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Memorandum



DATE: June 8, 1992
TO: J. Lohr/311
FROM: K. Sahu/7980 KS
SUBJECT: Radiation Report GGS/WIND/3D PLASMA Project
Part No. SNJ54HC4075J (Control No. 6302)

PPM-92-177

cc: L. Rabb/406
A. Sharma/311
Library/300.1

A radiation evaluation was performed on the SNJ54HC4075J 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 5, 10, 15, and 20 krads*. After 20 krads, the parts were annealed at 25°C for 168 hours. The dose rate was between 54 and 114 rads/hour, depending on the total dose level (see Table II for 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 three functional tests at Vcc=2 V, 4.5 V, and 6 V (test frequency = 1 MHz).

All four samples passed functional testing throughout irradiation to 20 krads and after annealing at 25°C for 168 hours. All parts passed all parametric tests upon irradiation to 10 krads. However, upon further irradiation to 15 krads, one part marginally exceeded the specification limits of 75 ns for TTLH at Vcc=2 V. A reading of 76 ns was recorded for one output of this Triple 3-Input OR Gate. After additional exposure to 20 krads and after annealing at 25°C for 168 hours, all four irradiated samples exceeded the specification limits for at least one of the following A.C. parameters at Vcc=2 V: TPLH, TPHL, TTLH and TTHL. No significant recovery was observed after annealing at 25°C for 168 hours.

The TPLH and TTLH readings which were in excess of the specified limits occurred mainly on gates which were in the logic low state during irradiation. The output low to high transition time at Vcc=2 V increased more rapidly for these gates. Similarly, any excessive TPHL readings occurred on gates which were in the logic high state during irradiation. The output high to low transition time at Vcc=2V increased more rapidly for these gates.

Table IV provides the mean and standard deviation values for each parameter 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:	HC4075
GGG/WIND/3D PLASMA Part Number:	SNJ54HC4075J
Control Number:	6302
Charge Number:	C23771
Manufacturer:	Texas Instruments
Lot Date Code:	8947Y
Quantity Tested:	4
Serial Numbers of Radiation Samples:	94, 95, 96, 97
Serial Number of Control Sample:	98
Part Function:	Triple 3-Input OR Gates
Part Technology:	CMOS
Package Style:	14 pin DIP
Test Engineer:	T. Scharer

TABLE II. Radiation Schedule for SNJ54HC4075J

EVENTS	DATE
1) INITIAL (PRE-IRRADIATION) ELECTRICAL MEASUREMENT	04/24/92
2) 5 KRAD IRRADIATION (54.6 rads/hour) POST 5 KRAD ELECTRICAL MEASUREMENT	05/07/92 05/11/92
3) 10 KRAD IRRADIATION (113.6 rads/hour) POST 10 KRAD ELECTRICAL MEASUREMENT	05/11/92 05/13/92
4) 15 KRAD IRRADIATION (113.6 rads/hour) POST 15 KRAD ELECTRICAL MEASUREMENT	05/13/92 05/15/92
5) 20 KRAD IRRADIATION (113.6 rads/hour) POST 20 KRAD ELECTRICAL MEASUREMENT	05/15/92 05/18/92
6) 168 HOURS ANNEALING AT 25°C POST 168 HOURS ELECTRICAL MEASUREMENT	05/19/92 05/26/92

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 steps were performed under bias.

