

2/ Post 2.5 krads electrical measurements are not provided in this table. This data is available upon request.

Figure 1: Radiation Bias Circuit for 54HC85A



Vcc = 5.0 +/- 0.5 V

R = 1kohm +/- 10%, 1/4W

C = 0.01μF, 50 V

Vcc/2 = 2.5 V