Table III. Electrical Characteristics of SNJ54HC4075J

+25°C					
TEST #	TEST NAME	TEST CONDITIONS	MIN	MAX	UNITS
1	V _{OH1} 1/	V _{IN} =0, 3, 1.5 V I _O =-20 μA V _{CC} =2.0 V	1.9	-	V
2	V _{OH2} 1/	V _{IN} =0.9, 3, 1.5 V I _O =-20 μA V _{CC} =4.5 V	4.4	-	V
3	V _{OH3} 1/	V _{IN} =1.2, 4, 2 V I _O =-20 μA V _{CC} =6.0 V	5.9	-	V
4	V _{OH4} 1/	V _{IN} =0.9, 3, 1.5 V I _O =-4 mA V _{CC} =4.5 V	3.98	-	V
5	V _{OH5} 1/	V _{IN} =1.2, 4, 2 V I _O =-5.2 mA V _{CC} =6.0 V	5.48	-	V
6	V _{OL1} 1/	V _{IN} =0, 3, 1.5 V I _O =20 μA V _{CC} =2.0 V	-	0.1	V
7	V _{OL2} 1/	V _{IN} =0.9, 3, 1.5 V I _O =20 μA V _{CC} =4.5 V	-	0.1	V
8	V _{OL3} 1/	V _{IN} =1.2, 4, 2 V I _O =20 μA V _{CC} =6.0 V	-	0.1	V
9	V _{OL4} 1/	V _{IN} =0.9, 3, 1.5 V I _O =4 mA V _{CC} =4.5 V	-	0.26	V
10	V _{OL5} 1/	V _{IN} =1.2, 4, 2 V I _O =5.2 mA V _{CC} =6.0 V	-	0.26	V
11	I _{IL}	V _{IN} =0, 6 V V _{CEST} =0 V V _{CC} =6.0 V	-0.1	0.1	μA
12	I _{IH}	V _{IN} =0, 6 V V _{CEST} =6 V V _{CC} =6.0 V	-0.1	0.1	μA
13	I _{CC1}	V _{IN} =6.0 V V _{CC} =6.0 V	0	8	μA
14	I _{CC2}	V _{IN} =0 V V _{CC} =6.0 V	0	8	μA
15	T _{PLH2} 3/	V _{IN} =0, 2 V V _{CC} =2.0	0.4	100	ns
16	T _{PLH45} 3/	V _{IN} =0, 4.5 V V _{CC} =4.5V	0.4	20	ns
17	T _{PLH6} 3/	V _{IN} =0, 6 V V _{CC} =6.0	0.4	17	ns
18	T _{PHL2} 3/	V _{IN} =0, 2 V V _{CC} =2.0	0.4	100	ns
19	T _{PHL45} 3/	V _{IN} =0, 4.5 V V _{CC} =4.5V	0.4	20	ns
20	T _{PHL6} 3/	V _{IN} =0, 6 V V _{CC} =6.0	0.4	17	ns
21	T _{T1H2} 3/	V _{IN} =0, 2 V V _{CC} =2.0	0.4	75	ns
22	T _{T1H45} 3/	V _{IN} =0, 4.5 V V _{CC} =4.5	0.4	15	ns
23	T _{T1H6} 3/	V _{IN} =0, 6.0 V V _{CC} =6.0	0.4	13	ns
24	T _{T1L2} 3/	V _{IN} =0, 2 V V _{CC} =2.0	0.4	75	ns
25	T _{T1L45} 3/	V _{IN} =0, 4.5 V V _{CC} =4.5	0.4	15	ns
26	T _{T1L6} 3/	V _{IN} =0, 6.0 V V _{CC} =6.0	0.4	13	ns

NOTES:

- 1/ V_{IH} and V_{IL} are tested during V_{OH} and V_{OL} testing.
- 2/ Functional tests are performed at V_{CC}=2.0, 4.5 and 6.0 V at 1MHz. Output levels for functional tests are V_{CC}/2 V. Input levels are 0, V_{CC} V.
- 3/ A 15 pf load + system capacitance load is placed on the outputs during AC tests.

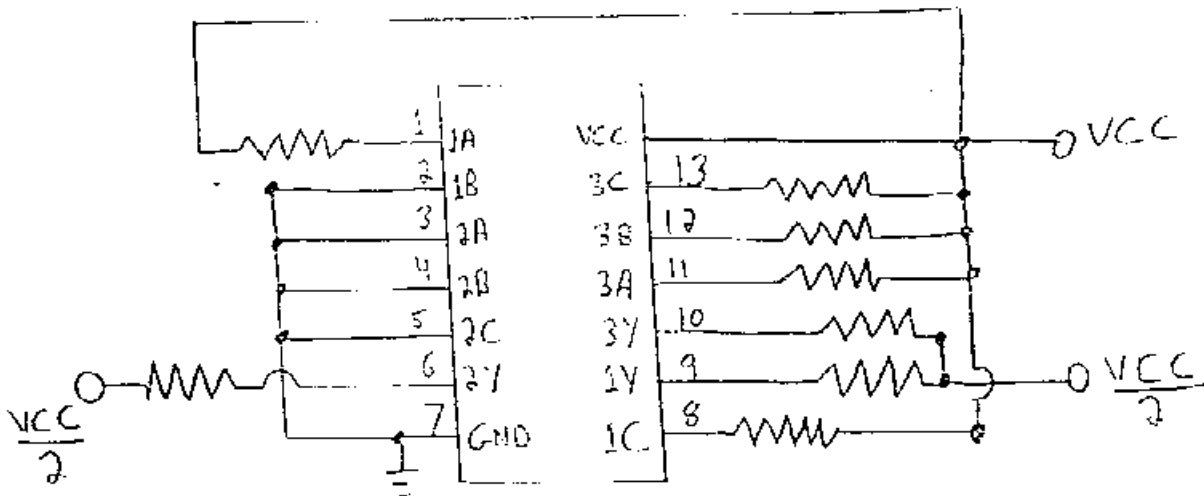
TABLE IV: Summary of Electrical Measurements After Total Dose Exposures and Annealing for SNJ54HC4075J 1/

Parameters	Spec Limits min max	Total Dose Exposure (TDE) (krads)										Anneal	
		0 (Pre-Rad)		5		10		15		20		168 hrs @25°C	
		mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd
FUNC1 1 MHz		Pass		Pass		Pass		Pass		Pass		Pass	
FUNC2 1 MHz		Pass		Pass		Pass		Pass		Pass		Pass	
FUNC3 1 MHz		Pass		Pass		Pass		Pass		Pass		Pass	
VOH1 2.0V V	1.90 -	2.01	0.00	2.02	0.00	2.02	0.00	2.02	0.00	2.00	0.00	2.00	0.00
VOH2 4.5V V	4.40 -	4.51	0.00	4.52	0.00	4.52	0.00	4.52	0.00	4.50	0.00	4.50	0.00
VOH3 6.0V V	5.90 -	6.00	0.00	6.01	0.00	6.01	0.01	6.01	0.01	6.00	0.01	6.00	0.00
VOH4 4.5V V	3.98 -	4.32	0.01	4.31	0.01	4.30	0.01	4.28	0.02	4.26	0.02	4.25	0.02
VOH5 6.0V V	5.48 -	5.80	0.01	5.80	0.01	5.78	0.01	5.77	0.02	5.77	0.01	5.74	0.02
VOL1 2.0V mV	0 100	3.67	0.04	3.69	0.08	3.80	0.10	3.96	0.12	4.19	0.06	4.34	0.19
VOL2 4.5V mV	0 100	2.92	0.11	3.85	0.48	3.98	0.46	3.75	0.74	4.27	0.85	3.87	0.43
VOL3 6.0V mV	0 100	3.61	0.40	6.70	1.89	6.28	1.53	5.07	1.91	6.37	2.22	5.58	1.24
VOL4 4.5V mV	0 260	147.8	3.23	162.4	5.48	168.2	6.09	177.3	9.85	185.6	10.58	195.9	11.54
VOL5 6.0V mV	0 260	153.2	4.14	172.3	7.60	176.5	7.36	184.5	12.71	190.9	13.13	200.6	12.30
I _{IH} uA	-0.1 0.1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
I _{IL} uA	-0.1 0.1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
I _{CCH} uA	0 8.0	0.01	0.00	0.01	0.00	0.02	0.00	0.10	0.01	0.21	0.03	0.08	0.01
I _{CCL} uA	0 8.0	0.00	0.00	0.00	0.00	0.02	0.00	0.17	0.04	0.52	0.14	0.14	0.03
TPLH2	ns 0 100.0	36.74	1.34	41.38	1.82	47.72	3.73	57.82	8.09	80.26	18.27	81.96	16.71
LH4.5	ns 0 20.0	12.46	0.66	13.07	0.55	13.60	0.61	14.46	0.80	15.35	1.11	15.39	0.99
LH6	ns 0 17.0	10.20	0.59	10.57	0.43	10.81	0.47	11.36	0.60	11.82	0.73	11.74	0.70
TPHL2	ns 0 100.0	35.94	2.80	39.11	3.50	43.79	4.74	52.26	7.76	73.10	16.77	76.86	15.60
LH4.5	ns 0 20.0	11.80	0.84	12.33	0.78	12.81	0.83	13.72	0.97	14.67	1.10	14.90	0.97
LH6	ns 0 17.0	9.00	0.62	9.39	0.59	9.58	0.59	10.22	0.69	10.69	0.74	10.71	0.70
TTLH2	ns 0 75.0	29.78	1.23	35.00	2.27	43.38	4.96	56.25	11.40	68.92	32.51	89.33	31.74
LH4.5	ns 0 15.0	12.17	0.35	12.42	0.47	12.75	0.50	13.42	0.67	14.00	0.80	14.54	1.08
LH6	ns 0 13.0	10.17	0.71	10.25	0.50	10.46	0.40	10.71	0.62	11.04	0.69	11.33	0.94
TTHL2	ns 0 75.0	23.87	0.61	23.75	0.66	24.96	0.54	27.58	1.22	34.88	2.89	37.83	1.19
LH4.5	ns 0 15.0	11.17	0.56	11.08	0.70	11.46	0.45	11.88	0.57	12.46	0.45	13.00	0.56
LH6	ns 0 13.0	8.56	1.38	8.54	1.37	8.79	1.22	9.04	1.22	9.66	1.16	9.83	1.27

Notes:

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

Figure 1. Radiation Bias Circuit for SN354HC4075J



$$VCC = 5V \pm 5\%$$

$$\frac{VCC}{2} = 2.5V \pm 5\%$$

$$R = 1k\Omega \pm 10\%, \frac{1}{4}W$$

$$I_{out} = \frac{2.5V}{1k} = 2.5mA \text{ max}$$

$$1Y, 3Y = \text{Logic } 1$$

$$2Y = \text{Logic } 0$$